UNLOCKING THE POWER OF HEALTHY LONGEVITY

Compendium of Research for the Healthy Longevity Initiative



WORLD BANK GROUP

UNLOCKING THE POWER OF HEALTHY LONGEVITY

Compendium of Research for the Healthy Longevity Initiative

AUGUST 2024

Editors:

Prabhat Jha
George Alleyne
Paul Isenman
Seemeen Saadat
Jeremy Veillard
Sameera Altuwaijri

WORLD BANK GROUP

© 2024 The World Bank
1818 H Street NW, Washington DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

Some rights reserved.

This work is a product of The World Bank. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of the Executive Directors of The World Bank or the governments they represent.

The World Bank does not guarantee the accuracy, completeness, or currency of the data included in this work and does not assume responsibility for any errors, omissions, or discrepancies in the information, or liability with respect to the use of or failure to use the information, methods, processes, or conclusions set forth. The boundaries, colors, denominations, links/footnotes and other information shown in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries. The citation of works authored by others does not mean the World Bank endorses the views expressed by those authors or the content of their works.

Nothing herein shall constitute or be construed or considered to be a limitation upon or waiver of the privileges and immunities of The World Bank, all of which are specifically reserved.

Chapter 4: The economic value associated with avoidable mortality: a systematic assessment by cause of death across world regions © Harvard University.

Rights and Permissions

The material in this work is subject to copyright. Because The World Bank encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given.



Attribution—Please cite the work as follows: "World Bank. 2024. *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington, DC: World Bank. Creative Commons Attribution CC BY 3.0 IGO. © World Bank."

Any queries on rights and licenses, including subsidiary rights, should be addressed to World Bank Publications, The World Bank, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; email: pubrights@worldbank.org.

Cover design and typesetting: Karim Ezzat Khedr, Creative Director; email: karim.ezzat@gmail.com.

Compendium at a Glance

Theoretical framework
Chapter 1: Enhancing human capital and boosting productivity by tackling non-communicable diseases: results of a research initiative
Chapter 2: Toward s a framework for impact pathways between non-communicable diseases, human capital and healthy longevity, and wellbeing outcomes

Economic cost of avoidable mortality
Chapter 3: The economic value of avoidable mortality
Chapter 4: The economic value associated with avoidable mortality: a systematic assessment by cause of death across world regions
Chapter 5: Rates of progress in mortality decline, 2000-2019

Behavior change and healthy longevity
Chapter 6: Behavioral aspects of healthy longevity
Chapter 7: Taxation of harmful products, including tobacco, alcohol and sugar-sweetened beverages (SSBs), and related topics

Gender and Aging
Chapter 8: Gender gaps in health and well-being of older adults: A review of the burden of non-communicable diseases and barriers to healthcare for women and men
Chapter 9: Gendered responsibilities, elderly care, and labor supply: evidence from four middle-income countries

Long-term care
Chapter 10: Health and long-term care needs in a context of rapid population aging
Chapter 11: Demand for and supply of long-term care for older persons in low- and middle-income countries

Social protection and jobs
Chapter 12: Exploring the labour market outcomes of the risk factors for non-communicable diseases: a systematic review
Chapter 13: Productive longevity: what can work in low- and middle-income countries?
Chapter 14: Adequacy pensions and access to healthcare: maintaining human capital during old age

Prioritizing action
Chapter 15: Priority setting for NCD control and health systems investments
Chapter 16: Control of non-communicable diseases for enhanced human capital: the case for whole-of-society action

Monitoring indicators for healthy longevity
Chapter 17: Healthy longevity initiative: a performance dashboard for decision-making in low- and middle-income countries
Chapter 18: Assessing human capital, non-communicable diseases, and healthy longevity in low- and middle-income countries: healthy longevity dashboard and the case for india

Contents

Foreword xv
Preface xvi
Acknowledgements xvii
Overview xx
Abbreviations xxxix

I Theoretical Framework **1**

Chapter 1 Enhancing human capital and boosting productivity by tackling non-communicable diseases: results of a research initiative **2**

Introduction and Overview 3
Research inputs and policy discussions 5
Recommendations for key stakeholders 27
Conclusions and way forward 29
References 30
Annex 1.1: Toronto workshop agenda 31
Annex 1.2: Toronto workshop, list of participants 32

Chapter 2 Towards a framework for impact pathways between NCDs, human capital and healthy longevity, economic and wellbeing outcomes **33**

Introduction 34
Factors in developing a framework, some definitions and cross-cutting themes 35
Human capital, growth and country wealth 40
Inequality and gender dimensions of NCD and human capital pathways 53
Wellbeing effects of addressing NCDs 58
Policies and interventions for NCDs and healthy longevity 60
Conclusion 66
References 67
Annex 2.1 79

II Economic Cost of Avoidable Mortality **83**

Chapter 3 The Economic Value of Avoidable Mortality **84**

Introduction 85
Conceptual Framework 85
Methods 87
Results 90
Discussion 99
Conclusion 102
Dedication 102
References 102

Chapter 4 The economic value associated with avoidable mortality: a systematic assessment by cause of death across world regions 104

Introduction 105
Methods 106
Results 109
Discussion 119
References 121

Chapter 5 Rates of progress in mortality decline, 2000-2019 123

Introduction 124
Rates of progress over 2000-09 and 2010-19 125
Countries' rates of progress during 2000-09 and 2010-19 127
Rates of progress in cause-specific mortality 130
Cost of saving a life over time 132
References 133
Annex 5.1: Interrupted time-series (ITS) analysis methodology 134
Annex 5.2: Methods used to estimate country performance during 2000 to 2019 135
Annex 5.3: Model using to estimate critical income 153
Annex References 154

III Behavior Change and Healthy Longevity 156

Chapter 6 Behavioral aspects of healthy longevity 157

Introduction 158
A behavioral science framework for NCD policies 160
NCD formation: Healthy lifestyle and habit formation 163
NCD detection: Screening 167
NCD management 170
Recommendations for a policy toolkit 172
Conclusion 178
References 179
Annex 6.1 185

Chapter 7 Taxation of harmful products, including tobacco, alcohol and sugar-sweetened beverages, and related topics 186

Introduction: Consumption of unhealthy products and the healthy longevity agenda 187
The consumption of harmful products and their effects 188
Taxation: economic rationales and effectiveness 192
Effectiveness of price policies 193
Related topics 197
Combination of taxes and non-price interventions 199
Challenges from the industry 199
Conclusions 203
References 204

IV Gender and Aging 216

Chapter 8 Gender gaps in health and well-being of older adults: A review of the burden of non-communicable diseases and barriers to healthcare for women and men 217

Introduction 218
Gender differentiated health outcomes of aging populations 222
Aging, gender, and demand for services 233
Supply for health and care services for aging populations 236
Women as long-term care providers 242
Discussion 246
References 249
Annex 8.1: Cancer mortality and prevalence by type for older women and men 257

Chapter 9 Gendered responsibilities, elderly care, and labor supply: evidence from four middle-income countries 259

Introduction 260
Data 263
Methodology 264
Results 264
Heterogeneity 275
Robustness check 276
Conclusion 278
References 279
Annex 9.1 280

V Long-term Care 286

Chapter 10 Health and long-term care needs in a context of rapid population aging 287

Introduction 288
Main trends in longevity 289
Aging, health, and the challenges for health care systems 293
Increasing risk of functional dependency and challenges for long-term care systems 314
Final remarks and key policy considerations 328
References 331
Consulted surveys and databases 340

Chapter 11 Demand for and supply of long-term care for older persons in low- and middle-income countries 341

Introduction 342
A demand side view - current LTC landscape in MICs 343
A supply side assessment current LTC landscape in LMICs 356
Discussion and policy considerations 363
References 367

VI Social Protection and Jobs 370

Chapter 12 Exploring the labour market outcomes of the risk factors for non-communicable diseases: a systematic review 371

Introduction 372
Methods 373
Results 374
Discussion 379
References 381
Annex 12.1 384

Chapter 13 Productive longevity: what can work in low- and middle-income countries? 385

Introduction 386
A global policy agenda for aging 387
Work in old age – some stylized facts 389
What holds back productive longevity? 395
Productive longevity: what could work in LMICs? 402
Conclusions: some meta-lessons for productive longevity 410
References 411
Annex 13.1 417

Chapter 14 Adequacy pensions and access to healthcare: maintaining human capital during old age 418

Introduction 419
Financial protection 420
Access to health and long-term care services 426
Conclusions 432
References 432

VII Prioritizing Action 434

Chapter 15 Priority setting for NCD control and health systems investments 435

Introduction 436
Identifying candidate NCD interventions 436
A framework for prioritizing NCD interventions 438
Policy implications 443
References 446
Annex 15.1: Methods 448

Chapter 16 Control of non-communicable diseases for enhanced human capital: the case for whole-of-society action: The case for whole-of-society action 450

Introduction 451
Why Focus on NCDs? 451
Impact of Covid-19 Pandemic on NCDs 457
Rationale for a whole-of-society approach to NCDs 458
Engaging non-staff actors (for profit and non-profit) 465
What has been achieved so far, and what have we learned? 468
Opportunities and challenges for a WOS approach: What have we learned? 483
The way forward 486
References 487

VIII Monitoring Indicators for Healthy Longevity 491

Chapter 17 Healthy longevity initiative: a performance dashboard for decision-making in low- and middle-income countries 492

Introduction 493
Contextualizing dashboards for performance monitoring and strategic action 494
A common framework for healthy longevity measurement 494
Case studies: Sierra Leone, India, and Colombia 497
Discussion and future directions 503
Limitations 507
Conclusion 508
References 508
Annex 17.1: Examples of dashboards for global goals 511
Annex 17.2: Available data to better understand population ageing 519

Chapter 18 Assessing Human Capital, Non-communicable Diseases, and Healthy Longevity in Low- and Middle-Income Countries: Healthy longevity dashboard and the case for India 520

Introduction 521
Methods 521
Results 526
Discussion 529
Conclusion 530
References 531
Annex 18.1 532
Annex References 533

Appendix 1: Acknowledgements by Chapter 535
Appendix 2: Workshops and Consultations 539

Boxes

Box 1.1: Key messages 5
Box 8.1: Gender gaps and the life course 219
Box 8.2: The healthy longevity framework and gender 220
Box 8.3: Understanding long-term care arrangements 237
Box 8.4: Provider behaviors and access to care for older adults 240
Box 8.5: Improving quality of care through standards and practice in the OECD 241
Box 10.1: When is a country "aging"? 290
Box 10.2: Health and socioeconomic status 298
Box 10.3: How is functional dependency measured? 314
Box 10.4: The importance of timely and sound data 330
Box 11.1: Data used for the demand side analysis 343
Box 16.1: Rationale for WoS approach – a sample of arguments 462
Box 16.2: Examples of Public-Private Partnerships for Non-Communicable Diseases 467
Box 16.3: Clínicas del Azúcar: a retail approach to diabetes care 482
Box 16.4: Georgia Healthcare Group: universal health care delivered through the private sector 483
Box 17.1: Case study of a healthy longevity dashboard in Sierra Leone 499
Box 17.2: Case study of a healthy longevity dashboard in India 501
Box 17.3: Case study of a healthy longevity dashboard in Colombia 502

Figures

Figure 1.1: GDP and GDP per capital gains, average for 10 countries, with an NCD package 8
Figure 1.2: GDP with (perturbed) and without (projected) an NCD package 8
Figure 1.3: Illustration of the theoretical model in terms of individual optimizing behavior 10
Figure 1.4: Estimated health capital per capita (logarithmic scale), for 92 countries, 2011 US4 PPP 11
Figure 1.5: Effect of NCDs on health capital and health investment 12
Figure 1.6: Worsening adult male mortality in former Soviet states, 1950-2000 16
Figure 1.7: Substantial NCD burdens among children in low- and middle-income countries (1.7a: NCD share of total DALYs in <5 year olds; 1.7b: NCD share of total DALYs in 5-14 year olds) 21
Figure 1.8: Trends in the risk of dying between ages 50 and 69 in 25 countries, 1970-2010 25
Figure 1.9: Framework for analyzing health research needs 26
Figure 2.1: Human capital life course trajectory 38
Figure 2.2: Impact channels between NCDs and inclusive growth 42
Figure 2.3: Impact channels between NCDs and human capital across the life cycle 45
Figure 3.1: Frontier mortality rates from 2000, 2019, and 2050 90
Figure 3.2: Avoidable mortality as percentage of total mortality, year 2019 91
Figure 3.3: Avoidable mortality globally and by region, year, and age group 93
Figure 3.4: Gap in life expectancy at birth between observed/projected life expectancy and frontier life expectancy 94
Figure 3.5: Ratio of average VSMU to initial VSMU, for United States age group 0-1 94
Figure 3.6: Value of avoidable mortality as percentage of annual income for years 2000, 2019, 2021, and 2050 (projected) 95
Figure 3.7: Relationship between avoidable mortality rate, GNI per capita, and value of avoidable mortality 96
Figure 3.8: Age-group contributions to the total value of avoidable mortality and population composition by age in year 2019 97
Figure 3.9: Value of avoidable mortality for females and males as percentage of annual income in year 2019 97
Figure 4.1: Mortality frontiers (females and males) for the period 2000-2050 111
Figure 4.2: Economic values of avoidable mortality 117
Figure 4.3: Rates of change (percent per year) of the economic values of avoidable mortality assigned to selected causes of death 118
Figure 5.1: Change in risk of death at start of age range, by age group and country income level, 1990-2019 124
Figure 5.2: Preston curve showing the relationship between life expectancy at birth and income (Preston 1975) 132
Figure 5A.1: Schematic representation of an interrupted time series analysis 134
Figure 5A.2: Mortality rate, global and by country income level, by age and sex, between 2000 and 2019 135
Figure 5A.3: Correlation between performance in mortality decline during 2010-19 among males and females 146
Figure 6.1: Conceptual model of traditional and behavioral determinants of NCDs and healthy aging 160
Figure 6.2: Example of specific biases affecting hypertension formation, detection, and management 162
Figure 8.1: Structure and linkages for women and aging in health review 221
Figure 8.2: Cardiovascular mortality among older adults by regional and income aggregates 223
Figure 8.3: Ratio of female to male CVD mortality by regional and income aggregates 223
Figure 8.4: Cardio-vascular disease by sex for older populations (ages 45 years and above) 224
Figure 8.5: Deaths due to diabetes, ages 45+ (by income groups and regional aggregates) 225

Figure 8.6: Ratio of female to male mortality due to diabetes by regional and income aggregates 226
Figure 8.7: Gender gaps in diabetes for older populations (ages 45 years and above) 227
Figure 8.8: Deaths due to cancers, ages 45+ (by income groups and regional aggregates) 228
Figure 8.9: Ratio of female to male mortality due to cancers by regional and income aggregates 229
Figure 8.10: Gender gaps in cancers among older populations (ages 45 and above) 230
Figure 8.11: Gender gaps in depressive disorders among older adults 231
Figure 8.12: Gender gaps in self-harm among older adults (ages 45 and above) 232
Figure 8.13: Breakdown of health expenditure per capita in PPP, 2019 238
Figure 8.14: Out of pocket expenditures, 2019 239
Figure 8.15: Share of female LTC workers in select OECD countries (% of total, latest available year) 243
Figure 8A.1: Cancer mortality by type, Ages 45+ years 257
Figure 8A.2: Prevalence of cancer by type, ages 45+ years 258
Figure 9.1: Gross domestic product (GDP) per capita and male-female labor force participation gap, four countries, 2013-2018 261
Figure 9.2: Share of individuals (ages 25 to 59) with a coresident parent and young children in the household 266
Figure 9A.1: Kernel density of long-term care provision by age and country 282
Figure 9A.2: Work hours and care hours gradient 283
Figure 9A.3: Correlation between time spent on long-term care and employment 283
Figure 9A.4: Correlational effect of providing long-term care on individual employment by choice of control group 284
Figure 9A.5: Correlational effect of providing long-term care on annual earnings by choice of control group 284
Figure 9A.6: Correlational effect of providing long-term care on work hours by choice of control group 285
Figure 10.1: Population by broad age group (thousands), estimates 1950-2020 and projections 2025-2100 289
Figure 10.2: Years required or expected for the population share aged 65+ to rise from 7 percent to 14 percent 290
Figure 10.3: Healthy and unhealthy life expectancy at age 65 years, 1990 and 2017 291
Figure 10.4: Burden of disease, by disease type, 1990-2017 (% of total DALYs) 293
Figure 10.5: Percentage of countries that have a national strategy for chronic diseases and their risk factors, by demographic stage 303
Figure 10.6: Percentage of countries with policies that target main chronic diseases risk factors, by type of policies and country's demographic stage 305
Figure 10.7: Countries that have national dementia plans in place, and percentage of their populations aged 80 or more 310
Figure 10.8: Projected increase in health care expenditures due to demographic effects, 2010-2060 (in percentage points) 313
Figure 11.1: Having difficulty with any one ADL (Age 65+) 345
Figure 11.2: Needing help with any one ADL (Age 65+) 345
Figure 11.3: Having difficulty with any one IADL (age 65+) 348
Figure 11.4: Needing help with any one IADL (Age 65+) 348
Figure 11.5: Average number of cumulative ADL & IADL difficulties (Age 65+ having difficulty with an ADL or IADL) 351
Figure 11.6: Average number of cumulative ADL & IADL needs (Age 65+ needing help with an ADL or IADL) 351
Figure 11.7: Care mix (Age 65+ having difficulty with an ADL or IADL) 353
Figure 12.1: PRISMA flow diagram in search and selection of records 374

Figure 12.2: Proportion of studies by World Bank regions (World Bank 2022) 375
Figure 12.3: Differences in outcomes identified by biological sex 379
Figure 13.1: Demographic changes differ across regions, but aging is coming everywhere 389
Figure 13.2: Labor force participation for older workers falls with a country's income 390
Figure 13.3: Labor force participation patterns are similar over the life cycle across richer and poorer countries 390
Figure 13.4: In MICs, pension coverage remains low 391
Figure 13.5: Healthy life expectancy has been increasing across the globe 393
Figure 13.6: A policy framework for longer and more productive working lives 395
Figure 13.7: Participation in formal or non-formal training, by age 398
Figure 13.8: Access to training through employers is limited, especially in L/MICs 400
Figure 14.1: Coverage of non-contributory pensions, % population 65+ 422
Figure 14.2: Old age social pension beneficiaries, % population 65+ 422
Figure 14.3: Benefit amount, % GDP per capita 424
Figure 14.4: Expenditure on non-contributory pensions, % GDP (latest year) 425
Figure 14.5: Projected share of 60+ in total population in SAR 425
Figure 14.6: Out-of-pocket expenditure (% of current health expenditure) 430
Figure 14.7: Average share of out of pocket health expenditure by quintile and presence of persons age 65+ 431
Figure 15.1: Cost per DALY averted for 24 clinical interventions, by health system type 439
Figure 15.2: Final prioritization of NCD interventions, by health system type 442
Figure 15.3: Contribution of NCD interventions towards avoidable all-cause mortality 445
Figure 16.1: Trend in global deaths and disease burden by major cause (annual rate, 1990-2019) 452
Figure 16.2: Trend in deaths and disease burden by major cause in LMICs (annual rate, 1990-2019) 453
Figure 16.3: Global deaths attributed to major risk factors, by sex, 2019 454
Figure 16.4: Global disease burden from NCDs by age, 1990 to 2019 455
Figure 16.5: Components of a "whole-of-society" approach 460
Figure 16.6. Framework for multisector causation and impact of non-communicable diseases 463
Figure 16.7: Global policy actions relevant to sugar-sweetened beverages 469
Figure 16.8: Singapore's Healthy Living Master Plan 474
Figure 16.9: Singapore's "War on Diabetes" 475
Figure 16.10: Thailand's ThaiHealth Program 476
Figure 16.11: WBG investment lending on NCDs between FY16 and FY20 478
Figure 17.1: Healthy Longevity Initiative conceptual framework of human capital (HC) across the life course 495
Figure 17.2: Criteria for selecting healthy longevity indicators 496
Figure 17A.1a: Polio transition program monitoring and evaluation dashboard 511
Figure 17A.1b: Polio transition program monitoring and evaluation dashboard 511
Figure 17A.2: Global Malaria Dashboard – Campaign Dashboard 513
Figure 17A.3: Global Malaria Dashboard – Supply Chain Dashboard 514
Figure 17A.4: Page 1 of The Countdown Country Profile: A Tool For Action for Colombia 515
Figure 17A.5: Section of the Child Health and Well-being Dashboard 516
Figure 17A.6: Climate Action Tracker dashboard for Canada 517
Figure 17A.7: Section of the Open SDG Data Hub Country Profile: India 518
Figure 18.1: Criteria and process of indicator selection 523

Maps

Map 14.1: High shares of informality in developing countries 427
Map 14.2: Global Aging in 2020 428
Map 14.3: Global Aging in 2050 428

Spotlights

Spotlight 13.1: Ok, Boomer! The aging brain and implications for work 395
Spotlight 13.2: Gray matter – training for the aging brain 404
Spotlight 13.3: Individual learning accounts to foster adult learning 405
Spotlight 13.4: Generation – facilitating labor market transitions over the working life 405
Spotlight 13.5: Firms with age-sensitive management practices 408

Tables

Table 1.1: Determinants of log adult (40q30) mortality and effect of intervention on adult mortality 17
Table 2A.1: Mapping the human capital trajectory and its interactions with NCDs across the life cycle 79
Table 2A.2: Selected policies for human capital and NCDs across the life course 80
Table 2A.3: Human capital promoting policies during working life for accumulation, deployment and protection of HC 82
Table 3.1: Gap between observed and frontier life expectancy at birth in years, 2000, 2019 and 2050, globally and by region 90
Table 3.2: Total mortality and percentage of mortality that is avoidable in 2019, globally and by region, for all ages and by age 91
Table 3.3: Value of avoidable mortality in 2019 globally and by region and age group 95
Table 4.1: Causes of death 107
Table 4.2: Economic values of avoidable mortality as a percentage of annual income by region and cause of death, for the years 2000, 2019, and 2030 112
Table 5.1: Results from interrupted time series analysis of the change in mortality rates) from 2000-10 to 2010-19, by country income, age, and sex 125
Table 5.2: Top 10 and worst 10 performance rankings among 71 LMICs in the rate of decline of mortality, by sex and age, 2000-10 and 2010-19 127
Table 5.3: Diseases and conditions showing country income level and age group with the fastest and slowest progress in mortality reduction, 2000-19 131
Table 5.4: Global maximum survival rates and critical income levels, 1990 to 2019 133
Table 5.5: Top five LMICs with the lowest critical income for ages under 15 years, 15-49 years, and 50-69 years 133
Table 5A.1: Results of the hierarchical model predicting levels of mortality, by age and sex 137
Table 5A.2: Performance rankings of 71 LMICs in the rate of decline of mortality, by age and sex: 2000-10 and 2010-19 138
Table 5A.3: Change in performance in the annual rate of decline in mortality under 15 years, 15-49 years, 50-69 years, and 70-84 years, by sex from 2000-10 decade to 2010-2019 decade 146
Table 5A.4: Deaths avertable globally in 2019 from specific causes of deaths and age groups if rate of decline was same as that from HIV/AIDS (ages 0-14, 15-49) and tuberculosis (ages 50-69, 70+) 154
Table 6A.1: Summary of Behavioral Economics Concepts 185
Table 8.1: Key search teams for the review (not an exhaustive list) 220
Table 8.2: Typology to classify a country's long-term care services and supports system 237
Table 9.1: Definition of long-term care by country 263
Table 9.2: Co-residency and long-term care provision among individuals ages 40 to 59 265
Table 9.3: Determinants of parental care, three-country pooled sample 267
Table 9.4: Labor supply among individuals ages 40 to 59 268

Table 9.5. Correlational effect on employment of providing long-term care to parents, by gender, four-country pooled sample 271
Table 9.6: Gender difference in the effect on employment of providing long-term care to parents, four-country pooled sample 272
Table 9.7: Correlational effect of providing long-term care to parents on employment, by country 272
Table 9.8: Correlational effect on employment of care hours devoted to parents, pooled sample from three countries 274
Table 9.9: Heterogeneous effect of long-term care provision by education level, pooled sample from four countries 275
Table 9.10: Heterogeneous effect of long-term care provision by presence of children in household, pooled sample from four countries 276
Table 9.11: Sensitivity check: including the number of adult females/males in households 277
Table 9.12: Correlational effect on employment of the intensity of long-term care provision to parents, pooled sample from three countries 278
Table 9A.1: Correlational effect on employment of providing long-term care to parents 280
Table 9A.2: Gender difference in the effect on employment of providing long-term care to parents 281
Table 10.1: Years gained in life expectancy and healthy life expectancy at birth, 1990-2017. Both sexes, by demographic group 291
Table 10.2: Reasons given by adults aged 60 years or older for not accessing health care services, by country income category 298
Table 10.3: Long-term care services, by type 316
Table 11.1: Individual ADLS (Age 65+) 344
Table 11.2: Marginal effects from logistic regressions of having difficulty/needing help with at least one ADL 346
Table 11.3: Individual IADLs (Age 65+) 348
Table 11.4: Marginal effects from logistic regressions of having difficulty/needing help with at least one IADL 349
Table 11.5: Linear regressions of count of cumulative ADL & IADL difficulties/help needs 351
Table 11.6: Marginal effects from logistic models of receiving any care (Age 65+ having difficulty with an ADL or IADL) 354
Table 11.7: Marginal effects from logistic models of receiving formal care (Age 65+ having difficulty with an ADL or IADL) 355
Table 12.1: Total number of studies by countries + characteristics of 8 countries which produced the highest number of studies 376
Table 12.2: Frequencies of risk factors studied in included studies 376
Table 12.3: Frequencies of outcomes identified in included studies 376
Table 12.4: Frequency of studies associated with different combinations of exposures and outcomes 377
Table 12A.1: Search strategy for Ovid (MEDLINE) Sample 384
Table 13A.1: Labor market data for older adults 417
Table 14.1: Design and scope of non-contributory programs targeted to the elderly 420
Table 14.2: Additional dimensions to identify factors to incorporate in the concept of adequacy pensions 426
Table 14.3: Comparison of average shares of OOP health expenditure between households with elderly in the poorest quintile versus households with elderly in the richer quintiles 430
Table 15.1: Interventions considered in this paper 437
Table 15.2: Cost and impact of all NCD interventions by 2050, by world region 438
Table 15.3: Value for money among interventions outside the health sector 440
Table 15.4: Non-cost-effectiveness criteria for prioritizing clinical interventions 441

Table 15.5: Cost and impact of locally tailored high-priority NCD packages, by world region 443
Table 15.6: Total cost per capita for priority NCD interventions by year and country income group 444
Table 15.7: Workforce and facility requirements for implementing the high-priority NCD package by 2050 444
Table 16.1: Bi-directional relationship between selected non-health sectors and NCDs – some illustrations 463
Table 16.2: NCD control and prevention system in Japan 472
Table 16.3: Major NCD Management Initiatives in China 473
Table 16.4: WBG IPF Operations with a >50% focus on NCDs 479
Table 16.5: DPL operations relevant to NCDs supported by the World Bank Group, 2009-2019 482
Table 17.1: Key actions and related domains when developing a healthy longevity dashboard 495
Table 17.2: Healthy longevity dashboard indicators for Sierra Leone, India, and Colombia 497
Table 17.3: Data ecosystem features by domain and information infrastructure maturity level 504
Table 17.4: Proposed healthy longevity indicators by information infrastructure maturity level 505
Table 17.5: Key dashboard users, their purpose, and types of measures needed by users 506
Table 17A.1: Available data to better understand population ageing 519
Table 18.1: Key actions and related domains when developing a healthy longevity dashboard 522
Table 18.2: Indicator domains and indicators in the HLI dashboard for setting with moderate data infrastructure, and data sources for the India HLI dashboard 524
Table 18.3: Indicators of context– India, lower-middle income countries and world in 2019 526
Table 18.4: HLI health indicators (domains 1-6) and scores based on percentile rank approach (P) and z-score approach (Z) for India 527
Table 18.5: HLI social and economic indicators (domains 7-10) and scores based on percentile rank approach (P) and z-score approach (Z) for India 528
Table 18A.1: List of 33 lower-middle income countries with population of more than 7 million in 2020 532
Table 18A.2: Indicator data sources for the HLI India dashboard 532

Foreword

There is no doubt that the world's population is ageing at a dramatic speed. By 2050 at least a third of the population will be over 60 years of age, and a large proportion of these older adults will be in lower- and middle-income countries (LMICs). Global aging brings new opportunities but also challenges for economies. Many nations are ill-prepared for the magnitude and pace of these demographic shifts. Timely and effective control of noncommunicable diseases (NCDs), the primary cause of adult deaths, is crucial, especially in LMICs – where they already account for over 70 percent of all deaths and a significant portion of disability.

While aging is inevitable, healthy longevity is a choice. Over the last two years, the World Bank established the Healthy Longevity Initiative (HLI) to advance technical and operational knowledge about interventions, strategies and measurement promoting healthy longevity to sustain human capital productivity and identify policy priorities in key areas of engagement to reframe the aging policy narrative from one solely focused on risks to one that is also about finding opportunities.

The World Bank's Healthy Longevity Initiative (HLI) complements the work the World Bank has been leading on the Human Capital Project through focusing the spotlight on middle and older age adults, and the main challenge to maintaining (and expanding) their human capital. The initiative is part of a broader effort by the World Bank, in collaboration with the University of Toronto and other prestigious academic and development partners, to spotlight the urgency of, and identify critical policy actions for addressing NCDs worldwide. It's a call to action for policymakers everywhere to recognize the critical importance of combating NCDs for the sake of our collective future.

This compendium, featuring 18 insightful chapters, delves into the intricate relationship between NCDs, human capital, and productivity, drawing on a wealth of analytical work. It is the companion volume to the report, *"Unlocking the Power of Healthy Longevity: Demographic Change, Noncommunicable Diseases, and Human Capital"*. The compendium presents the comprehensive and cutting-edge background research on key issues related to aging, the economic strain of non-communicable diseases (NCDs), preventable mortality, long-term care, behavioral change, labor market implication, social protection, and holistic government strategies that support the pursuit of a healthy, extended life – the pursuit of which begins in the womb.

Promoting 'healthy, productive and inclusive longevity' which happens throughout the life course, will require among others a focus on health, labor markets and skills, financial protection, long term care, and fiscal policies. The recommendations across the compendium underscore the necessity for cross-sectoral thinking and action, and the importance of collaboration between governments, civil society, and development partners to create positive synergies, given the multidimensional nature of aging.

I hope that the research in this compendium and overall recommendations of the HLI will significantly contribute to policy dialogue and action to promote healthy longevity.

Juan Pablo Uribe
Global Director
Health, Nutrition, and Population Global Practice
World Bank

Preface

Global demographic transformations are rapidly occurring, marked by a significant increase in noncommunicable diseases (NCDs). These changes present a challenge comparable in scale to threats from climate change or pandemics.

The World Bank's Healthy Longevity Initiative (HLI) conducts analytic research to help countries address demographic and NCD challenges. The HLI originated from the United Nations General Assembly session on the NCD challenge in 2014. Following the launch of the World Bank's Human Capital Index and project in 2017, which aimed to accelerate investments in essential health and education services, there was a clear need to adopt a life-course approach to improving health and well-being. There was a need to further elaborate the link between adult health and the effective use of human capital as a crucial resource for countries.

Thus, the HLI was established, beginning with a partnership between the World Bank, World Health Organization, and the University of Toronto. This collaboration produced the first report in 2018, titled *Non-Communicable Diseases and Human Capital Research Initiative*. While the COVID pandemic slowed progress on the report, it underscored the connection between pandemics and adults with existing NCDs, highlighting the resulting significant health, social, and economic losses.

The HLI focuses on generating and gathering robust analytical materials to support its overall report and encouraging academic and policy research on key components. This Compendium includes 18 detailed background papers written by over 90 authors from various countries, covering six key themes: theoretical base and economic costs; behavior change; financial and social protection; long-term care; gender; and prioritizing action.

The Compendium papers were further curated by extensive consultations over four years. We hope that it will spur further analytical work and methodological advances at the country level. Latin American countries have begun applying HLI methods to assess the economic value of avoidable mortality.

Finally, we emphasize that analyses must be accompanied by expanded country-level action on NCDs, linking such investments to nationwide efforts to build human capital.

The HLI Compendium Editors

Prabhat Jha
George Alleyne
Paul Isenman
Seemeen Saadat
Jeremy Veillard
Sameera Altuwaijri

August 15, 2024

Acknowledgements

The Healthy Longevity Initiative (HLI) is a multi-year, multi-disciplinary analytical study to advance technical and operational knowledge about interventions, strategies and measurement promoting healthy longevity and support human capital formation and maintenance through better prevention and control of non-communicable diseases (NCDs).

This work was led by Sameera Altuwaijri (Global Lead, Population and Development, Health, Nutrition and Population Global Practice, World Bank), and Prabhat Jha (Professor, Dalla Lana School of Public Health), along with a core team consisting of Sir George Alleyne (Director Emeritus, Pan American Health Organization), Paul Isenman (Former Policy and Operations Manager, World Bank and OECD), Seemeen Saadat (Consultant, Population and Development, Health, Nutrition, and Population Global Practice, World Bank), Jeremy Veillard (Lead Health Specialist, Latin America and the Caribbean, World Bank), Daphne Wu (Research Coordinator, Centre for Global Health Research, University of Toronto), Gisela Garcia (Evaluation Officer, IEG Human Development and Corporate Program, World Bank), Meriem Boudjadja (Consultant, Health, Nutrition, and Population, East Asia and the Pacific, World Bank), Debapriya Chakraborty (Research Coordinator, Center for Global Health Research, University of Toronto), and Victoria Haldane (Ph.D. Candidate, Institute of Health Policy, Management and Evaluation, University of Toronto). The HLI builds on the Non-Communicable Diseases and Human Capital Research Initiative, which was spearheaded by Jeremy Veillard.

The HLI was conducted under the supervision of Juan Pablo Uribe (Global Director, Health, Nutrition, and Population Global Practice) and Monique Vledder (Practice Manager, Health, Nutrition, and Population Global Practice). The work was conducted in collaboration with colleagues from the Social and Protection and Jobs Global Practice who contributed several chapters to this compendium. The team would like to thank Michal Rutkowski (Regional Director, Eastern Europe and Central Asia/former Global Director, Social Protection and Jobs Global Practice), as well as to the Human Capital Project team, led by Iffath Sharif (Global Director, Social Protection and Jobs Global Practice/former Manager, Human Capital Project) and Gabriel Demombynes (Manager, Human Capital Project) for their support and contributions. Overall guidance for this work was provided by Mamta Murti, Vice President, Human Development, World Bank.

This compendium presents the wealth of research conducted under the HLI. In all there are 18 chapters organized by theme. Each chapter was developed by a dedicated team of Bank staff, researchers and academics, and peer reviewed by experts in their respective fields. The HLI team would like to thank all authors and peer reviewers for their contributions to the Initiative:

Chapter 1 was coordinated by Sir George Alleyne (PAHO), Timothy Evans (McGill University), Alexander Irwin (Independent Global Health Writer and Researcher), Prabhat Jha (University of Toronto), and Jeremy Veillard (World Bank). It is based on the proceedings of a workshop titled, *Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop*, hosted in Toronto by the University of Toronto Dalla Lana School of Public Health on July 9-10, 2019.

Chapter 2 was authored by Phillip O'Keefe (University of New South Wales) and Victoria Haldane (University of Toronto). **Chapter 3** was authored by Angela Y. Chang (University of Southern Denmark), Gretchen A. Stevens (Independent Researcher), Diego S. Cardoso (Purdue University), Bochen Cao (WHO), and Dean T. Jamison (UCSF). **Chapter 4** was written by Stéphane Verguet (Harvard T.H. Chan School of Public Health), Sarah Bolongaita (Harvard T.H. Chan School of Public Health), Angela Y. Chang (University of Southern Denmark), Diego S. Cardoso (Purdue University), and Gretchen A. Stevens (Independent Researcher).

Chapter 5 was drafted by Daphne C. Wu (University of Toronto), Debapriya Chakraborty (University of Toronto), Ryan Hum (University of Toronto), Prabhat Jha (University of Toronto), and Dean T. Jamison (University of California at San Francisco). **Chapter 6** was developed by Ana Maria Rojas (World Bank), Ana Maria Munoz Boudet (World Bank), Ellen Moscoe (World Bank), Julian Jamison (University of Exeter), and Carlos Riumallo Herl (Erasmus University). **Chapter 7** was authored Guillermo Paraje (Escuela de Negocios, Universidad Adolfo Ibáñez), Prabhat Jha (University of Toronto), William Savedoff (Social Insight), and Alan Fuchs (World Bank). Daniel Araya provided useful research assistance. **Chapter 8** was written by Seemeen Saadat (World Bank), Meriem Boudjadja (World Bank), and Sameera Altuwaijri (World Bank). **Chapter 9** was authored by Roberta Gatti (World Bank), Daniel Halim (World Bank), Allen Hardiman (University of Illinois), and Shuqiao Sun (World Bank). **Chapter 10** was composed by Natalia Aranco Araújo (World Bank) and Gisela M. Garcia (World Bank). **Chapter 11** was developed by Elena Glinskaya (World Bank), Xiaohui Hou (World Bank), Zhanlian Feng (RTI International), Marco Angrisani (University of Southern California), Guadalupe Suarez (Research Triangle Institute), Jigyasa Sharma (World Bank), Drystan Phillips (University of Southern California) , Jenny Wilkens (University of Southern California), Jinkook Lee (University of Southern California), Yeeun Lee Yoo (University of Southern California), Samuel Lau (University of Southern California), Hae Yeun Park (University of Southern California), and Yizhou Chen (University of Southern California). **Chapter 12** was written by Debapriya Chakraborty (University of Toronto), Daphne Wu (University of Toronto), and Prabhat Jha (University of Toronto). and David Lightfoot (Unity Health) supported the literature search. **Chapter 13** was written by Sara Johansson de Silva (World Bank) and Indhira Santos (World Bank). **Chapter 14** was authored by Gustavo Demarco (World Bank), Johannes Koettl (World Bank), Miglena Abels (World Bank) and Andrea Petrelli (World Bank), with support from Claudia Rodriguez Alas (World Bank) and Ana Sofia Martinez Cordova (World Bank) on household survey data analysis, and from Danilo Aristizabal (World Bank), who prepared the calculations for the household survey analysis. **Chapter 15** was authored by David Watkins (University of Washington), Sali Ahmed (University of Washington), and Sarah Pickersgill (University of Washington). **Chapter 16** was drafted by Ramesh Govindaraj (World Bank) and Sundararajan Srinavasa Gopalan (Independent Researcher) with support from Nora Wu (World Bank) and Charles Dalton (IFC). **Chapter 17** was composed by Victoria Haldane (University of Toronto), Gisela M. Garcia (World Bank), Tahir Bockarie (University of Warwick), Daphne Wu University of Toronto), Cristian A Herrera (World Bank), Maria Luisa Latorre Castro (Fundación Universitaria Juan N Corpas), Debapriya Chakraborty (University of Toronto), Beverly Essue (University of Toronto), Prabhat Jha (University of Toronto), Jeremy Veillard (World Bank); and **Chapter 18** was developed by Daphne Wu (University of Toronto), Jeremy Veillard (World Bank) Victoria Haldane (University of Toronto), Seemeen Saadat (World Bank) and Prabhat Jha (University of Toronto).

Many reviewers offered extensive advice and insightful comments, including (in alphabetical order of last name): Shambhu Acharya (World Health Organization), Tanima Ahmed (World Bank), Francisca Akala (World Bank), Faiza Benhadid (Independent Expert on Gender and Human Rights), Indu Bhushan (Partnership for Impact), Adriana Blanco (PAHO), Danielle Bloom (World Bank), Mukesh Chawla (World Bank), Sarbani Chakraborty (Access Accelerated), Pedro Conceicao (UNDP), Damien De Walque (World Bank), Gustavo Demarco (World Bank), Gabriel Demom¬bynes (World Bank), Erica Di Ruggiero (University of Toronto), Daniel Dulitzky (World Bank), Patrick Hoang-Vu Eozenou (World Bank), Beverley Essue (University of Toronto), Ian Forde (World Bank), Linda Fried (Columbia University Mailman School of Public Health), Cristian Hererra (World Bank), John Giles (World Bank), Elena Glinskaya (World Bank), Vivek Goel (University of Toronto), Amparo Elena Gordillo-Tobar (World Bank), Michele Gragnolati (World Bank), Sue Horton (University of Waterloo), Dean T. Jamison (University of California, San Francisco), Alexey Kulikov (World Health Organization), Christoph Kurowski (World Bank), Victoria Levin (World Bank), Kate Mandeville (World Bank), VR Muraleedharan (Indian Institute of Technology Madras), Rachel Nugent (Research Triangle Institute (RTI) International), Patrick Osewe (Asian Development Bank), Ceren Ozer (World Bank), Patrick Petit (International Monetary Fund), John Pig¬gott (University of New South Wales), Usha Ram (International Institute of Population Sciences), Gonzalo Reyes (World Bank), Hana Ross (University of Cape Town), Akshar Saxena (Nanyang Technological University), Norbert Schady (World Bank), Miriam Schneidman (World Bank), Daniel Sellen (University of Toronto), Owen Smith (World

Bank), Marc-Francois Smitz (World Bank), Victoria Strokova (World Bank), Jeff Sturchio (Rabin Martin), Cornelis Peter Van Walbeek (University of Cape Town), Michael Weber (World Bank), Derek Yach (Independent Global Health Consultant), and Feng Zhao (World Bank).

All chapters benefited from feedback from members of the core HLI team at various stages and from participants at the Healthy Longevity Initiative Technical Workshop held in Mexico City in May 2022 hosted by *Escuela de Salud Pública De México*, World Bank, and University of Toronto, and the Healthy Longevity Initiative's Author Workshop held in October 2022 at the World Bank in Washington D.C (Annex A.2). A special thanks to Sir George Alleyne and Paul Isenman for their thorough review of all chapters. Please see Annex A.1 for chapter by chapter acknowledgements.

The chapters also benefitted from an editorial review by Alexander Irwin. Karim Ezzat provided graphics and typesetting support while Arlene Lucindo Fitz-Patrick (World Bank), Jocelyn Haye (World Bank), and Venus Jaraba (University of Toronto) provided operational support over the course of the project. The team gratefully acknowledges the support of the Access Accelerated Trust Fund and the Centre for Global Health Research, Unity Health Toronto, Dalla Lana School of Public Health in making this work possible.

The findings, interpretations, and conclusions expressed in this document are solely those of the authors and do not necessarily reflect the views of the Board of Executive Directors of the World Bank or the governments they represent.

Any errors are the sole responsibility of the authors/HLI team.

Overview

Noncommunicable diseases (NCDs) are among the major health and development challenges of our time. Every year, about 41 million people die due to NCDs. This makes up about 74 percent of all deaths globally, the majority of which are in low- and middle-income countries (LMICs).[1] Countless more people live with NCDs every day. Yet, NCDs are largely treatable and preventable. The risk of developing NCDs and deaths from them can both be lowered with appropriate attention to prevention and treatment.

However, weak health systems and limited access to affordable care and information, especially in LMICs, contribute to lapses in seeking and receiving appropriate and timely care. While individual responsibility plays an important role in health maintenance, addressing NCDs requires a concerted effort on the part of societies as a whole to invest in better health and well-being of individuals across the life course, that is, in healthy longevity. Reduced NCDs can boost human capital especially when coupled with education, skills development, and labor market opportunities.

Strengthening and protecting human capital is essential for countries' overall welfare and to build inclusive, secure societies. Health, at both the individual and societal levels, is a key contributor to human well-being and a key objective of the development process, over and above its impact on outcomes such as productivity and growth. Prioritizing the health and well-being of individuals throughout their lives, from cradle to old age, not only improves health outcomes but also enhances other aspects of human capital—education, skills, and ability to participate in the labor market.

However, the links between human capital and better health through a reduced burden of NCDs across the life course—from childhood to adulthood—need to be more explicitly explored and articulated. Filling this analytic gap is a fundamental motivation for the Healthy Longevity Initiative (HLI).

This compendium is a compilation of 18 chapters, each exploring a different but related topic in the nexus of NCDs, human capital, and productivity. It is based on a series of analytical work taken up by the World Bank to support the HLI—a collaborative effort between the World Bank, the University of Toronto, and key academic and development partners including the Harvard University and the University of Washington. The HLI presents one of a growing set of efforts to increase the urgency of policy response to NCDs across the world.

Chapter 1. Enhancing Human Capital and Boosting Productivity by Tackling Non-Communicable Diseases: Results of a Research Initiative

Chapter 1 summarizes the proceedings of a technical workshop as part of the project, 'Non-Communicable Diseases and Human Capital Research Initiative'. The project, which was the precursor to the HLI, was led by the World Bank Human Capital Project in partnership with the University of Toronto. It focused on the impact of NCDs on the global economic burden of disease and selected aspects of human capital such as educational outcomes, adult survival, and productivity. The main messages from this research are as follows:

- Rising NCD burdens threaten countries' human capital, a critical determinant of their economic success.
- By tackling NCDs with proven, cost-effective interventions, countries can reap substantial economic benefits, with some quick wins (within 1–5 years). Gains will come mainly from higher effective labor supply and improved productivity.
- Tackling NCDs in children and their caregivers may drive longer-term gains in human capital and productivity by improving children's educational outcomes.
- Firms across multiple industries could reap productivity benefits from action on NCDs.
- Strong, country-owned measurement systems are crucial for NCD success and human capital benefits.

1 WHO (World Health Organization). 2023. "Fact Sheet: Noncommunicable Diseases." https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.

The evidence presented supports ramping up investments in NCD prevention and control that have the potential for countries to bolster their human capital and higher productivity in relatively short time frames. Moreover, the growing appreciation of the importance of human capital creates a window of opportunity for collaboration between the World Bank, the World Health Organization (WHO), and other partners to help countries enhance their human capital by tackling NCDs. These themes are further developed across the chapters in the compendium.

Chapter 2. Towards a Framework for Impact Pathways between NCDs, Human Capital and Healthy Longevity, Economic and Wellbeing Outcomes

This chapter lays out the pathways between NCDs, human capital, and the end outcomes of healthy longevity, inclusive growth, and well-being. It summarizes the substantial literature on the impacts of health and longevity on growth, using macroeconomic, growth accounting, and microeconomic approaches.

Research shows that human capital accounts for almost two-thirds of global wealth and on average accounts for an increasing share of national wealth as countries grow richer. While there is debate on the extent and causality, analyses of macro-level impacts of NCDs point to a negative relationship between NCD prevalence and economic growth and conversely a positive contribution to growth from implementing a basic package of interventions for the 'big four' NCDs (cardiovascular diseases [CVDs], diabetes, respiratory diseases, and cancers) and mental health conditions. Moreover, the impact of increased longevity on human capital accumulation and growth differs according to the stage of demographic transition. There are three channels through which NCDs affect inclusive growth:

- **The macroeconomic/savings channel.** Despite much debate and the challenges related to accounting for non-health factors such as institutions and geography, a growing body of empirical work, including from developing countries, supports a negative relationship between NCD prevalence and economic growth.

- **The fiscal channel.** NCDs also have clear fiscal impacts on the expenditure and revenue sides. Higher NCD incidence increases the need for public spending on health care services and long-term care (LTC), which can lead to budget deficits and crowding out of private sector investment. On the revenue side, to the extent that NCDs compromise workforce participation or productivity at work (from higher absenteeism), they will reduce revenues from labor income and corporate tax revenues.

- **The human capital channel.** Growing evidence suggests that the negative impacts of NCDs on human capital occur across the life course. NCDs compromise both the entire trajectory of human capital and returns to human capital: its formation and ongoing accumulation, its deployment in terms of both duration and productive use, and its protection and preservation in the face of shocks and late life decline.

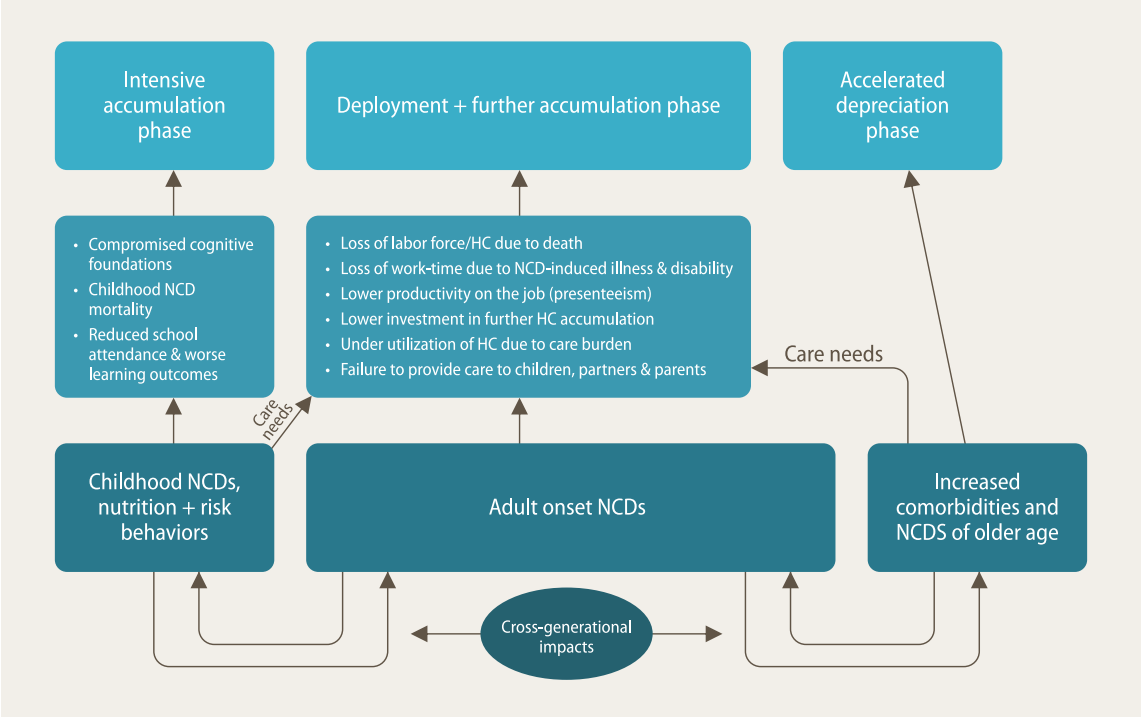
The human capital channel can be further delineated across the life course (figure 1) specifically as follows:

- In early life, there is strong evidence that NCDs and poor nutrition compromise cognitive foundations, school attendance, and learning outcomes, all affecting labor market outcomes in adult life. There are also immediate effects from the growing burden of childhood NCD mortality and morbidity.

- During the stage of human capital deployment, NCDs can compromise returns to human capital and its further accumulation, and accelerate depreciation through several mechanisms: (a) total loss of labor supply as a result of premature mortality (over 40 percent of NCD deaths occur before age 70); (b) reduced returns to human capital from NCD-based morbidity and disability, for example, because of unemployment, early withdrawal, absenteeism, or 'presenteeism' (being at work but less productive); and (c) failure to invest in further accumulation of human capital over adult life, for example, due to reduction in on-the-job learning and behavioral impacts on subsequent efforts to accumulate human capital.

- In the later stages of life, NCDs accelerate the depreciation of human capital, and the NCDs of older parents contribute to the underutilization of human capital of their adult children in the labor market, particularly of women, due to care demands. There may be a ripple effect also to grandchildren to the extent that NCDs in older ages constrain the caring contributions of grandparents.

FIGURE 1 Impact Channels between NCDs and Inclusive Growth



Source: Original figure for this publication.
Note: HC = Human capital.

Health outcomes are also affected by key dimensions of equity such as poverty or wealth, gender, and overall well-being. For example, evidence points to a higher incidence of cancer, CVD, and multiple NCDs in households with lower socioeconomic status (SES) in LMICs. Such households have a significantly higher prevalence of NCD risk factors such as tobacco and alcohol use, and poorer nutrition compared to households with higher SES. At the same time, differences in availability and coverage of financial protection and the cumulative effects of catastrophic health spending over the life course contribute to variations in outcomes. A growing body of evidence that uses the WHO's multidimensional quality-of-life measure also finds negative associations between a range of NCDs and quality of life, and that better health is strongly associated with higher levels of happiness.

While NCDs dominate the disease burden globally for both genders (accounting for two-thirds of female deaths annually), there are differences in the gender-specific patterns of NCD prevalence and risk factors. For example, male smoking rates (and tobacco-attributable deaths) are substantially higher than those in women globally, while women disproportionately suffer and die from Alzheimer's and other dementias. Moreover, the burden of informal care for those with serious NCDs falls disproportionately on women—almost 50 percent of women outside the labor market in middle-income countries (MICs) and over 33 percent in low-income countries (LICs) cite unpaid care duties as the main reason for dropping out of the labor markets. Based on data from 53 countries across income levels, the International Labour Organization (ILO) estimates that women's unpaid care work would amount to 6.6 percent of global gross domestic product. These themes are explored further in chapters 8–11 in the compendium.

Consequently, policy responses to prevent and control NCDs also need to take a life course approach. Some of the major policy areas of interest include nutrition, public health, and health care services, where the economic and social returns to investments are high, and affordable packages of essential NCD interventions are available. While cost-effectiveness is a key consideration for developing countries in prioritizing within limited budgets, it is also important to integrate other considerations such as equity and financial protection, as well as feasibility of implementation given the diverse states of health systems. Outside of health, attention to taxation policies to reduce risky behaviors (most notably tobacco use) while rais-

ing revenue, policies and interventions that improve road safety, and expanding coverage of social security systems hold promise as policies to mitigate and manage NCDs and their social and economic impact.

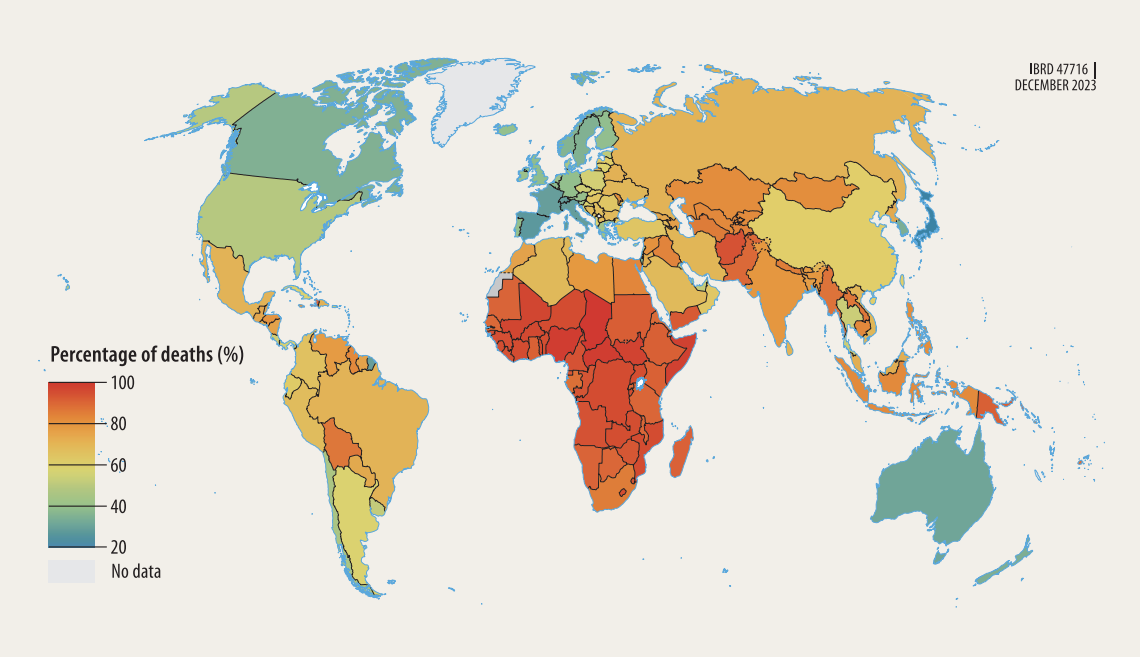
Chapter 3. The Economic Value of Avoidable Mortality

This chapter addresses an important question—what is the benefit of reducing mortality from NCDs? It estimates the economic value of avoidable mortality by world region, sex, and age, between 2000 and 2019, with projection to 2050. The chapter introduces two novel methods for defining and estimating the economic value of avoidable mortality.

First, a frontier approach is used to compute avoidable mortality by identifying the lowest observed or projected mortality rate. This is established as the frontier for each age group and year, with avoidable mortality defined as the difference between the frontier and current mortality levels for each country by age, sex, and year. Importantly, the frontier lowest rates are seen in many countries and not just in select high-income countries (HICs) like Japan and Republic of Korea. Second, the economic value of avoidable mortality in a given year is defined as the proportion of annual income one is willing to forego to live that year at the frontier survival probabilities. Then empirical estimates of the value per statistical life are calculated accounting for the effect of large risk changes by using a logarithmic function to model a nonlinear trade-off relationship between income and risk reduction.

Figure 2 presents the proportion of avoidable mortality globally for 2019. Results show that 69 percent, or 40 million deaths globally, were avoidable. HICs had the lowest (42 percent) and Sub-Saharan Africa had the highest (91 percent) levels of avoidable deaths (in part due to persisting high and avoidable burdens from malaria and other infections in the continent). Globally, more avoidable deaths occurred in older adults than children, adolescents, or younger adults. The economic value of avoidable mortality globally in 2019 was 23 percent of the annual income, with China having the lowest value at 19 percent and Sub-Saharan Africa having the highest value at 34 percent. The economic value is approximately 37 percent higher for males than females, reflecting the higher avoidable mortality rates of males.

FIGURE 2 Avoidable Mortality as a Percentage of Total Mortality, 2019



Source: Original figure for the HLI.

These findings have implications for policy and planning. They highlight the economic gains from reducing avoidable mortality in adults. As governments worldwide engage in policy dialogues on how and how much to invest in improving population health, this analysis provides supportive evidence

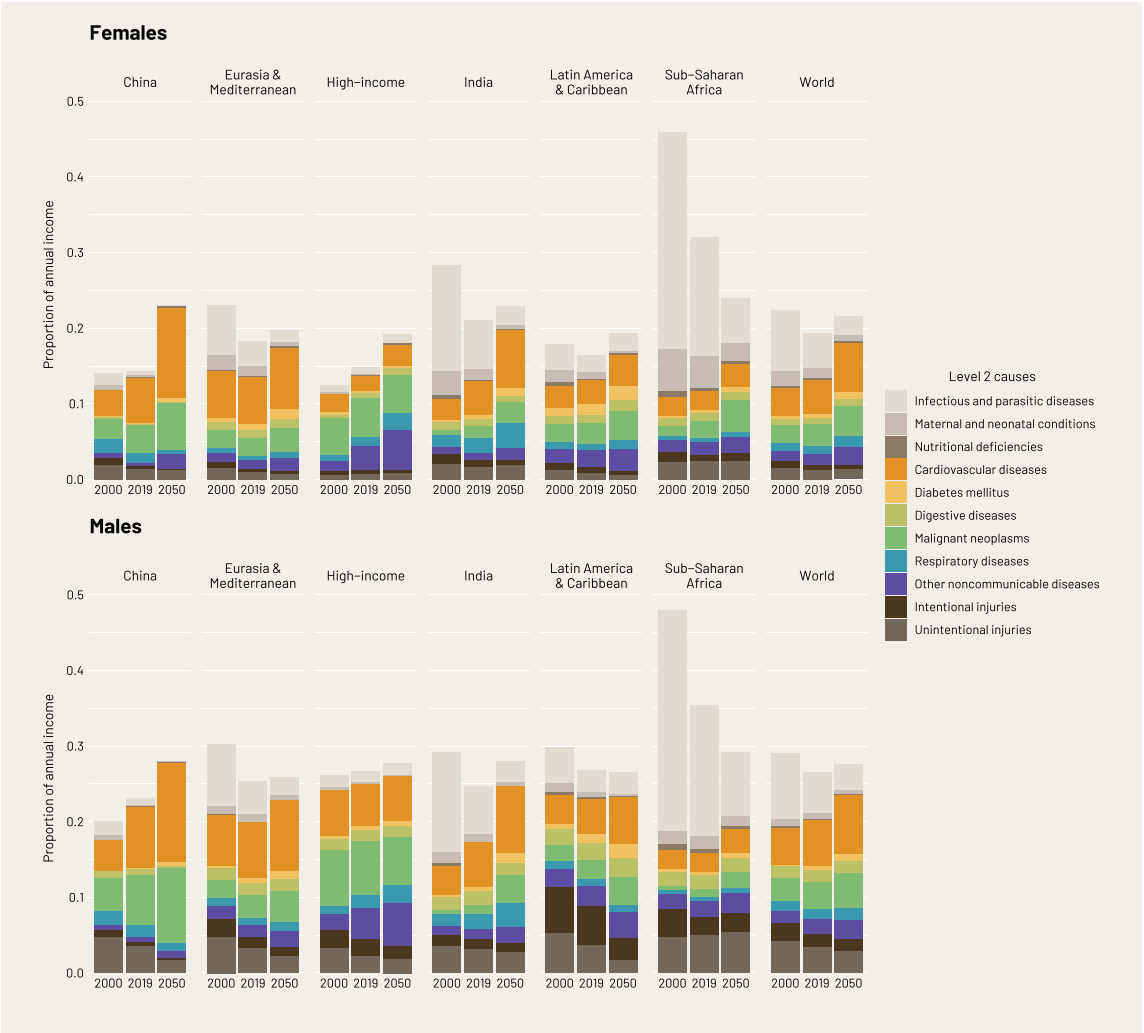
on the high economic value placed on improving health, even when considering resource constraints.

Chapter 4. The Economic Value Associated with Avoidable Mortality: A Systematic Assessment by Cause of Death across World Regions

Chapter 4 builds on the analysis in chapter 3 by estimating the economic value of avoidable mortality by major disease groups including key NCDs and injuries for six large world regions: China, India, HICs, Eurasia and the Mediterranean, Latin America and the Caribbean, and Sub-Saharan Africa.

Using data from the WHO's Global Health Estimates for 2000–2019 for an exhaustive set of 31 causes of death including major NCDs and injuries, the 2022 World Population Prospects population estimates, and the World Bank's World Development Indicators, the chapter first quantifies avoidable mortality, that is, the difference between lowest-achieved mortality frontiers (the 10th percentile of age-specific mortality rates) and projected mortality trajectories, for each cause of death, for 2000–2050. The value of a statistical life approaches is applied to assign economic values to the estimates of avoidable mortality by cause of death, region, and calendar year. These economic values capture the percentage of income an individual would be willing to forego to live one year under the lowest possible mortality rate for a given cause of death.

FIGURE 3 Economic Values of Avoidable Mortality (as % of Annual Income) by Select Causes of Death, Region, and Sex for 2000, 2019, and 2050



Source: Original figure for the HLI.

Results show that the economic implications of controlling NCDs and injuries would be substantial, particularly for CVDs, cancers, and injuries, with some variations depending on the region and sex. The economic value associated with CVD avoidable mortality would be universally large for both females and males, with values spanning 2–8 percent of annual income (for 2019). For cancers, it would be large (for both males and females) in HICs and China, while for injuries, it would be substantial for males in Latin America and the Caribbean (intentional injuries) and males in Sub-Saharan Africa (unintentional injuries).

With rapidly aging populations, national health systems must set difficult priorities toward improving the healthy longevity of their populations. This chapter provides a systematic monetary assessment of the economic value associated with elevated NCD and injury mortality, globally and regionally, and derives an economic metric directly comparable to annual incomes (for example, gross national income), which can help countries in priority setting for the health sector as well as other sectors.

Chapter 5. Rates of Progress in Mortality Decline, 2000–2019

This chapter summarizes the data on global mortality decline and assesses the monetary cost of saving a life at different ages. Using interrupted time series, it analyzes the change in mortality rates from 2000–09 to 2010–19, by age and sex, and by country income level. Results show the following:

- Between 2000 and 2010, mortality rates declined significantly across all age groups irrespective of country income level, except among older men of ages 70–84 in LMICs.
- The rate of mortality decline in the first half of the study period (2000–09) was significantly faster for almost all country income levels than during the latter half, that is, 2010–19 for age cohorts under 70.
- For ages 70–84, the rate of decline was significantly faster during 2010–19 for men in LICs and for both men and women in MICs.

The chapter also presents data on the country-level performance on mortality decline. A further analysis of the rates of progress in cause-specific mortality, by country income level and age, from 2000 to 2019 using average annual rates of reduction (AARR)[2] shows the following:

- While childhood-cluster diseases (including whooping cough, diphtheria, measles, and tetanus) showed the fastest rate of decline in mortality in upper-middle-income countries (AARR of 9 percent for ages 0–14 years), progress on NCDs was much slower, with the fastest decline in respiratory diseases (AARR of 5 percent) among ages 50–69.
- The slowest progress was in tobacco-attributable cancers and breast cancer among those of ages 70 and older in LICs.
- Roughly 13.5 million deaths due to all causes could have been avoided (of which about 34 percent would have been under the age of 70) if efforts to address these had yielded similar rates of progress as observed for HIV/AIDS and tuberculosis during the same time period.

Finally, the chapter assesses the cost associated with saving a life using the concept of 'critical income', defined as 'the income needed to achieve 80 percent of the global maximum life expectancy'. The analysis shows that the critical income for child survival fell from US$1,452 to US$800 (at 2017 purchasing power parity [PPP]) between 1992 and 2017, representing a decline of 46 percent. However, it remained relatively constant for adults of ages 15–49 but increased by 26 percent (from US$914 to US$1,180) for ages 50–69. At the country level, the critical income needed to save a life was the lowest for LICs and in Sub-Saharan Africa.

Technological change and policy attention through efforts such as the Millennium Development Goals have played an important role in improving survival among younger cohorts and reducing the cost of saving a life. Similar attention to addressing NCDs can yield further gains in reducing mortality and saving lives. This would require investments in research and development and global public goods, paired with expanded service deliv-

2 Calculated using standard WHO methodology.

ery, to 'bend the cost curve' for NCDs.

Chapter 6. Behavioral Aspects of Healthy Longevity

Chapter 6 examines the role of behavioral science as a policy tool for reducing NCDs. Addressing NCDs to achieve healthy longevity for an aging population has become central to global health policy goals. New policy tools are needed to effectively and efficiently tackle health and lifestyle behaviors and habits linked to the development of NCD risk factors. Behavioral science offers insights into psychological barriers, mental models, biases, and other factors that influence decision-making and habit formation. Applying these insights can support current policy efforts toward healthy longevity.

The chapter develops a framework to clarify relationships between NCD occurrence, detection, and management and behavioral determinants at the individual, community, and health systems levels, documenting frequently identified behavioral barriers at three key stages of patients' NCD trajectories. It identifies policy lessons from the behavioral science literature to address such barriers and, together with other policies, reduce NCD incidence and improve treatment effectiveness.

More and more health systems, at least in MICs and HICs, have started focusing on NCD prevention and treatment. However, providing information may not by itself be sufficient, because individuals may not act on that information due to a myriad of reasons ranging from their own assessment of the perceived need, distrust or dissatisfaction of the health system, social norms and behaviors of reference groups, and peer pressure. These obstacles can be exacerbated by system features such as complicated processes that can increase people's 'hassle perception' about engaging with the health system, health insurance, and related institutions and processes.

Behavioral interventions that aim to address the factors behind risky behaviors appear to support the reduction of NCD lifestyle risk factors. Traditional policy tools based on the rational subject model have been moderately effective in changing unhealthy behaviors. Insights from the behavioral sciences can complement these traditional tools, increasing their efficacy and impact. The behavioral science toolkit is large. No single policy tool can address the complexity of behavioral barriers across the whole journey toward healthy aging, nor should these be considered stand-alone interventions that can operate independently of other services, health system resources, and other structural factors. Some important tools include the following:

- **Small financial incentives.** Financial incentives seem to promote healthy behaviors in the short term, but effects disappear when the incentives are removed. Combinations with other behavioral insights such as peer and framing effects tend to render lasting results.

- **Commitment contracts.** They have also been used to encourage other forward-looking behaviors such as weight loss or quitting smoking. However, results have been mixed.

- **Saliency and vividness.** They have also been found effective in highlighting the risks of unhealthy behaviors and inflecting those behaviors such as through advertising the negative effects of smoking.

- **Plan-making.** This can also make adherence more salient by focusing on the motivation factors and identifying obstacles and planning to address those that are under the individual's control. The technique has been shown to reduce drinking and smoking, improve healthy food consumption, increase physical activity, and support weight loss.

- **Reminders.** Electronic reminders are increasingly being used by the health system to address poor medication adherence and appointment attendance rates. They are especially helpful in the short run for medication adherence and have been shown to improve appointment attendance.

- **Choice architecture.** Choice architecture refers to the practice of influencing choice by 'organizing the context in which people make decisions' (Mikic 2020). Removing temptation from one's choice set or making the healthy and unhealthy options equally convenient has shown promising results for a range of behaviors, from improving healthy eating habits to suicide prevention.

While ongoing management of NCDs, mainly via medication adherence, is among the most cost-effective strategies for NCD control, policy tools to influence individual health-seeking behavior can support adherence by addressing barriers that

currently prevent individuals from entering and remaining in care, thereby improving the effectiveness of such interventions.

Chapter 7. Taxation of Harmful Products, including Tobacco, Alcohol, and Sugar-Sweetened Beverages (SSBs), and Related Topics

This chapter reviews the evidence on the effect that changes in prices and incomes have on the consumption of tobacco, alcohol, and SSBs, as a way of assessing the consumption impact of raising excise taxes. Key findings of the review include the following:

- The large and growing disease burden associated with health-damaging products poses challenges for health systems and sustainable development. Reducing the consumption of such products is key for a healthy longevity agenda.

- Taxation is one of most cost-effective tools to decrease consumption of tobacco and alcohol as well as SSBs. It is particularly effective in influencing early life consumption (for example, during adolescence or youth) that may have a permanent effect.

- Firms usually control the rate at which taxes are passed to prices, and there is consistent evidence that in most cases taxes are fully passed to prices (and often over-shifted, that is, the pass through to prices is greater than the taxes). Hence, taxes are effective at decreasing consumption.

- Excise taxes on harmful products increase economic efficiency, as they correct consumption-related externalities (that is, market prices without taxes do not reflect all costs borne by society) and internalities (that is, individuals' ignoring or not correctly considering harmful health effects to themselves when they consume these products). Hence, taxation increases individual and social welfare.

- When considering the costs to households of health care, foregone income, and premature mortality linked to the consumption of health-damaging products, taxes on these products are found to be progressive, as they save valuable resources in low-income households. Though taxation may have short-term negative financial consequences for low-income households, these are largely compensated by medium- and long-term financial benefits from better health even leaving aside the intrinsic value of better health.

- Negative effects of taxation on employment have been largely exaggerated in industry-friendly reports and mostly rest on narrow, single-market analyses. When general equilibrium approaches are considered, it is found that taxes do not destroy jobs. Often, they create jobs as fiscal revenues are spent on labor-intensive services. Similarly, the effect of tobacco taxation on illicit trade is overemphasized. Illicit trade depends on institutional weaknesses and regulatory deficiencies rather than the level of tobacco taxes.

In essence, reducing consumption of tobacco, alcohol, and SSBs and the burden of disease associated with them reduces health care costs, increases the social return on human capital, reduces human suffering, and lowers poverty, among other benefits. Taxation is one of the most cost-effective ways to reduce the consumption of harmful products and increase social welfare.

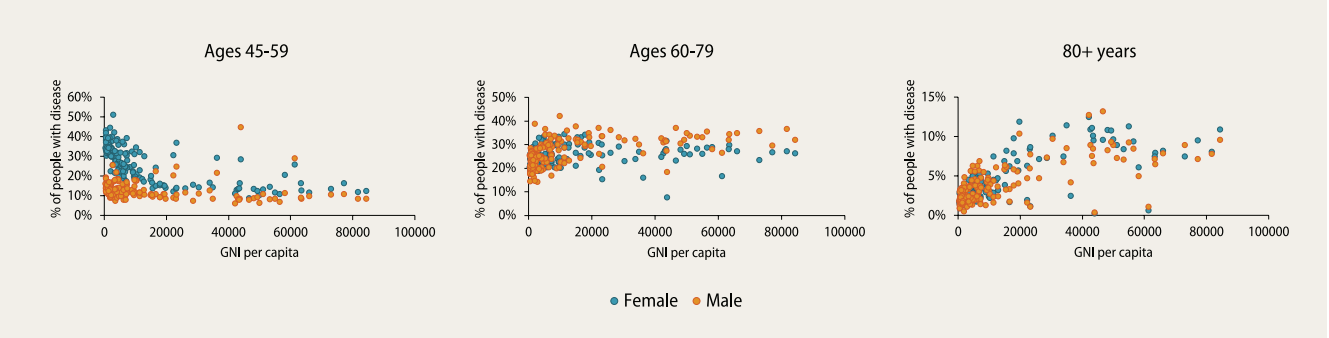
Chapter 8. Gender Gaps in Health and Well-Being of Older Adults: A Review of the Burden of NCDs and Barriers to Health Care for Women and Men

Chapter 8 examines the gender gaps in the health and well-being of older adults, focusing on the barriers in access to health care and LTC. It examines gender gaps in mortality, prevalence, and disability-adjusted life years (DALYs) for major NCDs and mental health using data from the Global Burden of Disease 2019 study for older adults in three age groups: 45–59, 60–79, and 80 and above, as well as country income data from the World Development Indicators. It also reviews the barriers to demand for health care for women (and men) particularly in LMICs and the challenges in providing health care and LTC from a gendered perspective, with special attention to caregivers, particularly women who provide informal care to older adults.

Data analysis for CVD and diabetes across countries shows that the burden of disease is similar for women and men ages 45–59, with some exceptions. For CVD, the burden of disease is higher for men in upper-middle and high income countries for ages 60–79, whereas for ages 80 and above, women

bear the greater burden. For diabetes, gender gaps begin to appear for ages 60–79, particularly LICs, and for 80 years and above, there is once again a greater burden of disease for women. Cancers present a more mixed picture with a higher prevalence among women of ages 4559 compared to men in the same age group. However, for older ages, the gender gap in cancer prevalence narrows in LICs but grows larger in upper-middle and high income countries, particularly affecting men of ages 60–79 (figure 4).

FIGURE 4 Prevalence of Cancers among Older Adults (%) by Sex and Gross National Income (GNI)



Source: Institute for Health Metrics and Evaluation (IHME) Global Burden of Disease (2020), World Development Indicators (2020).

Another key area of concern is mental health. Prevalence of depressive disorders is consistently higher for women compared to men for all age groups 45 and above, but mortality due to self-harm is higher among men for all age groups. The choice of method to inflict self-harm and not seeking help due to the stigma associated with mental illnesses are linked to these outcomes.

While aging signals the onset of NCDs for both women and men, their health outcomes vary. Several studies highlight higher male mortality at earlier ages due to heart disease or diabetes, particularly in HICs and MICs. On average, life expectancy at birth for women is about 5 years higher than that for men globally. However, in MICs the difference is generally about 8–10 years. Although women in these countries exhibit similar patterns of NCD prevalence, they tend to live longer and often with a lower quality of life. Women also go through menopause as they age, which takes a physical and mental toll and is linked to an increased risk of developing NCDs. Moreover, older women, especially in LICs with weaker health systems and limited financial protections, are more likely than men to have greater financial vulnerability and often limited mobility due to social norms—a direct consequence of gender gaps over the life course that affect women's patterns of labor force participation, income opportunities, and decision-making power.

As populations age, the demand for LTC, which includes health care and assistance for performing daily activities, grows. Evidence from aging economies, primarily high- or middle-income Organisation for Economic Co-operation and Development (OECD) countries, shows considerable diversity in the quality and accessibility of LTC services, influenced by governmental policies, social norms, and resource availability. These arrangements, encompassing family care, public institutions, private residences, and assisted-living environments, reflect different care needs.

Delivery of LTC services through the public or private sector has a significant effect on the cost of care. HICs often allocate health care costs through public funds, while LICs rely more on out-of-pocket (OOP) payments, exacerbating affordability challenges, particularly for women especially in the absence of robust social protection systems. For example, despite efforts to provide social protection for LTC across HICs, OOP expenses remain common, especially in countries that have lower national incomes and less comprehensive coverage.

While informal, family-based care may still be the norm in many LICs, not all families are able to provide appropriate support, and medical costs remain a barrier to care for the aging, particularly women. Such unmet LTC needs can have a catastrophic effect on the quality of life and chances of survival of older adults.

The increase in demand for LTC has implications for women's employment as well. Evidence from aging economies has shown that women will

often reduce their working hours, drop out of the labor market temporarily, or retire early to provide elder care (explored further in chapters 9–11). The need for LTC also creates employment opportunities within this labor-intensive sector comprising both formal and informal caregivers. Here again women play a significant role, albeit associated with migratory labor, low wages, and stressful conditions contributing to high turnover rates, notably in regions like Europe.

The chapter points out key policy and programmatic areas for intervention to reduce gender gaps in health care and LTC for aging populations and caregivers.

Chapter 9. Gendered Responsibilities, Elderly Care, and Labor Supply: Evidence from Four Middle-Income Countries

Chapter 9 explores the relationship between providing care for older parents or parents-in-law and labor supply among middle-aged men and women of ages 40–59 in four countries: Colombia, Indonesia, Poland, and Arab Republic of Egypt.

Much of the responsibility for informal care is often shouldered by women. Time-use surveys from 64 countries show that 76 percent of the total time spent on unpaid care work is by women. This is three times more than that of men. Caregivers are also likely to be in their prime working years, which can affect their participation in the economy and income potential. According to one global estimate, 647 million working-age individuals are outside of the labor force due to family responsibilities and 606 million (94 percent) of them are women.

Across the four countries studied in this chapter, an examination of socioeconomic characteristics shows that less-educated women are more likely to provide care to an elderly parent, likely due to the greater opportunity cost of leaving high-paying jobs by other family members. Older women are more likely to provide care to their parents, but this relationship is not significant for men. Being married reduces the likelihood of providing parental care for both men and women. However, the number of children ages 0–18 is associated with an increase in the propensity of men providing parental care.

While in all four countries, men are more likely than women to live with their older parents, women bear the majority of the responsibility to provide care for their parents. In general, women are at least twice as likely as men to provide care to their older parents. Indonesia has the largest proportion of women who provide LTC to their parents, while Poland has the smallest proportion of women providing such care. In addition, women in Indonesia spend a significantly longer time caring for their parents. On the other hand, in Colombia men spend a slightly longer time than women on care responsibilities for their parents.

In Colombia and Poland, both men and women who provide parental care are significantly less likely to be employed. In Indonesia, while there is no overall change in the extensive range of labor supply for either gender, there is a significant decline in formal employment among both men and women who provide care. However, while men transition from formal to informal employment when they provide care for their parents, women are more likely to drop out of the workforce.

Overall, the analysis finds that providing care to older parents is associated with significant reduction in the probability of employment, weekly hours worked, and annual earnings. This decline is significantly larger among women than men and among intensive caregivers, those who provide care for more than 10 hours per week. The analysis shows that LTC is associated with a 6 percentage point gender employment gap and a 32 percent gender earnings gap to women's disadvantage.

There is also substantial heterogeneity across the four countries, with the largest significant declines in employment in Poland and Colombia for both women and men. In Indonesia, men who provide care experience a large decline in work hours and annual earnings, driven by their transition to casual employment, while in Egypt, labor supply for men and women was not affected by the presence of disabled parents or parents-in-law in the household.

Although the evidence presented in this chapter is not causal, these results can contribute to future policy dialogue to reduce the gender imbalance in LTC burdens, particularly in rapidly aging regions where the gender gap in labor market participation is large.

Chapter 10. Health Care and LTC Needs in a Context of Rapid Population Aging

This chapter explores key challenges in health care and LTC as populations age and provides examples of how countries are responding to them. It was originally developed as a background report for the Independent Evaluation Group evaluation 'World

Bank Support to Aging Countries' and adapted for the HLI. The chapter focuses on developing countries that are aging fast and where anticipation and action are especially important. It documents health care experiences aimed at increasing coverage, adapting systems to new epidemiological profiles, focusing on the prevention of chronic diseases, and promoting healthy aging and discusses mental health policies, a comparatively overlooked area until recently.

The evidence presented highlights the slow and uneven progress in addressing LTC needs of functionally dependent older adults, particularly in developing countries. The scope and depth of the policies vary, and in some cases, little is known about their actual implementation. The role of the government in providing and regulating LTC services becomes crucial given changes in social norms and the lack of affordable and high-quality private services in many settings.

Addressing the gaps in LTC policies and programs is critical for meeting the growing care needs of older persons. There is a need for holistic strategies that focus on strengthening health care and LTC systems. This requires increasing coordination and integration between the social care and health care sectors, given the paramount importance of such integration both to achieve a continuum of care for the older person and to obtain efficiency gains. Strengthening primary and community care is key to achieving these goals while containing costs.

There is also a need for renewed focus on building capacity of human resources that work with older persons, both in the health care and the LTC sectors. This is a priority, given that skilled human resources are an important determinant of the quality of care that older people receive.

Besides being accessible and affordable, LTC services should be person-centered encouraging, whenever possible, the provision of home care services (aging in place). A person-centered model is crucial for adequate management of chronic diseases, given the high prevalence of comorbidities. For example, aging in place has been shown to provide the best results in terms of older people's mental and physical health and to be cost-effective for governments.

Finally, to solve the challenges brought by population aging, it is also important to take a life course approach. How people age is, to a large extent, determined by their health earlier in life and the choices they made when young. The range of policies should also promote healthy lifestyles, like physical activity and healthy eating, throughout the entire life course.

Chapter 11. Demand for and Supply of Long-Term Care for Older Persons in Low- and Middle-Income Countries

Chapter 11 examines the demand for and the current landscape of supply of LTC services in six MICs: China, India, Malaysia, Mexico, Poland, and Romania. With rapid population aging, especially in LMICs, over the next few decades, the currently predominant model of family-based elder care will not be sufficient to meet the escalating demand for LTC (which covers both medical care and nonmedical services and support for older adults).

The demand-side assessment is based on the analysis of individual-level data sets that are part of the International Network of Health and Retirement Studies focusing on the measurement of activities of daily living (ADL) and instrumental activities of daily life (IADL) among those 65 years and older. The supply-side evaluation is a synthesis of findings from a review of relevant literature for the past 22 years (2000–2022), which also covers other countries. It encompasses Asia (where data are available), Central and South America, Southern Europe and Middle East, and Sub-Saharan Africa.

The demand-side analysis finds differences across countries in terms of difficulty performing ADLs and IADLs. Individuals' SES and gender are correlated with difficulty in performing ADLs or IADLs. Overall lower education is associated with greater difficulty in performing ADLs with country variations. For example, in India, there is a 5–6 percentage point difference between those with secondary and lower or no education, while in Poland and Romania, the probability of having an ADL difficulty is about 10 percentage points lower for individuals with secondary education compared to those with a primary education.

In China, India, Malaysia, and Mexico, women were about 7–9 percentage points more likely than men to experience at least one ADL difficulty. In contrast, in Poland, men were 6 percentage points more likely than women to experience difficulty with an ADL.

Age stands out as one of the most important predictors of needing help with ADL or IADL. For example, those of ages 80 and over were more likely to experience difficulty with IADL in all countries compared to those of ages 65–79 years.

However, the availability of formal LTC is limited, and familial (or informal) care remains the primary form of care for older persons, albeit with

variations across regions and countries. In some countries, particularly in the Middle East, cultural norms emphasize familial care, particularly by women. Often there is a lack of regulatory frameworks and limited public funding. While private sector LTC services are increasing, these are generally expensive and clustered around urban areas.

The chapter recommends designing a hybrid system of informal and formal LTC services for LMICs; engaging the private sector in developing LTC services, markets, and delivery systems in LMICs; strengthening government stewardship for clear guidance on rules of engagement, quality assurance, and regulatory capacity; establishing a systematic approach to public LTC financing, ideally following a broad-based social insurance model to improve affordability of services; and, drawing on the experiences of HICs, considering multipronged strategies to build and strengthen the LTC workforce and to support family caregivers in LMICs.

There is no ideal LTC system that works in all countries, but policy makers in LMICs can learn from the LTC systems in HICs. The WHO recommends an integrated continuum of LTC framework that supports person-centered, primary health care-driven, and integrated delivery systems. The care continuum should also include palliative care and end-of-life care. At present, such integrated LTC service provision and delivery models largely remain a concept in most LMICs. Nevertheless, the growing knowledge base on international LTC research and cross-country learning can help countries innovate and adapt best practices.

Chapter 12. Exploring the Labour Market Outcomes of the Risk Factors for Non-communicable Diseases: A Systematic Review

Chapter 12 presents a review of the associations between labor market outcomes and major risk factors for NCDs (smoking and heavy alcohol consumption), key metabolic changes due to the risk factors (overweight and obesity, hypertension, and type 2 diabetes), and major depressive disorders. It also examines gender differences across these dimensions.

The chapter is based on a systematic review of cohort and longitudinal studies before July 2022 to establish causality between exposures and outcomes in peer-reviewed literature. The search parameters for resulted in 109 studies that were eligible for the review. All studies were published in English. The majority (96 percent) of the studies were conducted in HICs with 63 percent from Europe and Central Asia.

High body-mass index (BMI) was the most frequently reported exposure (reported by 46 percent of the studies), while income was the most studied outcome (reported by 33 percent of studies). Of the studies, 77 percent reported significant ($p < 0.05$) adverse associations between the exposures and outcomes.

All of the studies included in this review that looked at plausible causal relationships between NCD risk factors and labor market outcomes were from HICs and UMICs (USA, northern European countries, and Republic of Korea). The main finding of these studies is that individuals with obesity, diabetes, hypertension, depressive disorders, excessive alcohol use, and cigarette use are more likely to have lower rates of employment, lower income, and higher rates of sickness absence and disability pension.

Chapter 13. Productive Longevity: What Can Work in Low- and Middle-Income Countries?

This chapter focuses on labor market characteristics and related policies that can address the key constraints to productive longevity in LMICs. By 2050, one in six persons globally will be at least 65 years of age, with nearly four out of five living in LMICs. Changing demographics with larger cohorts of older populations will likely require higher public and private expenditures for health care and LTC services. There is a need for policies that can sustain welfare levels and ensure that welfare is equitably distributed across generations and socioeconomic groups.

Labor market policies that help extend productive working lives and increase the labor force participation and productivity of older workers—'productive longevity'—are part of this important agenda. Several stylized facts about older workers have a bearing on policy decisions:

- Old-age labor force participation is generally lower, the higher a country's average income level. In the average LIC, more than half of the 65+ population is active in the labor market.

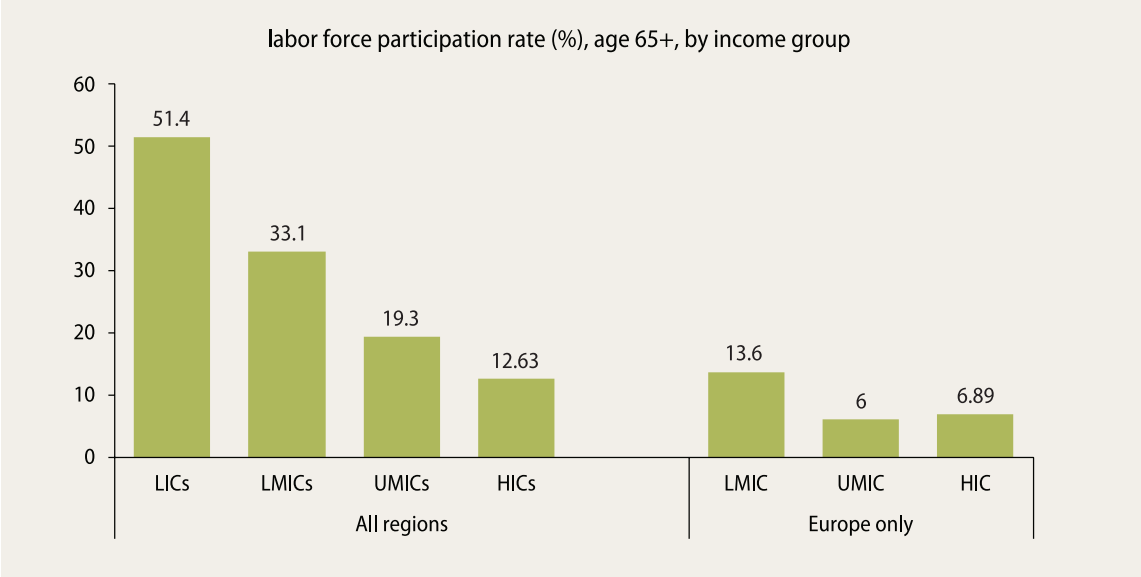
- Gender gaps among mature workers appear more important for MICs than HICs, with greater employment gaps and women's earlier exit from the labor force. In LICs, gender gaps are smaller—the

poorer the country, the higher the chances that women will also work into old age.

- Lacking social protection, many mature workers in LMICs continue working to secure their livelihoods.
- Better-off workers are also considering continuing working later in life, whether to top up retirement income or for other benefits, such as social connections.
- Old-age labor force participation and education interact differently across countries. While in HICs, people with higher education may remain in the work force, in LICs, those with higher education are more likely to retire early because they are less likely to be financially constrained.
- Globally, self-employment is more common among older workers than other age groups, with the highest rate of self-employment among the 55–64 age group.
- In advanced economies, the labor market participation of older workers has increased in the past few decades. However, the COVID-19 pandemic has resulted in a significant withdrawal of older workers from the labor market.
- The changing nature of work may be contributing to more age-friendly jobs. Technology is enabling automation of many tasks, but it also raises the demand for skills that are (still) complementary to technology, such as creativity, problem solving, and socio-emotional competencies.

Policies that support older adults remaining healthy, skilled, and economically active have positive impacts across generations. The experience from HICs and some MICs shows that the cost of inadequate solutions can be substantial. Unsustainable pension systems or insufficient attention to skills development for older generations have long-term repercussions. Research on HICs also shows that opportunities for voluntary part-time paid work or volunteering activities can contribute to strengthening the physical and mental health at older ages, including for those over 80 years. LICs with less-developed systems can learn from these experiences.

FIGURE 5 Labor Force Participation Rate for Ages 65+, by Country Income Group



Source: Estimates based on Staudinger et al. 2016[3].
Note: Refers to 2013 data.

3 Staudinger, U.M., et al. 2016. A Global View on the Effects of Work on Health in Later Life. Gerontologist, 56(S2): 281–292.

Given high informality and weak enforcement in LMICs, reforms in the formal sector policies, regulations, or taxation will only reach a small segment of workers compared to HICs. In such dual labor markets, policy reforms will also need to examine options to avert old-age poverty for those in informal markets. This would need to center on strengthening human capital with health interventions and strategic, demand-led skills development; supporting the businesses operated by mature workers; and providing social safety nets.

Even with constraints, countries can work to identify 'win-win' policies that benefit all generations. For example, providing LTC for the elderly and childcare, thus alleviating the care burden, can stimulate labor market participation and the move to more productive work in both older and younger workers, in particular women. Facilitating access to work, for example, with safer transportation systems, will have benefits for vulnerable groups in general. Looking in detail at how gender, skills, location, and other factors affect productive longevity in different settings will be essential to develop adequate policies.

This chapter presents a first attempt at highlighting policy areas and mapping out the associated evidence at an aggregate level. Productive longevity does not affect all groups similarly, and a more nuanced analysis is needed. More evidence is needed on what works for productive longevity. Most evidence for what works is based on HICs, which have faced aging pressures for a longer time. Even in these countries, however, there is scope for further research, especially as the evidence is often mixed, pointing to the challenges associated with this policy agenda.

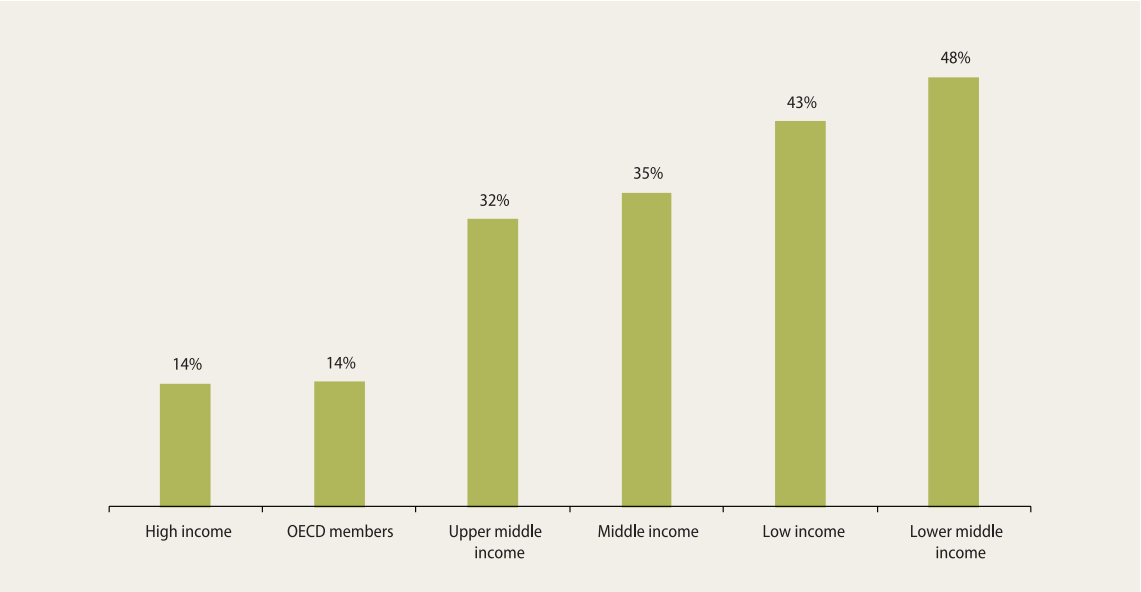
Chapter 14. Adequacy of Pensions and Access to Health Care: Maintaining Human Capital during Old Age

Chapter 14 discusses the adequacy of pensions for health care in old age, particularly for LMICs. Maintaining human capital during old age requires access to affordable quality health care as well as adequate pensions to provide financial coverage necessary to afford this care. Yet, there is a lack of adequate social protection in most countries, particularly for informal workers, who make up large proportions of working adults in LMICs.

An examination of OOP payments by households globally shows that (a) households with the elderly have 1.3 percentage points higher OOP payments health expenditure compared to households without the elderly; (b) lower-income households with the elderly have a 16 percent higher burden of OOP on average compared to higher-income households with the elderly; and (c) lower-income households are more likely to be pushed below the poverty line (US$3.2 per day) due to OOP health spending (World Bank Atlas of Social Protection Indicators of Resilience and Equity [ASPIRE] data).

While overall OOP payments are the highest in LMICs (figure 6), impoverishment due to OOP spending occurs even in countries where the entire population is officially covered by a health insurance scheme or by national or subnational health services.

FIGURE 6 OOP Expenditure (% of Current Health Expenditure)



Source: WHO Data Portal.

Even though countries with universal quality health care may be able to ensure a minimum standard of living for the elderly at a lower benefit level (which may not always be sufficient), in countries where the elderly face high OOP health expenses, pensions may need to be higher to achieve that same minimum living standard.

Determining what level of pensions is 'adequate', what constitutes a 'minimum level of protection', and who should be eligible are the biggest design challenges today. Constrained fiscal space, multiple competing development objectives, and the growing number of older people due to demographic aging generally means that developing countries would need to afford to provide either a lower benefit to a larger share of the elderly population or a higher benefit to a more limited share of the elderly population.

While there can be different approaches to improving coverage, many countries, including LICs, have introduced noncontributory mechanisms to cover the informal sector and the self-employed. However, this also has its limitations. Fiscal constraints will limit both the size of this kind of pension and the income and age to be eligible to receive the old-age benefit. Another major challenge is ensuring that programs remain affordable over time, given population aging and the potential for discretionary increases in the benefit amounts.

The chapter concludes that including the costs of access to quality health care in the definition of 'adequate' pensions does not necessarily imply that increased pensions are preferrable to addressing the deficiencies of the health system. It may just reflect the additional financial needs pensioners will face if access to universal health care (UHC) of good quality is not granted. Improving this access is, no doubt, a more efficient and permanent solution, but it may take longer to implement.

Chapter 15. Priority Setting for NCD Control and Health System Investments

Chapter 15 focuses on prioritizing health interventions for NCD control. It builds on the work of the NCD Countdown Collaborators and shares a set of modified recommendations from the *Disease Control Priorities Project*, specifically, the third edition (DCP3), published between 2015 and 2018 (Jamison et al. 2018[4]). This chapter takes a broader view of NCDs than the Countdown report and considers any DCP3 intervention that can reduce NCD mortality, including surgical care and mental health care.

Priority setting starts with an assessment of cost-effectiveness. The following three additional criteria for identifying high-priority health sector interventions for NCDs are also considered: equity, financial risk protection, and implementation feasibility. Data show considerable variation in intervention cost-effectiveness across health systems and underscore the importance of local analysis.

Overall, the cost and impact of scaling up the package of recommended interventions to achieve 80 percent population coverage in all countries by 2050 or sooner are assessed. Implementing the package of high-priority interventions fully could avert up to 150 million deaths (or 2.2 billion DALYs) by 2050, at an incremental cost of US$1.3 trillion. This translates to US$9,300 per death averted or US$620 per DALY averted.

These interventions represent a significant proportion of what health systems already do to address NCDs such as CVD primary prevention, diabetes management, and mental health care. Roughly half of the interventions would be very cost-effective in nearly all settings. Some of the surgical and mental health interventions would be on the borderline of being cost-effective in most settings, whereas others (for example, appendicitis management and chronic depression treatment) would be very cost-effective. For diabetes care, glycemic control by itself is not cost-effective, but when implemented with CVD prevention, it would be cost-effective. There are also several interventions 'outside the health sector' that are all incredibly cost-beneficial, with tobacco control yielding the highest returns.

However, most countries are nowhere near full implementation of these interventions. While the proposed package of interventions would be very cost-effective, the budgetary consequences would be considerable, with a larger 'incremental cost' as a share of the current health budget for LICs due to the need to build up currently weak health systems and underspending on health. The prioritization

4 Jamison, D.T., et al. 2018. "Universal Health Coverage and Intersectoral Action for Health: Key Messages from Disease Control Priorities , 3rd Edition." The Lancet 391 (10125): 1108–20.

of interventions also provides a framework for sequencing them over time, and intersectoral policies and health interventions that are very cost-effective and can be delivered through primary health care platforms by nonphysician health workers should be scaled up as early as possible.

There are several important limitations of the analysis presented in this chapter including data availability, modelling assumptions about current coverage of interventions, and the effect of the COVID-19 pandemic on NCD incidence and mortality as well as health system resources in the medium term.

Yet, the proposed set of recommendations can help countries achieve significant reductions in NCD mortality, helping them achieve the Sustainable Development Goal (SDG) 3.4 target and post-SDG targets for NCDs. Implementing the HLI package of interventions has the potential to help countries reduce their avoidable mortality across all age groups to about halfway to the observed mortality rates in the best-performing countries. In addition to reducing adult mortality, these interventions could improve nonfatal outcomes by reducing the incidence of disease overall and by reducing the severity of chronic illness, especially for mental and substance use disorders. The recommendations could also help bring a necessary focus and fiscal discipline to national NCD strategies and plans and be used as benchmarks for future World Bank lending efforts to support NCD program development in lower-resource countries.

Chapter 16. Control of Non-Communicable Diseases for Enhanced Human Capital: The Case for Whole-of-Society Action

Chapter 16 makes the case for a whole-of-society (WoS) approach to address NCDs, in view of the two-way relationship of NCDs with certain economic sectors and makes recommendations for the way forward.

Building on the WHO's 5 × 5 framework of NCDs, which considers five sets of diseases and five risk factors,[5] the chapter proposes a broader definition of NCDs, including 'any disease or disability that is not transmissible through infection'. This encompasses endocrine disorders beyond diabetes, malnutrition (both under- and overnutrition), autoimmune diseases, chronic kidney disease, various occupational hazards, and injuries, both accidental and intentional. This definition strengthens the argument for a WoS approach, due to the importance of non-health sectors in the causation of and actions against these diseases.

A WoS approach is a comprehensive approach to planning, design, implementation, and monitoring of policies and programs that not only includes the 'whole-of-government' (WoG) but also non-state actors (for-profit and nonprofit), communities, households, and individuals. The WoS approach emphasizes engaging all branches of government (the judiciary, the legislature, and the executive) and political leaders from opposition parties, as the latter play a critical role in supporting or opposing government initiatives and their relative success.

Similarly, non-state actors have a key role in preventing, managing, and controlling NCDs, with the caveat that while there are strong benefits to public-private partnerships, bringing the private sector on board requires a clear-eyed approach on the part of governments, bearing in mind the risks emerging from the profit motive of commercial entities that diverge from public health interests (figure 7).

The chapter highlights several examples of innovative and mutually beneficial public-private partnerships for the prevention and control of NCDs though they are limited in scale and scope. It stresses the key role that the nonprofit private sector (nongovernmental and community-based organizations) can play, given these organizations' ubiquity in LMICs, notably the poorest, and their comparative advantage in community mobilization.

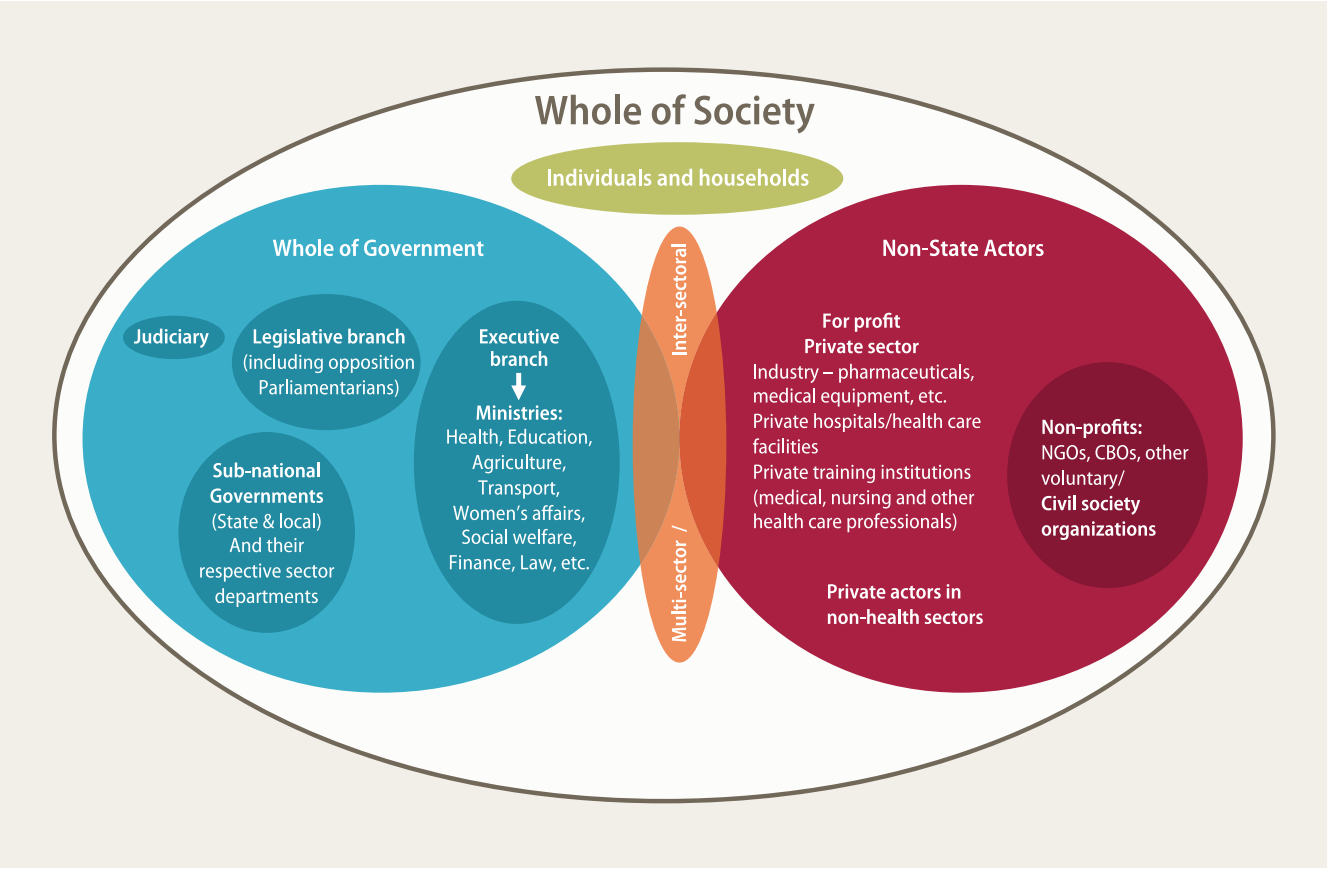
Given country experiences and lessons learned, the chapter presents 10 key recommendations (the 10 'I's):

1. Involve key stakeholders from the outset, leveraging any congruence of interests, to build effective alliances for change.

2. Include non-state actors as appropriate and within a mutually agreeable policy, operational, and regulatory framework.

5 The five diseases are CVDs, diabetes mellitus, chronic respiratory diseases, cancers, and mental health, while the five risk factors include tobacco use, harmful use of alcohol, unhealthy diets, physical inactivity, and air pollution.

FIGURE 7 Components of a WoS Approach



Source: Original figure for this publication.

3. Identify clear roles and responsibilities for every sector and actor through consensus and with a clearly identified team lead.

4. Institutionalize mechanisms for coordination and cooperation.

5. Invest in human and other resources for better coordination and concertation.

6. Innovate continuously for successful and sustained implementation of a WoS approach to NCDs.

7. Information sharing through knowledge-exchange platforms, such as clearing houses and South-South platforms, is essential.

8. Incorporate lessons learned from global NCD experiences to rapidly integrate best practices and avoid repeating others' mistakes.

9. Interventions should be prioritized on burden-of-disease assessment, cost-effectiveness, and societal value choices.

10. Indicators of success and failure need to be monitored continuously for effective decision-making, with course corrections as necessary.

Chapter 17. HLI: A Performance Dashboard for Decision-Making in Low- and Middle-Income Countries

This chapter presents a framework for monitoring progress toward healthy longevity. A healthy longevity agenda offers an opportunity to promote and monitor progress toward human capital accumulation and preservation, health, and well-being across the life course.

One way for countries to measure this progress is through performance dashboards. Performance dashboards are data visualization tools that bring

together representations of indicators into a unified interface that allows stakeholders to monitor and assess performance and progress across selected dimensions. The healthy longevity dashboard is an ongoing effort to develop and refine a suite of indicators that bring together relevant data to measure and monitor country progress toward healthy longevity.

The chapter first offers a common framework for such a dashboard and presents three country case studies—Sierra Leone, India, and Colombia—that illustrate a range of possibilities for developing a country-specific but internationally comparable dashboard that considers differing data and information system contexts.

The common framework takes a life course approach and is grounded in the HLI conceptual framework (chapter 2). Indicators cover three key actions and ten related domains that map the dashboard to the HLI framework allowing for a holistic and comprehensive view of population health, while drawing attention to the multi-sectoral efforts needed to promote healthy longevity, inclusive growth, and well-being.

The three countries selected represent different contexts in terms of income level, epidemiological and demographic profiles, and different data infrastructure contexts. Sierra Leone's dashboard illustrates how countries with nascent data infrastructure can bring together available indicators based on key investments in healthy longevity and NCDs in a meaningful way. India presents a case where data are more readily available, including from international sources, driven by national policy objectives, and can be used for benchmarking. Colombia offers an example of how countries can leverage more extensive data sets across multiple sectors.

The chapter concludes with a discussion on what actions are needed to assist country stakeholders in producing, presenting, using, and institutionalizing a healthy longevity dashboard tailored to their unique demographic and epidemiological context and data infrastructure.

Chapter 18. Assessing Human Capital, Non-communicable Diseases, and Healthy Longevity in Low- and Middle-Income Countries: Healthy Longevity Dashboard and the Case for India

This chapter expands on the development of the HLI performance dashboard for LMICs using India as an example. The dashboard comprises internationally comparable, country-level indicators from international institutions that can be mapped to the overarching HLI conceptual framework and across different stages of the life course. This approach supports the selection of indicators that reflect a given country's data infrastructure maturity while ensuring comparable and consistent conceptual underpinnings.

Dashboard indicators are categorized as either contextual or measuring healthy longevity. Contextual indicators provide crucial information on basic social, demographic, and economic characteristics of a country that enables policy makers and other dashboard users to correctly interpret the setting from which other performance-related indicators are drawn. These indicators are further classified into 10 broad domains: (a) life expectancy, (b) mortality at different life stages (under five years, school age (ages 5–14), youths and young adults (ages 15–29), adults (ages 30–69), and older ages (ages 70 and above), (c) child health, (d) adult immunizations, (e) risk factors, (f) access to care for NCDs and NCD management, (g) education, (h) gender equality, (i) labor force, and (j) social protection.

Once indicators are selected, a country's performance, in this case, India, is estimated compared to other countries, using percentile and Z scores. In both approaches, the study country is compared with other countries that fall under the same income strata as the study country and have a population of more than 7 million (or 0.1 percent of the world population). The dashboard for India highlights its performance on HLI indicators in comparison to similar LMICs and the world. For example, India has a higher proportion of deaths that are attributable to NCDs and higher UHC coverage compared to the average of LMICs but lower than the global average. Moreover, where gender-disaggregated data are available, the dashboard shows that males score better than females on health indicators except in harmful alcohol use and prevalence of hypertension.

In addition to focusing on healthy longevity, the novelty of the HLI dashboard lies in its focus on international comparisons. The current HLI dashboard relies on data readily available in the public domain. As such, LMICs can replicate the dashboard for their countries without the need for additional data collection. However, relying only on readily available data restricts the range of indicators included in the dashboard. This only underscores the need for countries to invest in building up their essential data infrastructure to produce performance information of sufficient granularity

to enable relevant decision-making at the appropriate governance level, with information of high quality and of relevant timeliness and granularity. Finally, further research is required in understanding the drivers of healthy longevity, improving its measurement, and producing performance dashboards of use to policy makers.

Abbreviations

ACS	Acute coronary syndrome
ADI	Alzheimer's Disease International
ADL	Activities of daily living
AOR	Adjusted odds ratio
BCA	Benefit-cost analysis
BMI	Body mass index
CD	Communicable disease
CDC	Centers for Disease Control and Prevention
CEA	Cost-effectiveness analysis
CHARLS	China Health and Retirement Longitudinal Study
CHE	Catastrophic health expenditure
CI	Confidence interval
CMPs	Communicable, maternal, perinatal, and nutritional conditions
COPD	Chronic obstructive pulmonary disease
COVID-19	Coronavirus disease of 2019
CRVS	Civil Registration and Vital Statistics
CVD	Cardiovascular disease
DALY	Disability-adjusted life year
DCP3	Disease Control Priorities, 3rd Edition
DPL	Development Policy Lending
DTP3	Diphtheria, tetanus, and pertussis
EAP	East Asia, and the Pacific
ECA	Eastern Europe and Central Asia
ECBA	Extended cost-benefit analysis
EU	European Union
FCV	Fragility, Conflict and Violence
FeEd	Female education
GAP	Global Action Program
GBD	Global Burden of Disease
GDP	Gross domestic product
GDPPC	Gross domestic product per capita
GNI	Gross national income
HALE	Health-adjusted life expectancy/ healthy life expectancy
HC	Human Capital
HCI	Human Capital Index
HCP	Human Capital Project
HED	Heavy episodic drinking
HIC	High-income countries
HIV/AIDS	Human immunodeficiency virus / Acquired immune deficiency syndrome
HLI	Healthy Longevity Initiative
HLM	High Level Meeting
HLMP	Healthy Living Master Plan
HMIS	Health Management and Information System
HNP	Health, Nutrition and Population (sector of the World Bank)
IADL	Instrumental activities of daily living
IARD	International Alliance for Responsible Drinking
ICER	Incremental cost-effectiveness ratio
IDU	Injection drug use
IFBA	International Food and Beverage Association
IFC	International Finance Corporation
IHME	Institute for Health Metrics and Evaluation
ILO	International Labour Organisation
INT$	International dollar
ITS	Interrupted time-series
LAC	Latin America and the Caribbean (World Bank regional vice presidency)
LASI	Longitudinal Aging Study in India
LIC	Low-income countries
LMICs	Low- and middle-income countries
LTC	Long-term care
MAP	Multi-sector Action Plan
MARS	Malaysia Ageing and Retirement Survey
MCC	Multiple chronic conditions
MCDA	Multi-criteria decision analyses
MDD	Major depressive disorder
MDGs	Millennium Development Goals
MHAS	Mexican Health and Aging Study
MIC	Middle-income countries
MNA/ MENA	Middle East and North Africa (World Bank regional vice presidency)
MOH	Ministry of Health
MUP	Minimum unit prices
NCD	Non-communicable disease
NGO	Non-governmental organization
NIH	National Institutes for Health
OECD	Organization for Economic Co-operation and Development
OOP	Out of Pocket

OPAs	Older People's Associations
PAHO	Pan American Health Organization
PAICC	Programme for the International Assessment of Adult Competencies
PCI	Percutaneous coronary intervention
PHC	Primary Healthcare
PPP	Purchasing power parity *or* Public-Private Partnership
QALY	Quality-adjusted life year
QOL	Quality of life
RIP	Relative Income Price
SAGE	Study on Global Ageing and Adult Health
SAR	South Asia Region (World Bank regional vice presidency)
SBCC	Social and behavioral change campaign
SDG	Sustainable Development Goal
SDHs	Social determinants of health
SES	Socio-economic status
SHARE	Survey of Health, Ageing, and Retirement in Europe
SIGI	Social Institutions and Gender Index
SMU	Standardized mortality unit
SSA	Sub-Saharan Africa (World Bank regional vice presidency)
SSBs	Sugar-sweetened beverages
STI	Sexually transmitted infections
UHC	Universal health coverage
UK	The United Kingdom
UMIC	Upper-middle-income countries
UNWPP	United Nations World Population Prospects
USA	The United States of America
VSL	Value per statistical life
VSMU	Value of standardized mortality unit
WBG	World Bank Group
WHO	World Health Organization
WoG	Whole-of-government
WoS	Whole-of-society
WPP	World Population Prospects
YLD	Years lived with disability

Theoretical Framework

Chapter 1

Enhancing human capital and boosting productivity by tackling non-communicable diseases: results of a research initiative

Chapter 2

Towards a framework for impact pathways between non-communicable diseases, human capital and healthy longevity, and wellbeing outcomes



1

Enhancing Human Capital and Boosting Productivity by Tackling Non-Communicable Diseases

Results of a research initiative

George Alleyne [a], Timothy Evans [b], Alexander Irwin [c], Prabhat Jha [d], Jeremy Veillard [e]

[a] Director Emeritus, Pan American Health Organization (PAHO)
[b] School of Population and Global Health, McGill University
[c] Independent Global Health Writer and Researcher
[d] Centre for Global Health Research, Unity Health Toronto, University of Toronto, Canada
[e] Health, Nutrition, and Population, Latin America and the Caribbean, World Bank

INTRODUCTION AND OVERVIEW

Non-communicable diseases (NCDs) (especially cardiovascular disease, diabetes, cancer, chronic respiratory disease, and mental health disorders) increasingly threaten countries' health achievements and economic future. WHO estimates that 71 percent of all deaths in 2015 were due to NCDs. Over one billion persons suffer from hypertension, which alone is responsible for over 10 million deaths worldwide each year, more than all infectious diseases combined prior to COVID-19. The burden of NCDs continues to rise disproportionately in low-income countries (WHO 2018). NCDs also contribute to 80 percent of the global burden of disability (IHME 2018). Many non-communicable conditions strike working adults during their most economically fruitful years: cutting short lives and careers, undermining productivity, bankrupting families, diverting public resources from more productive uses to cover treatment costs, and preventing society from recouping its investments in workers' training and skills. In low- and middle-income countries (LICs and MICs), NCDs tend to affect people at younger ages, reducing educational attainment and lifetime earnings.

Political mobilization around the NCD threat is increasing but still not commensurate with the scale of the challenge. The United Nations political declaration on NCDs, adopted in 2011, broke the silence at top levels. The 2013 WHO Global Action Plan established a framework for coordinated efforts to counter NCD epidemics nationally and internationally. In 2015, the Sustainable Development Goals (SDGs) placed NCDs prominently on the global development agenda, with a dedicated NCD target (SDG 3.4).

Despite increased attention to NCD issues, however, investment and action at country level continue to fall short. NCD epidemics are growing explosively in many low- and middle-income countries (LMICs), while influential policy makers, particularly in ministries of finance, remain poorly informed about the implications of NCD burdens for their countries' economic development.

NCDs and human capital – clarifying a critical relationship

Against this backdrop, in 2017, the WHO Director-General established a High-Level Commission to advise on means of accelerating action against NCDs. One of the Commission's recommendations was to seek to incorporate NCDs into global policy discussions on human capital.

Countries increasingly recognize the critical importance of human capital—the health, education, and skills of the population—for economic growth and competitiveness. Since 2017, more than 80 countries have joined the World Bank's Human Capital Project, signaling high momentum for investment in the creation, protection, and enhancement of human capital. The Human Capital Project aims to improve human capital at country level through investment in health and education. The Project's human capital index (HCI) is an advocacy tool that quantifies the contribution of health and education to the productivity of the next generation of workers. Countries are using the HCI to assess how much income they forego because of human capital gaps, and how much faster they can turn these losses into gains if they act now.

Countries' growing recognition of the importance of human capital represents an unprecedented opportunity to accelerate progress on NCDs, particularly in LICs and MICs. NCDs pose a powerful threat to human capital. They damage and devalue it in the short term, mainly through impacts on adult survival and productivity. They also compromise future human capital creation, in particular by impacting educational performance. Countries can reap substantial economic rewards via improved human capital, both short- and long-run, by taking bold action to prevent and control NCDs.

Growing concern about human capital creates a window of opportunity for collaboration between the World Bank, WHO, and other partners to help countries enhance their human capital by tackling NCDs.

The NCDs and Human Capital Research Initiative: research to inform policy

Human capital is emerging as a pivotal concern for countries and a powerful lens to guide public policy and investment. Yet important knowledge gaps on human capital persist. Today, most countries are not clear on the opportunities that exist to strengthen human capital by tackling NCDs, the rewards such

efforts may yield, the levels and types of investment needed, and the specific policy and implementation steps that will work best.

To respond, in April 2019, the World Bank, in partnership with WHO, launched a time-limited research initiative on NCDs and human capital. The work was situated within the World Bank's Human Capital Project. It engaged leading academic researchers and policy experts in a collaboration to answer priority questions on NCDs' human-capital impacts and entry points for an effective policy response. The effort pursued four main tasks:

1. Evaluate the impact of NCDs on education, as it relates to human capital
2. Evaluate the impact of NCDs on human capital understood as effective labor supply
3. Estimate the impact of NCDs on longevity
4. Consider what measurement systems are needed to buttress the arguments for investing in human capital at country level and to monitor progress

The NCDs and Human Capital Research Initiative commissioned original research from five scientific teams at major universities and international organizations.[1] Research teams began their work in May 2019, shared preliminary results in July 2019, and finalized their contributions in the following months, completing their work in December 2019. An executive report summarizing preliminary initiative findings served as an input to the concluding deliberations of the WHO High-Level Commission on NCDs and informed its final recommendations.

Methods developed and results obtained by the NCDs and Human Capital Research Initiative have subsequently been integrated into the World Bank's Healthy Longevity Initiative (HLI), launched in April 2021. The HLI is jointly led by the World Bank and the University of Toronto, with support from Access Accelerated. Several of the investigators whose findings from the NCDs and Human Capital Research Initiative are summarized in this chapter have gone on to contribute additional original research to the HLI.

The Toronto workshop and the role of this chapter

To review emerging results from the NCDs and Human Capital Research Initiative and reach consensus on their interpretation, project leaders convened a workshop in Toronto on July 9-10, 2019. The event was sponsored by Access Accelerated and hosted by the Centre for Global Health Research of the University of Toronto Dalla Lana School of Public Health. Participants included members of the project research teams, along with other distinguished scholars and representatives of organizations including Access Accelerated, the Pan-American Health Organization (PAHO), the United Nations Development Programme (UNDP), WHO, and the World Bank. The detailed workshop agenda appears in Annex 1.1 of this chapter. Annex 1.2 presents a full list of workshop participants.

This chapter summarizes the main findings emerging from the five core papers commissioned by the NCDs and Human Capital Research Initiative, together with the analysis, interpretation, and key messages for policy and practice jointly formulated by participants at the July 2019 Toronto workshop. All data and analysis in this chapter are pre-COVID-19.

The chapter follows the structure of the Toronto workshop. It provides an initial overview and contextualization based on the keynote address by Sir George Alleyne. It summarizes the five scientific inputs from project research teams and the discussion sparked by each paper in Toronto. The chapter then synthesizes policy lessons and recommendations from the workshop debates. Concluding sections describe the subsequent agenda of the NCDs and Human Capital Research Initiative and outline a future research and practice agenda to strengthen human capital through action on NCDs. This agenda has helped to shape the subsequent activities of the Healthy Longevity Initiative.

1 Participating research teams came from the Graduate Institute, Geneva; the Harvard T.H. Chan School of Public Health; the University of Toronto Dalla Lana School of Public Health; WHO; and the World Bank Group.

BOX 1.1 Key messages

- Rising non-communicable disease (NCD) burdens threaten countries' human capital, a critical determinant of their economic success.
- Policymakers' growing concern with human capital marks an unprecedented opportunity for the World Bank, the World Health Organization (WHO), and other partners to collaborate in supporting country action to prevent and control NCDs.
- By tackling NCDs with proven, cost-effective interventions, including intersectoral measures, countries can reap substantial economic benefits, while improving health. Economic gains from strengthening human capital through NCD control and prevention will come mainly from improved productivity. Some gains can be obtained rapidly (1-5 years).
- NCD prevention and control also lay foundations for longer-term improvements in human capital and economic competitiveness, notably through gains in young people's educational performance. New research is uncovering strong associations between NCDs and educational outcomes.
- NCDs are major drivers of impoverishment and inequality. Tackling NCDs will improve human capital most among the least well off. This will reduce inequalities, reinforce social stability, and ensure that countries harness talent from their whole populations, an advantage for competitiveness.
- Private firms across multiple industries could draw productivity benefits from action on NCDs. Private sector co-leadership can boost the speed and impact of the global NCD fight.
- Strong, country-owned measurement systems are crucial for countries to prevent and control NCD epidemics and reap the associated human-capital benefits.
- Knowledge gaps hamper countries' efforts to fight NCDs. NCD and human capital research—including research on prevention, the economic burden of disease, and how to measure productivity gains—needs to be aggressively ramped up.

RESEARCH INPUTS AND POLICY DISCUSSIONS

Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop: Toronto, July 9-10, 2019

Workshop Day 1, morning session

Daniel Dulitzky (World Bank) and **Prabhat Jha** (University of Toronto) chaired the meeting's first session. Following their welcoming remarks, **Sir George Alleyne** (Director Emeritus, Pan American Health Organization) delivered the keynote address.

Workshop keynote address: health, NCDs, and human capital

Sir George Alleyne

Dr. Alleyne began his talk by paying tribute to three persons whose work has powerfully informed his understanding of health, NCDs, and human capital: Professor Dean Jamison, Professor Prabhat Jha, and the late Philip Musgrove. Acknowledging these colleagues' foundational contributions, Dr. Alleyne then reflected on his own lifelong concern with health, which has two principal roots. First, his work as a physician and practitioner of public health policy has convinced Dr. Alleyne that the achievement of health equity is possible and technically feasible, whereas equity in other domains of human life is more difficult, perhaps impossible, to attain. This circumstance gives health a special status.

A second reason for Dr. Alleyne's enduring concern with health is his acceptance of health's instrumental value, as complementary to its intrinsic or constitutive value. In this connection, Dr. Alleyne evoked the conceptual framework developed by Par-

tha Dasgupta and colleagues (2017). Dasgupta views health as having four major dimensions in relation to human agency. Good health is important because it: (1) enhances human productivity, (2) enables persons to live longer lives (longevity), (3) enables better quality of life and well-being, and (4) yields positive externalities at individual and population levels.

This framework offers a conceptual armature for the work of the NCD and Human Capital Research Initiative. If Dasgupta's basic theorems are valid, Dr. Alleyne affirmed, then we should be able to frame an appropriate argument to convince policy makers of the salience of NCD prevention and control.

Dr. Alleyne noted that the Toronto workshop and the broader political process of which it is part "represent a tide in the NCD affairs which, hopefully, we can take at the flood." To justify such optimism, he cited the ongoing work of the WHO Director-General's High-Level Commission on NCDs, of which he was a member. The drafting of the High-Level Commission's final report was in progress at the time of the Toronto consultation. Dr. Alleyne had received the assurance that the results of the Toronto workshop would be reflected in the High-Level Commission's report. He pointed to the World Bank's Human Capital Project and related technical work on the "Changing Wealth of Nations" as further evidence of a rising tide of global concern with health and human capital that signals an exceptional political opportunity.

While much discussion of the Human Capital Project has focused on the foundations of human capital in early childhood, Dr. Alleyne observed:

> My view is that the focus on early childhood is a necessary but not sufficient rationale for an interest in human capital. I contend that our concern must be for the actual as well as the potential human capital. Our concern must be for the loss of human capital through premature mortality due to NCDs. Our concern must be for the billions, yes, billions of adults who suffer from one or more NCDs which impair their human capital.

In this light, he argued, one of the novel NCD approaches to be suggested to the WHO Director-General is that WHO make common cause with the World Bank at country level, ensuring that investment in human capital include not only future capital, but also the quality and quantity of the present stock of human capital, through prevention and control of NCDs.

In this respect, Dr. Alleyne concluded, "We have the opportunity to demonstrate that investing in prevention and control of NCDs represents a potent mechanism for preserving or restoring the productivity of human capital." Furthermore, we have the chance to project this message just as human capital is being promoted with renewed vigor by the World Bank, as a factor critical for countries' economic performance.

In closing, Dr. Alleyne signaled a concern of methodological and philosophical significance for human capital discussions, regarding whether scientists can "separate the asset of the individual from his or her person." With health and human capital, scientists measure, not health itself as the asset, but the factors (in this case NCDs) which diminish the asset; they then correlate these factors with labor productivity. Dr. Alleyne underlined his hope that the day comes "when economists find some measure of health which they can use to relate to the labor market outcomes they currently estimate."

Highlights of workshop discussion: In the discussion that followed, Dr. Alleyne posited that health as a state of being similar to happiness might be assessed using a metric derived from qualitative research. Regarding the relatively slow progress on NCDs to date, he urged that the NCD community frame its arguments more persuasively, and referred particularly to the need to address NCDs and their risk factors in children. An opportunity for progress is emerging through the confluence of current interests among major institutions: the World Bank in human capital; WHO in NCDs; and UNDP in inequality, along with the burgeoning engagement of civil society.

Summary and discussion of research papers

Paper 1: The human capital impacts of investing in interventions to reach the SDG-related targets for non-communicable diseases: an analysis of 10 low- and lower-middle income countries

Seoni Han, Jean-Louis Arcand*, Jeremy Addison Lauer***
(*) The Graduate Institute, Geneva; (**) World Health Organization, Geneva

Top-line messages: Expanding coverage of NCD interventions in low- and lower-middle income countries can raise countries' effective labor supply, boosting the economy.

- NCD interventions increase GDP by about 0.5% annually over 5 years

- NCD interventions increase GDP per capita by about 0.7% annually over 5 years

- NCD prevention and control are a major determinant of human capital and must figure prominently in universal health coverage (UHC) in the near term

Study background and aims: To support WHO's 2018 *Investment Case*, the researchers investigated the impact of scaling up NCD interventions on economic outputs in 10 low- and lower-middle income countries (LICs and LMICs) for the period 2019–2023. The countries were: Angola, Bangladesh, Brazil, China, the Democratic Republic of Congo, Ethiopia, India, Indonesia, Nigeria, and Pakistan.[2] The study aimed to calculate the GDP and GDP per capita gains these countries might obtain, if they successfully reached 60 percent population coverage of key NCD interventions, as stipulated under SDG targets.

Methods: The researchers used WHO's Economic Projections of Illness and Cost of Treatment (EPIC) model, which relates market-valued economic output in human-capital terms to the direct and indirect effect on human capital of the burden of non-communicable disease averted.[3]

The paper can be seen as presenting development-accounting mechanisms for the impact of improved health status on economic performance in the countries studied, since "human capital" is conventionally understood as a stream of future earnings (as a component of overall economic output). The authors take changes in overall economic output attributable to increases in labor supply due to improved NCD control (i.e., as estimated through the "labor share") as their measure of the improvement in human capital due to implementation of a package of NCD interventions.

The study considered the following NCDs: cardiovascular diseases, endocrine disease (diabetes), chronic obstructive pulmonary disease (COPD), asthma, anxiety, depression, bipolar disorder, psychosis, conduct disorder, attention deficit disorder, alcohol dependence, epilepsy, and colorectal, breast, and cervical cancer. NCD-related interventions included in the model were: policy and population-wide interventions; periodic outreach campaigns; primary care screening, treatment, and management; and limited specialized care (e.g., treatment of ischemic heart disease, COPD treatment, and cancer treatment). Cost estimates included the programmatic investments necessary for intervention delivery that do not generate economic returns on the selected time horizon.

The paper focuses on two main channels through which NCD interventions affect a country's economic outcomes: the cost effects of NCD interventions on the accumulation of manufactured capital, and the demographic and health impacts of NCD interventions on effective labor supply via improvements in human capital. This approach foresees that, when an NCD intervention takes place: (1) a decrease in the stock of physical capital is incurred because of the cost of the intervention[4]; while (2) an increase in labor supply results from a decline in the mortality and disability due to illness.

The researchers allow for heterogeneity at a country level, using country-specific economic and disease assumptions. It is necessary to take into account country-specific responses to changes in health status following intervention to control certain pathological conditions, because countries have experienced different stages of epidemiological transition (Deaton 2006). The model also takes into consideration the fact that the improved health status of children impacts on the productivity of their caregivers of working age.

Analyzing changes in health outcomes and the consequences of NCD investments for manufactured capital and the labor force, the authors compared gains and losses in terms of economic output for a "business as usual" scenario and an "ambitious realization of UHC" scenario from 2019 through 2023 (Sternberg et al. 2017). Under business as usual, population coverage rates for relevant interventions remain constant at 2015 levels. Under the ambitious scenario, countries reach their SDG coverage targets (for NCD services, 60 percent population coverage).

2 Together, these countries account for 67 percent of all expected global deaths for the period 2019-2023 that could be averted by specified advances toward universal health coverage (UHC). For details of the UHC scenarios considered, see Sternberg et al. (2017).

3 The EPIC model is based on a human-capital augmented Solow model and incorporates a recursive production function and exogenous equations of motion for the two production factors – stocks of physical capital and effective labor as modified by human capital.

4 Interventions reduce the funds available for investment because private savings are diverted to pay for interventions. (This is equivalent to out-of-pocket payments.) It is assumed that some portion of the total cost of treatment is funded from domestic savings, with the remainder displacing other consumption expenditures. There is no public sector in this model.

Key results: The findings suggest that investing in better prevention and control of NCDs would generate average annual gross domestic product (GDP) gains of 0.5 percent and average GDP per capita gains of 0.7 percent over baseline for these countries over the five-year period 2019–2023.

FIGURE 1.1 GDP and GDP per capita gains, average for 10 countries, with an NCD package

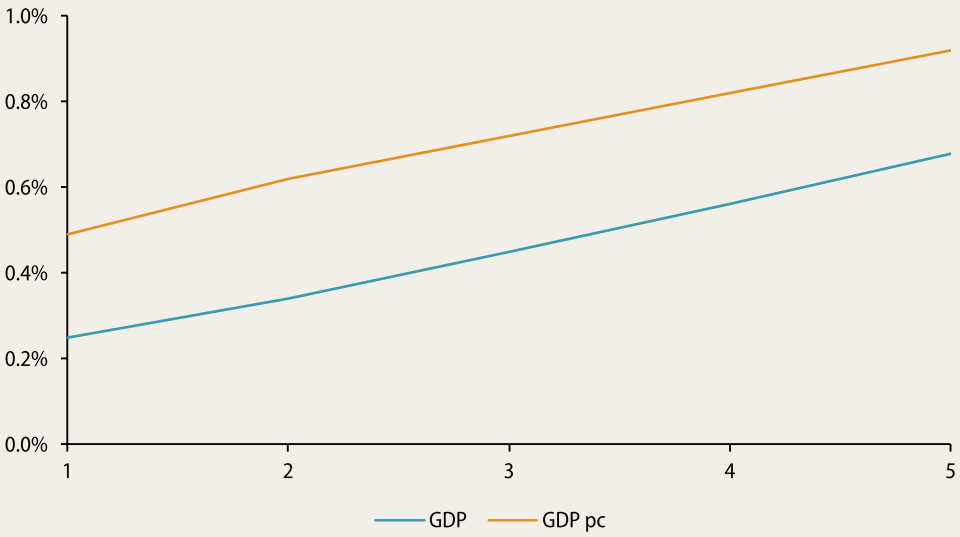
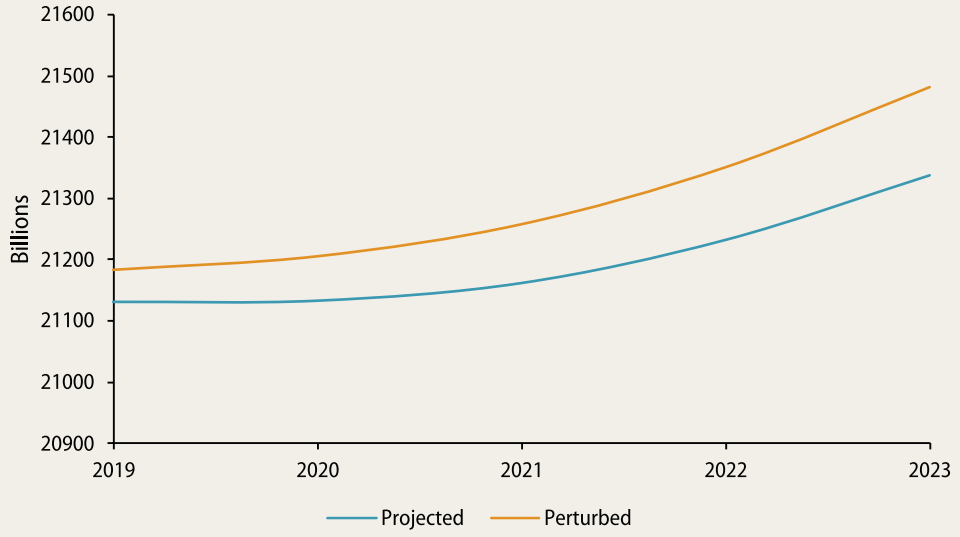


FIGURE 1.2 GDP with (perturbed) and without (projected) an NCD package



Discussion, interpretation, and next steps: Among other practical policy lessons, the results of this analysis suggest that economic gains from strengthened NCD prevention and control measures could manifest rapidly, within politically pertinent timeframes (1-5 years).

The model used in this study is flexibly applicable for different packages of disease conditions and various coverage of health interventions for different countries. The authors plan to explore for more countries the impacts of investing in prevention and control of NCDs through UHC. One important aspect for future work is to incorporate dynamics between the costs of a health intervention and its consequential health outcomes, in order to link the laws of motion of physical capital and labor in the model (that is, how these variables evolve over time). This work will follow amelioration of the law of motion for human capital.

Highlights of workshop discussion: Professors **Prabhat Jha** (University of Toronto) and **Sue Horton** (University of Waterloo) served as lead discussants for the day's first two papers. Deferring in-depth discussion until after the presentation of Paper 2 (see below), they asked participants for questions of clarification regarding Paper 1. Further explanation was sought on two main issues: (1) what the researchers mean by "physical capital"; and (2) whether the NCD interventions included in the model incorporated forms of multi-sectoral action.

Dr. **Jeremy Lauer** responded. On physical capital and its relation to human capital in the model, he referred participants to the equations included in the World Bank's recent *Human Capital Primer* (Flabbi and Gatti 2018). He noted that research generally considers human capital in terms of impact on national income, such as GDP. Human capital is in the labor term of the relevant equations. NCD interventions lead to a diminution of physical capital because of the costs involved, but they simultaneously improve the quantity and quality of human capital, yielding economic benefits. On the question of interventions outside the health sector, Dr. Lauer explained that the researchers' full model included 188 interventions, some of which go beyond clinical health care to encompass, for example, public policy choices affecting issues like road safety. Meanwhile, the focus here clearly remains on the first of the "three billions" highlighted in WHO's 2018 *Investment Case*: that is, expanding the number of people with access to universal health coverage (UHC). Dr. Lauer proposed that an appropriate way to restate the researchers' conclusions would be to say that: "Reaching NCD targets that are embedded within UHC should be expected to produce an increase in GDP of about 0.5 percent" annually across countries over the five-year period under consideration.

Paper 2: Health capital, economic growth, and the burden of disease

Jean-Louis Arcand, Daniele Rinaldo**
(*) The Graduate Institute, Geneva

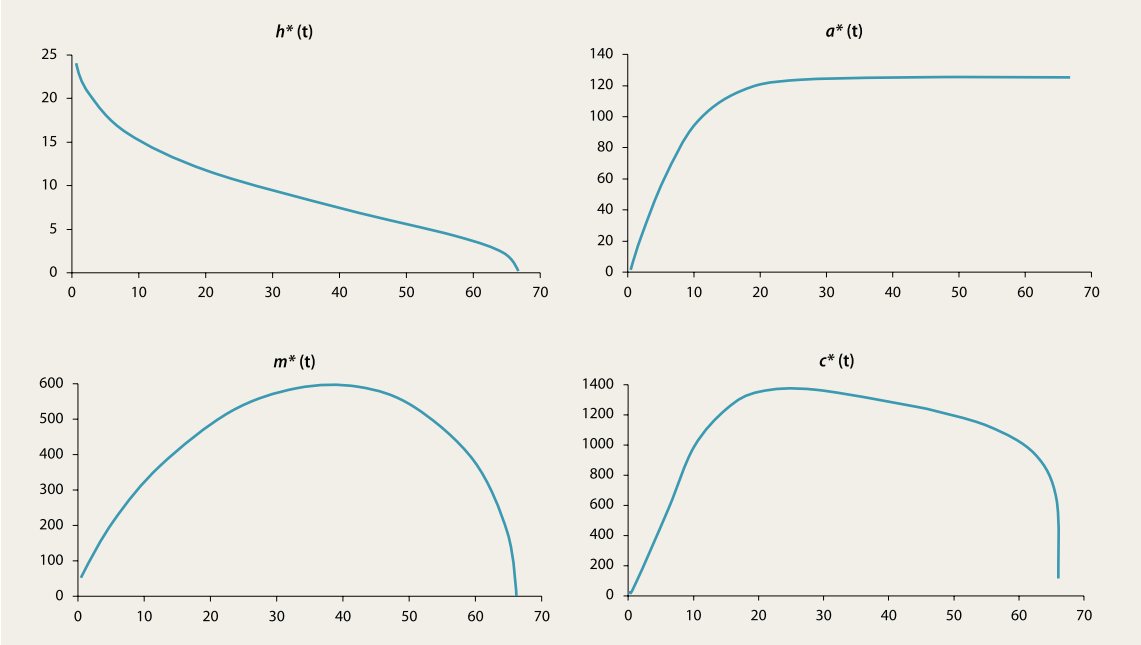
Top-line messages:

- Complementing empirical analyses, theoretical research in economics may yield new tools that will ultimately enable policymakers to better understand the links between health and economic conditions
- The theoretical model proposed here allows researchers to compute a stock of health capital, which can be measured in dollars, and which is compatible with individual optimizing behavior, for all countries in the world; this enables investigations and comparisons that were not achievable with previous tools
- Early results with the model include the observation that countries' health capital per capita tends to grow significantly faster than GDP per capita
- The model can be used to run counterfactual exercises that yield, for example, estimates of the reduction in global effective labor supply caused by NCD burdens

Study background and aims: In the field of health economics, Grossman (1972) is the canonical dynamic model of the demand for health. In this model, rational individuals are assumed to divide their income between (i) consumption, (ii) saving, and (iii) investing in health capital. Their welfare is assumed to depend solely on consumption: this, therefore, is a world in which health is a pure investment good. In the study summarized here, Arcand and Rinaldo develop an analytically tractable Grossman-type model, which they solve using standard dynamic programming methods, and which they are then able to fit to actual data, allowing them to run a number of interesting counterfactual exercises. They can do so because the theoretical model allows them to compute a stock of health capital, which can be measured in dollars, and which is compatible with individual optimizing behavior, for all countries in the world.

Methods: In contrast to standard dynamic macroeconomic models, individuals in Arcand's and Rinaldo's model are endowed with two stocks of capital: (i) assets which generate interest income and (ii) health capital, an important component of human capital, the latter being equated with effective labor supply. In accordance with human physiology, health capital is assumed to depreciate at an increasing rate as an individual ages, leading to finite lifetimes becoming both inevitable and optimal. The final analytical task is to derive average behavior in the economy at a given time by aggregating over all those individuals who happen to be alive. Remarkably, the expressions for aggregate behavior turn out to be almost as tractable as their individual components.

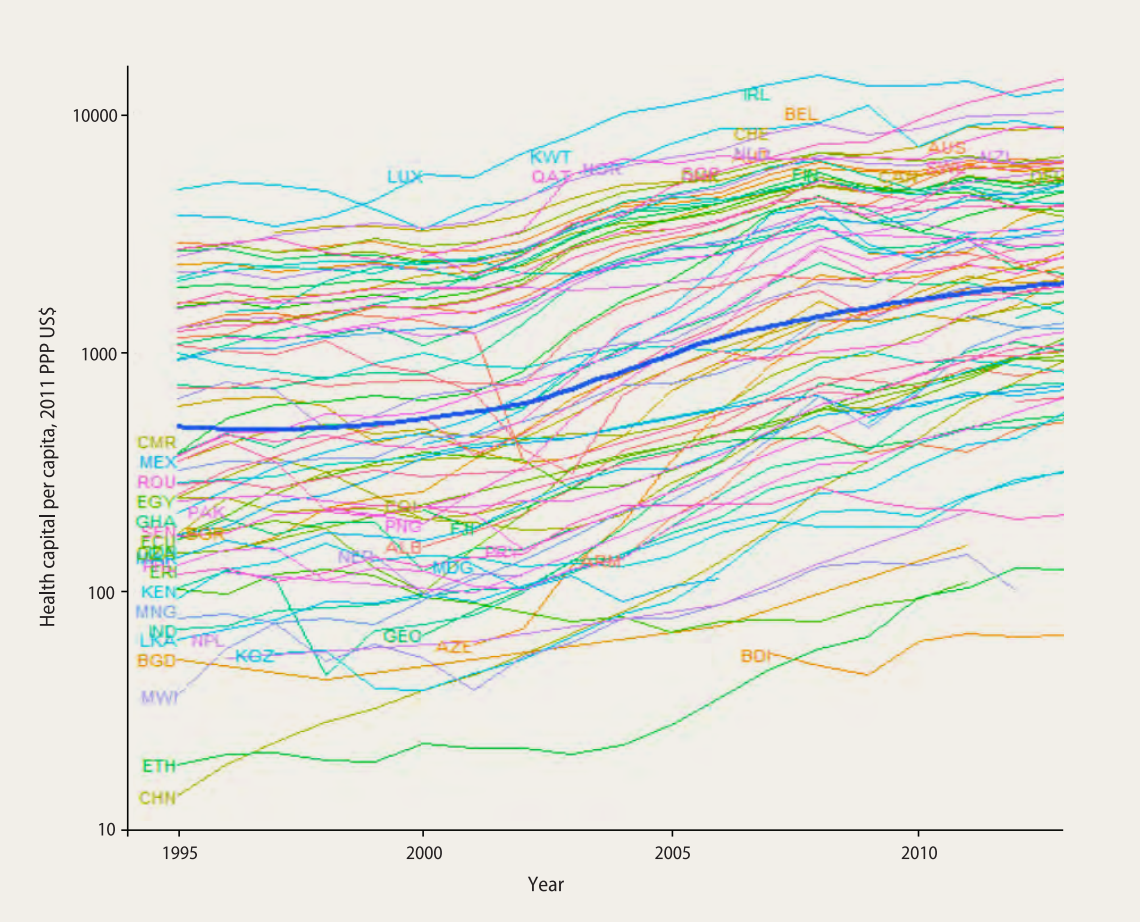
FIGURE 1.3 Illustration of the theoretical model in terms of individual optimizing behavior



The basic intuition of the theoretical model in terms of individual optimizing behavior is illustrated in Figure 1.3. The optimal health capital $h^*(t)$ of an individual is high at birth and gradually decreases, as the health depreciation rate increases with age 't'. This is also the path followed by effective labor supply, which falls to zero when health capital reaches the horizontal axis (which corresponds to death). Concomitantly, optimal health expenditures $m^*(t)$ initially increase with age (in order to smooth the path of health capital), but eventually fall, as the effect of the increasing depreciation rate of health capital become sufficiently large: this yields an inverse U-shaped pattern over time; optimal consumption expenditures $c^*(t)$ follows a similar path. Finally, individual assets (which through the usual national income accounting identity drive the behavior of the physical capital stock available to firms) increase at a decreasing rate: they cannot fall to zero until the time of death, because the individual's ability to finance consumption is increasingly dependent upon interest income, as labor income falls along with her health capital and effective labor supply.

The empirical calibration of the model relies on five types of data: (i) life expectancy at birth, which corresponds to the optimal finite lifetime of an individual blessed with perfect foresight and which corresponds, in Figure 1.3, to the point where the health capital curve intersects the horizontal axis; (ii) health expenditures per capita which, ceteris paribus, increase the stock of health capital; (iii) the difference between life expectancy at 60 and life expectancy at birth, which allows researchers to obtain a rough measure of the time-varying component of the depreciation rate of health capital; (iv) information on the labor share (measured by wages and salaries divided by value-added), which allows researchers to characterize the production technology that produces output using physical capital and effective labor input, and which is a key ingredient determining the optimizing behavior of producers; and (v) information on disability-adjusted life years (DALYs) lost to various pathologies, which allows researchers to parameterize the baseline (invariant) depreciation rate of health capital and, later, to conduct counterfactual simulations.

FIGURE 1.4 **Estimated health capital per capita (logarithmic scale), for 92 countries, 2011 US$ PPP**



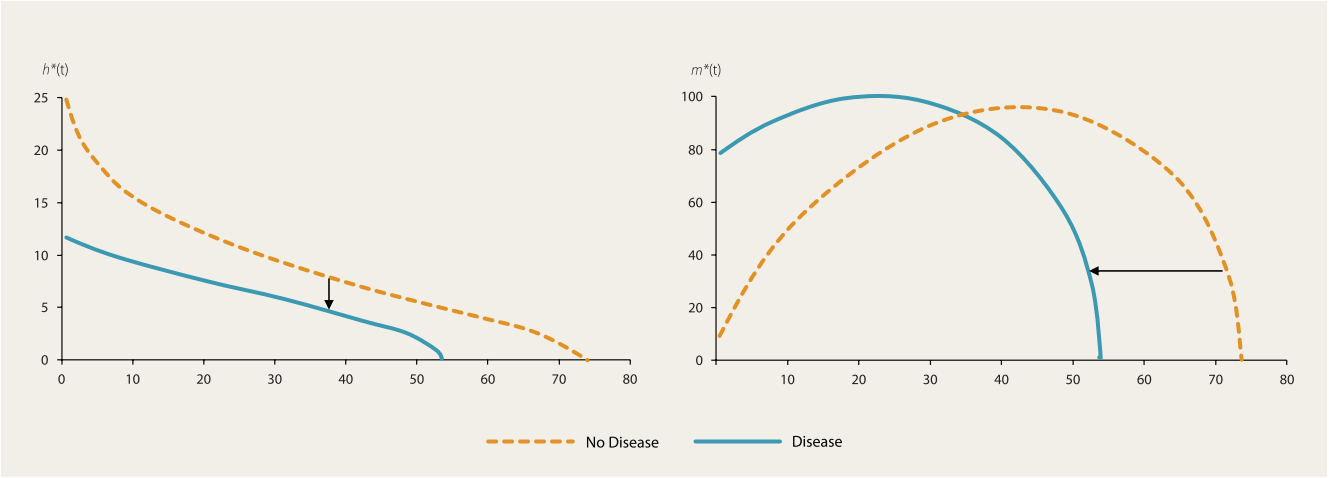
Note: The dark blue line corresponds to a nonparametric smooth of the average behavior in the sample. PPP = Purchasing Power Parity.

Results: Longevity, investment in health capital through health expenditures, and the depreciation rate of health capital are intimately tied together in the model by the fetters of optimizing behavior. Applying standard generalized methods of moments techniques, and the restrictions implied by the theoretical model, the researchers are able to estimate two key parameters: (i) the efficiency with which health expenditures are translated into increases in health capital and (ii) the sensitivity of effective labor supply to changes in health capital. With these two parameters in hand, they are then able to simulate, using the theoretical model, the path of the stock of health capital per capita for every country in their sample. This is illustrated in Figure 1.4 (note the logarithmic scale on the vertical axis). The paths followed by health capital per capita are computed by aggregating the optimal behavior of all generations of individuals alive in a given country in a given year, where the longevity of each generation is also determined endogenously in the underlying theoretical model.

Several interesting empirical regularities emerge. First, as one would expect, the stock of health capital per capita is positively correlated with GDP per capita, though the researchers' estimation procedure does not anchor the former on the latter – this is an important point, in that they are not deriving their estimate of health capital by a procedure that is in any manner linked to an estimate of the value of a statistical life. Second, health capital per capita tends to grow significantly faster than GDP per capita. A noticeable example in the above figure is China (see the CHN code in Figure 1.4), where health capital per capita goes from just above $10 in 1995 to almost $1,000 in 2013 –a far larger proportional increase than that of GDP per capita.

Applying the model: a counterfactual on NCDs. What are the implications of this model when it comes to the impact of NCDs on health capital? Figure 1.5 compares the paths of optimal individual health capital and health expenditures with and

FIGURE 1.5 Effect of NCDs on health capital and health investment



without NCDs, where the latter are assumed to increase the rate at which health capital depreciates. When the disease burden is reduced, individual optimal health capital unambiguously shifts upwards, whereas the inverse U-shaped path of optimal health expenditures shifts to the right: as one would expect, optimal longevity is also increased.

Highlights of workshop discussion: Professors **Prabhat Jha** and **Sue Horton** again led the conversation. The discussants noted broad consistency between the research presented and existing work on topics such as the "Portfolios of the Poor." Health capital growth appears to be faster than GDP growth, which again is consistent with existing work by Dean Jamison, Charles Kinney and others. It is thought-provoking that the world is growing more unequal in terms of income, yet may be improving in terms of health capital and its distribution. The discussants and workshop members encouraged Professor Arcand and his team to provide readers with a clearer feel for what the numbers represent and to proceed pedagogically in spelling out the implications for policy makers.

Workshop participants went on to note that, while the empirical analysis undertaken by Han, Arcand, and Lauer (Paper 1) could usefully be extended to 2030, there is value in focusing on a five-year timeframe, which approximates the electoral cycles that drive political decisions in many settings. That NCD investments can generate benefits in a timeframe of <5 years is an important political message. On the other hand, some felt that the actual GDP and GDP per capita benefits calculated might appear modest to policymakers. Participants discussed whether the model could be adjusted to more fully reflect the vast economic burden of mental health conditions, for example, and the benefits that would stem from effectively treating them.

Workshop Day 1, afternoon session

Erica Di Ruggiero (University of Toronto) and **Daniel Dulitzky** (World Bank) chaired the first day's afternoon session.

Paper 3: Estimating the longevity benefits of non-communicable disease mortality reductions in low- and middle-income countries over 2017-2030: findings from a modeling study

Aayush Khadka, Stéphane Verguet**
(*) Department of Global Health and Population, Harvard T.H. Chan School of Public Health

Top-line messages: By aggressively tackling non-communicable diseases (NCDs), and in particular reducing mortality from cardiovascular diseases (CVD), low- and middle-income countries can score substantial longevity gains that carry high monetary values.

The study shows:

- Potentially large, sustained longevity gains for

controlling NCDs (particularly CVD) and injuries

- Potentially substantial, sustained longevity losses (high cost of inaction) if countries fail to tackle NCDs (particularly CVD) and injuries

This work also establishes a priority-setting paradigm. It opens the way to a monetized assessment of the global burden of mortality by cause that will enable comparing health-sector and intersectoral investments.

Study background and aims: To best set priorities and allocate investments toward the health sector, it is essential to understand the respective contributions of different diseases and conditions to changes in longevity over time. The researchers estimate the longevity changes induced by various mortality trajectories between 2017 and 2030, the end date of the Sustainable Development Goals, for major disease groups including NCDs for low-income countries (LICs), lower-middle-income countries (LMICs), and upper-middle-income countries (UMICs). In addition, they quantify the monetary value associated with the changes in the mortality schedule that lead to these longevity changes. This effort can be thought of as contributing a "first brick" toward the construction of a money-metric priority setting framework for health sector investments, building on the momentum of "Global Health 2035," and drawing from the Copenhagen Consensus exercise.

Methods: The study's goal was to estimate money-metric values of longevity changes per disease category between 2017 and 2030 in two steps:

- **Step 1**: estimate changes in longevity (changes in mortality rates, hence life years) under different mortality scenarios

- **Step 2**: assign monetary values to the underlying changes in the mortality schedule responsible for changes in longevity by using value of statistical life (VSL) methods

Accordingly, the researchers model survival curves for 29 LICs, 50 LMICs, and 50 UMICs under three mortality scenarios between 2017 and 2030: a base-case trajectory that draws from annual age-sex-disease-country-specific mortality forecasts by the Global Burden of Disease study; a "high-performance" trajectory that is defined, for each country income group, as achieving (by 2030) age-sex-disease-specific mortality rates that correspond to the 90th percentile of the lowest mortality rates of the next-higher country income group in 2016; and a "low-performance" trajectory that relies on 2030 age-sex-disease-specific mortality rates that correspond to the 10th percentile of the next-higher country income group rates in 2016.

All three trajectories are examined for eight broad disease categories: neoplasms; CVD; chronic respiratory diseases; diabetes and other endocrine diseases; mental disorders; injuries; communicable diseases; and maternal, neonatal, and nutritional diseases. The study estimates per-person changes in longevity at all ages between base-case, low-performance, and high-performance trajectories as differences in age-sex-year-specific life expectancy per disease category. Using VSL methods, the researchers derive associated monetary values (in 2011 USD adjusted for Purchasing Power Parity). To assess the robustness of the estimated monetary values, they conduct several sensitivity analyses.

Key results: The high-performance scenario of CVD mortality control would be associated with impressive gains in longevity that carry a high monetary value for LICs, LMICs, and UMICs. The analysis shows potentially large per-person period-specific changes in longevity under the high-performing scenario for CVDs for both females and males by 2030; for LICs, LMICs, and UMICs, the monetary values associated with changes in the age-sex-disease-year-specific mortality schedule for females are estimated at about $1,700, $11,000, and $30,000 in 2030 respectively; for males, the associated monetary values in 2030 are estimated at $1,700, $15,000, and $42,000 respectively. Longevity benefits and the monetary value of the underlying changes in the mortality schedule would be smaller, albeit still substantial, for other NCDs and injuries considered in the analysis. In both LICs and LMICs, large longevity gains via continued reduction of mortality from communicable diseases could also be achieved in the short term.

Critically, the findings highlight potentially large longevity losses under the low-performance scenario for CVDs across all three income groupings: for females in 2030, the per-person monetary value associated with the change in mortality schedule leading to these losses is estimated to be of about $4,000, $15,000, and $42,000 in LICs, LMICs, and UMICs, respectively; for males, the respective per-person monetary values are projected to be of about $6,000, $31,000, and $55,000. Lon-

gevity losses due to injuries and their associated monetary value were especially high for males in LICs and LMICs, relative to other NCDs: in 2030, the per-person monetary values are projected to be around $6,000 and $28,000 in the two respective country income groupings.

Discussion, interpretation, and future work: The study finds that large longevity gains, as measured by life years and associated monetary values, could materialize via curbing NCD- and injury-related mortality. For women, the greatest gains would come from addressing CVDs and neoplasms; men's longevity gains would be greatest from better control of CVDs, neoplasms, and injuries. Furthermore, this study points to important setbacks if NCD control is not scaled up: substantial longevity losses could result, particularly for CVDs and injuries across all three country income groups. In addition, largely due to the unfinished agenda of infectious diseases, the researchers observe that, in the short term, much longevity could be gained via communicable disease mortality reduction in LICs and LMICs.

Generally, the analysis stresses that LICs and LMICs could see large longevity gains in the short term while focusing on the unfinished agenda of infectious diseases and maternal and child health. Yet, given the potentially large longevity losses of a low-performance trajectory for major NCDs like CVDs, LICs and LMICs should urgently address NCDs and injuries, where great sustained benefits lie ahead. UMICs, too, should prioritize reducing the burden of mortality due to NCDs and injuries, as the analysis highlights large potential losses in the case of inaction.

Nevertheless, the researchers found wide variations in the estimated per-person monetary values under various sensitivity analyses, which highlights the need to conduct more robust analyses in eliciting mortality risk valuations in LICs, LMICs, and UMICs, in terms of estimating the value of a statistical life. Future work can also build upon this study by replicating the approach in other countries and settings (e.g., sub-Saharan Africa, South Asia). Replications which rely on micro-data or administrative data collected in these countries and regions may provide an important point of comparison for the results presented in this analysis.

Future work should also examine within-country inequalities in the distribution of these longevity effects along the socioeconomic gradient and age groups. Likewise, disease-specific mortality reductions including from NCDs, mental disorders, and injuries should be viewed with their respective contributions toward reducing the burden of illness-related impoverishment and alleviating poverty.

This research shows that, by systematically monetizing the global burden of mortality by cause, one can conceive a priority-setting paradigm to best allocate investments toward the health sector, which can then be evaluated in terms of returns on investment and be compared across other sectors outside the health sector.

Highlights of workshop discussion: Professor **Dean Jamison** (UCSF) served as main discussant for the paper. Professor Jamison observed that the work presented could advance the generation of an "economic burden of disease by time and place," which would be highly informative for policy deliberations. The "economic burden of disease" would in a sense be complementary with the existing epidemiological GBD. Among other benefits, it would help stop the confusion spawned by the proliferating "Investment Cases" now regularly produced by many disease-specific programs and constituencies (including for NCDs!). This work could also, Professor Jamison suggested, be interpreted as a major step towards challenging the models of DALYs and QALYs.

The idea of a "global economic burden of disease" sparked the interest of workshop participants, who explored potential implications for policy and practice. Several participants requested that researchers orient the community in understanding how practitioners can best use these tools to assess and prioritize interventions (including prevention). Rewards will come from identifying anchoring points in these models where policy can engage.

Participants also asked how the monetized results obtained by Professor Verguet related to the calculations of GDP and GDP per capita gains presented earlier by Dr. Lauer and team (Paper 1 in this chapter). In the course of extended follow-up discussions, Professor Verguet explained that it is, in fact, difficult to directly compare the results from the two analyses. Fundamentally, the Khadka and Verguet (KV) analysis differs from the Han, Arcand, and Lauer (HAL) study in that KV estimate monetary values associated with changes in mortality risk, whereas HAL estimate changes in GDP and GDP per capita as a result of changes in the composition of the skill-augmented labor force and productivity. For HAL, GDP and GDP per capita estimates are the key outcomes, whereas for KV, gross national income (GNI) per capita (of which GDP is a component) is

an input in their analysis to ultimately estimate the monetary value of changes in mortality risk.

While not directly comparable, the two methods can be thought of as complementary approaches to putting a value on the health gains that countries can obtain by addressing the NCD epidemic. Both can provide potentially motivating information for decision-makers. Both expand the current toolkit of instruments for NCD analysis and policy dialogue.

Paper 4: Measurement and determinants of NCDs and their impact on adult survival

Daphne Wu, Jeremy Veillard**, David Watkins***, Ryan Hum*, Dean T. Jamison#, Prabhat Jha**
(*) University of Toronto; (**) World Bank; (***) University of Washington; (#) University of California at San Francisco

Top-line messages:

- Reducing adult mortality (probably) improves income growth
- Consider 40q30 (mortality from age 30 to 69) as the main metric of adult survival for the Human Capital Index and the SDGs
- Adult mortality is generally falling worldwide, but rising vascular mortality in some settings raises concerns
- Costs for reducing adult mortality, at the margin, are rising
- Increasing income and increasing spending on health are effective means of reducing adult NCD mortality
- An expanded package of NCD interventions would go a long way toward achieving the relevant SDGs

Study background and aims: The research being pursued under Paper 4 encompasses the following questions:

1. Does better adult health increase income growth?
2. Can we move from the current 45q15 adult mortality metric to 40q30?
3. What are the key trends in adult and NCD mortality?
4. Which macro-level policies reduce adult mortality?
5. By how much could stronger NCD interventions speed SDG progress and reduce premature deaths?

This summary focuses on questions 1, 4, and 5, which have particular salience for engaging policy makers (notably ministers of finance) around NCDs and human capital. Question 2 provoked lively discussion in the workshop, reflected in the section of this chapter on measurement challenges.

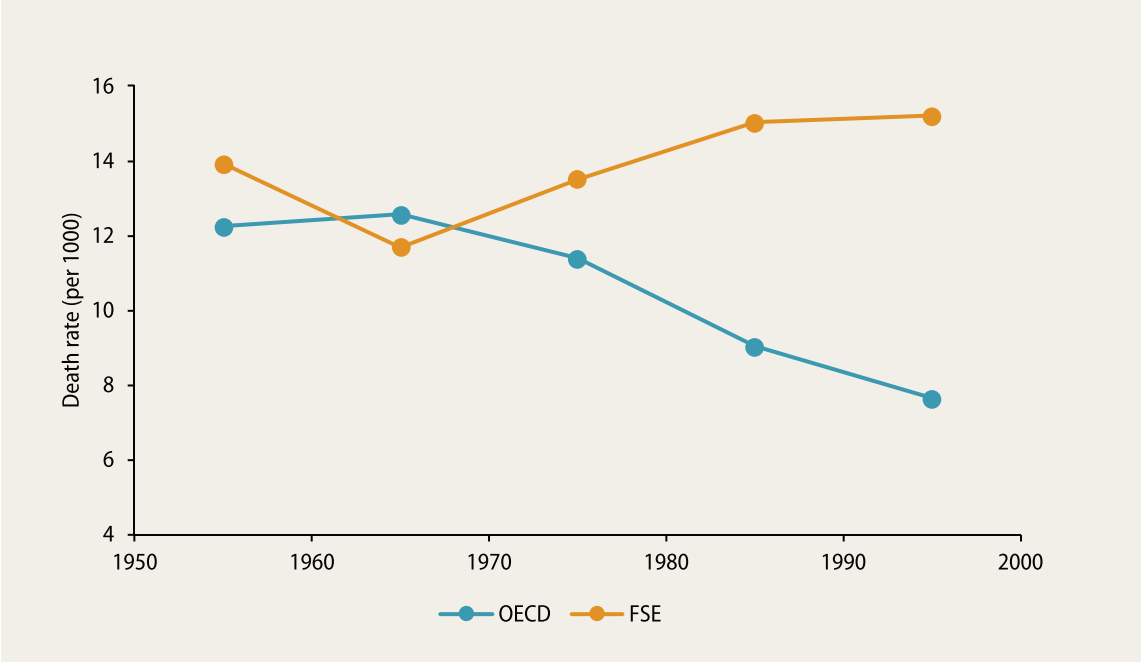
Economic benefits of reduced adult mortality

Ms. Wu and Professor Jha began by approaching from a new angle the question of potential economic payoffs from adult mortality gains, a key theme of the workshop's earlier papers. Wu and Jha argued that substantial evidence can be drawn from the existing public-health literature to bolster the case that gains in adult life expectancy can deliver major economic benefits for countries.

Earlier unpublished analysis of data from the former states of the Soviet Union provides one illustration. It is well known that adult male life expectancy in the former Soviet states declined sharply in the years preceding and after the dissolution of the USSR, with NCDs (particularly alcohol-related) among the drivers of increased mortality. Trends in adult male mortality in the former Soviet region and in Organization for Economic Co-Operation and Development (OECD) countries have diverged sharply over recent decades (Figure 1.6).

Building on earlier work by Jamison, Lau, and Wang (2005), Wu and Jha showed that it is possible to calculate the economic benefits that former Soviet states might have obtained by reducing their adult male mortality during the period. In 1990, the average 15-year-old male living in the former Soviet republics had a 72 percent likelihood of surviving to age 60. The corresponding probability in OECD countries was 86 percent. If adult male life expectancy in the former Soviet states had matched the OECD average from 1990 on, the ex-Soviet countries would have enjoyed a substantial boost in economic growth: growing at 1.4 percent per year, on average, over the past three decades, rather than the 1 percent average rate they actually experienced.

FIGURE 1.6 Worsening adult male mortality in former Soviet states, 1950-2000



Source: Peto et al. 1994.

Determinants of adult mortality (including macro-level policies)

Lowering adult mortality can yield substantial economic payoffs. But what are the policy levers that countries can use to bring mortality down? Wu and Jha explained that a key task for their paper is to shed light on this question by examining the macro-level determinants of adult mortality. The following notes briefly summarize the methodology that Wu, Jha, and team have used to analyze macro-level determinants, and the findings obtained to date.

Methods: The researchers examine the macro-level determinants of adult mortality (mortality at age 30-69, or 40q30), using a random effects regression model. In Wu's and Jha's model, the macro-level determinants of adult mortality are as follows: mean years of female education (FeEd), GDP per capita (GDPPC), health expenditure as a percentage of a country's GDP (health_exp), percentage of health expenditure that is borne out of pocket (OOP), malaria incidence per 1,000 population at risk (malaria), HIV prevalence as a percentage of the population age 15-49 (HIV), urban percentage (urban), and access to electricity (electricity). The model allows for differences across countries, such as the diffusion and adoption of new technologies, to affect the outcome. The model is given by:

$$\ln 40q30_{i,t} = \beta_0 + \beta_1 FeEd_{i,t} + \beta_2 \ln GDPPC_{i,t} + \beta_3 health_exp_{i,t} + \beta_4 OOP_{i,t} + \beta_5 malaria_{i,t} + \beta_6 HIV_{i,t} + \beta_7 urban_{i,t} + \beta_8 electricity_{i,t} + \mu_i + \varepsilon_{i,t}$$

The researchers used data from 163 countries for 2000, 2010, and 2016. They examined the association between the macro-level variables and adult mortality attributed to (1) NCDs, (2) communicable, maternal, and perinatal conditions (CMPs), and (3) injuries.

Results: The researchers found that, other things being equal, female education is not significantly associated with all-cause adult mortality, while a 10 percent increase in income is associated with a 1.5 percent reduction in all-cause adult mortality, and a 10 percent decrease in HIV prevalence is associated with a 34 percent reduction in adult mortality, respectively (Table 1.1).

The finding that there is no significant association between female education and adult mortality contrasts with the results of Pradhan and others (2017), as they did not control for the impact of other macro-level variables. Female education, however,

is significantly associated with CMP- and injury-attributable mortality: An additional year of female education decreases CMP- and injury-attributable mortality by 6 percent and 2.9 percent, respectively.

Income is significantly associated with all four categories of mortality: A 10 percent increase in income reduces both all-cause adult mortality and NCD-attributable mortality by 1.5 percent, CMP-attributable mortality by 2.5 percent, and injury-attributable mortality by 3.1 percent. An increase in health expenditure of 2.5 percent of GDP would reduce all-cause mortality by 3.8 percent, NCD-attributable mortality by 8.5 percent, and injury-attributable mortality by 5.7 percent. Lower out-of-pocket health expenditure (OOP) is associated with a reduction in adult mortality: a 10 percent decrease in OOP reduces all-cause adult mortality by 2 percent, though it does not affect NCD mortality.

TABLE 1.1 Determinants of log adult (40q30) mortality and effect of intervention on adult mortality

	Coefficient	Intervention	Reduction in adult mortality (%)
All-cause adult mortality			
Female education	-0.004		
ln GDP per capita	-0.145*	10% increase	1.45%
Health expenditure	-0.015*	2.5% GDP increase	3.78%
OOP	0.002*	10% decrease	1.95%
Malaria	0.000(1)		
HIV	0.034*	10% decrease	34.13%
Urban	0.000		
Electricity	-0.002*	10% increase	2.09%
NCD-attributable adult mortality			
Female education	0.000		
ln GDP per capita	-0.153*	10% increase	1.53%
Health expenditure	-0.033*	2.5% GDP increase	8.45%
OOP	0.001		
Urban	-0.003*	10% increase	2.62%
Electricity	0.005*	10% decrease	4.82%
CMP-attributable adult mortality			
Female education	-0.058*	1 additional year	5.95%
ln GDP per capita	-0.248*	10% increase	2.48%
Health expenditure	-0.020†	2.5% GDP increase	5.05%
OOP	-0.002		
malaria inc	0.000(2)		
HIV prev	0.090*	10% decrease	94.69%
Urban	0.001		
Electricity	-0.011*	10% increase	10.89%
Injury-attributable adult mortality			
Female education	-0.028*	1 additional year	2.86%
ln GDP per capita	-0.309*	10% increase	3.09%
Health expenditure	-0.022*	2.5% GDP increase	5.65%
OOP	-0.001		
Urban	0.004		
Electricity	0.005*	10% decrease	4.74%

Note: *p<0.05. Effect of intervention only indicated for variables with p<0.05.

Assessing implications for policy and programming. Initial analysis suggests that effective means to reduce adult mortality from NCDs include: increasing income and increasing spending on health. Of note, the researchers also found that a 10 percent decrease in out-of-pocket health expenditure (OOP) reduced 40q30 by 2 percent.

Further work is underway to deepen this analysis and clarify policy and program-delivery options. One clear conclusion from the investigation to date is the importance of robust health spending, guided by strong evidence. This approach is embodied in Disease Control Priorities 3 (DCP3), a key practical resource for country policy makers, their advisers, and partners. DCP3 defined an Essential Universal Health Coverage (EUHC) package, which consists of a list of 218 interventions that were deemed to provide good value for money in multiple settings, address a significant disease burden, and be feasible to implement in low- and middle-income countries (LICs and MICs) (Watkins et al. 2018). The package covers nearly all major health conditions from birth to death, including maternal and child health conditions, infectious diseases, NCDs, injuries, and health services such as surgery and rehabilitation. It even goes beyond direct health services to cover the health system interventions used for monitoring and surveillance.

Watkins and colleagues estimated that, for 80 percent population coverage, the EUHC package would cost a total of US$65 billion in low-income countries and US$270 billion in lower middle-income countries. Based on a total population of 0.90 billion and 2.7 billion in 2017, respectively, this would mean US$72 per capita in low-income countries and US$101 per capita in lower middle-income countries.

Of the total service delivery cost, which accounts for 60 percent of the total EUHC cost (while the remaining 40 percent consists of costs of ancillary services and programs to support health services), prevention and treatment of NCDs would account for about US$17 billion (or 41 percent) in low-income countries and about US$86 billion (or 51 percent) in lower middle-income countries.

Based on an estimated US$18 billion and US$73 billion in current spending, the additional cost to cover 80 percent of the population in low- and lower middle-income countries ("incremental cost") would be about US$46 and US$160 billion, respectively. Of the total incremental cost for service delivery, which accounts for 60 percent of the total EUHC cost, prevention and treatment of NCDs would account for about US$15 billion (or 52 percent) in low-income countries and about US$55 billion (or 56 percent) in lower middle-income countries.

With the implementation of EUHC, about 1.2 million deaths and 2.9 million deaths due to all causes could be averted in low- and lower-middle-income countries, respectively. The number of deaths averted due to NCDs, CMPs, and injuries would be about 0.53 million, 0.65 million, and 0.06 million respectively in low-income countries, and about 1.9 million, 0.94 million, and 0.1 million respectively in lower-middle-income countries. In terms of progress towards the 40q30 target, low-income countries would achieve greater progress in all-cause mortality reduction, as well as in all of the three areas of condition-specific mortality, compared to lower-middle-income countries (80 vs. 60 percent in all-cause mortality reduction, 88 vs. 70 percent in mortality reduction due to NCDs, 86 vs. 63 percent in mortality reduction due to CMPs, and 46 vs. 19 percent in mortality reduction due to injuries).

Similar analyses done in partnership with the Asian Development Bank for urban areas of Indian and Bangladesh also suggest significant benefits (Wu et al. 2020).

Highlights of group discussion. The principal discussants for the paper were **Adriana Blanco** (PAHO) and **Jeremy Veillard** (World Bank). A key topic of interest concerned the balance to be found between focusing on adult mortality and morbidity, in relation to NCDs. In terms of mortality as a proposed best measure of NCD impacts, some participants remained skeptical, in light of the magnitude of burdens imposed by non-fatal diseases such as mental health conditions, diabetes, obesity, and others. For many, disability remains a crucial measure for communicating the importance of NCD epidemics and the human and economic damage they inflict. Participants cited, for example, the rising tide of neurodegenerative disorders (e.g., Alzheimer) and mental health conditions. In the near future, in some settings, resources on the order of 5-7 percent of GDP may have to be channeled towards public-sector management of these burdens. Costs of such magnitude should catch decision makers' attention. Some participants noted that the human capital framing enables this discussion to be positioned in the context of how we can most intelligently invest in people.

In considering how governments and societies can respond, the promise of technology to alter the current equations has not been adequately grasped. Large-scale new investment in NCD interventions and technologies is needed. In this respect, some argued, digital health could mark a revolution, including in mental health and NCD care.

As co-chair, Dr. **Jeremy Veillard** summed up the discussion by observing that the challenge remains of turning the NCD story into a narrative that demands urgent action, a "narrative of crisis." He noted that education experts at the World Bank and elsewhere have been successful in communicating around the idea of an education crisis. The human capital framing may help the NCD community achieve comparable impact.

Workshop Day 2, morning session

Tim Evans (World Bank/McGill University) and **Rachel Nugent** (RTI) co-chaired the first session of Day 2. The session began with a review of main results from the first day of the workshop, summarized by **Sir George Alleyne** and Professor **Dean Jamison**.

Recapping results from Day 1

Health perspective

Sir George Alleyne

Dr. Alleyne prefaced his comments by noting that, while many aspects of the previous day's rich discussion would merit attention, he would focus on the workshop's core theme: links between NCDs and human capital. Through this lens, notable contributions emerged from each research paper.

Paper 1, presented by **Jeremy Lauer**, brought a powerful message on the GDP gains that countries could achieve by scaling up NCD interventions. The paper specified key avenues of intervention on NCDs, from primary care services to population-level and policy measures. Bringing relevant interventions to 60 percent coverage would lead to a decrease in physical capital concomitantly with an increase in the effective labor supply. The net result for countries would be an average annual increase of 0.5 percent in GDP and 0.7 percent in GDP per capita over five years.

From Paper 2, presented by **Jean-Louis Arcand**, the most critical message for Dr. Alleyne was the demonstration of a valuation of health capital which had two possible measurements – dollars or years. The key contribution of this approach is the ability to quantify the impact of NCDs on health capital and to validate that health capital grows faster than GDP.

Stéphane Verguet, in Paper 3, had proposed a novel monetized assessment of the longevity benefits of interventions to decrease NCDs. Dr. Alleyne noted that much of the workshop discussion of this paper turned around the merit of a conjoined measure such as DALYs, which minimize the importance of disability—a key facet of NCD impacts on human capital.

Prabhat Jha and Daphne Wu, in Paper 4, had argued persuasively for adopting the 40q30 measure—rather than or in addition to 45q15—to assess the effect of NCDs on adult mortality. The subsequent conversation had again highlighted the importance of considering disability in setting priorities for NCD prevention and control.

Dr. Alleyne noted that, at various points throughout the day, the issue of a whole-of-government approach to NCDs arose, and the point was made that a human capital perspective makes the fiscal demands of dealing with NCDs easier to accept, because it opens a clear line of sight from NCD spending to economic gain.

Economics perspective

Dean Jamison

Professor Jamison reported three main reactions to the research findings and discussion on Day 1.

First, on the **economic benefits of NCD action**, he observed that the community is now close to being able to assemble a robust account of the economic benefits of the gains in NCD prevention and control and the dollar values that will be achieved. The literature on this issue is generally consistent, and workshop contributors have that literature well in hand.

The **intersectoral dimension of NCD challenges** is a second key topic, where consensus within the community appears more elusive. On this topic, important choices (including for the workshop group)

remain outstanding. Pressing problems around intersectoral action include at least two sub-issues:

1. ***Intersectoral policies to manage behavioral and environmental risks***. What policies are effective, and how would we know? What avenues of research should be prioritized, to provide the answers policy makers need? Professor Jamison cited the control of obesity as an example: evidence-based policy recommendations are generally lacking; the obesity problem still belongs more to the research agenda than to the domain where policies can be chosen from a set of proven options, with well-understood costs and benefits. In general, Professor Jamison argued, the economics of risk factors lags far behind the economics of health.

2. ***The financial impacts of NCD epidemics outside the health sector***. An example concerns the costs of long-term care. Professor Jamison noted the case of the Netherlands, where an aging population with increasingly complex NCD comorbidities is propelling a cost explosion in long-term care.

As a third and final point, Professor Jamison evoked the **perspective of ministries of finance on the fiscal consequences of NCD burdens**. He noted what appears as an inevitable trend in many countries, whereby NCD-related services that had been informally provided in households are being shifted onto the public sector (relevant diseases include mental health conditions and neurodegenerative disorders). The fiscal consequences of this shift are likely to be very substantial in many settings.

As a result, Professor Jamison noted that his personal takeaway from the first day's discussion was the opportunity for a "pithy focus on the crisis." The major social problem we are facing, he argued, is the fiscal consequence for government of managing the growing burden of NCDs—linked to the fiscal opportunities that may arise from better management of these diseases.

Paper 5: NCDs, education, and human capital: how do NCDs interact with education to affect human capital accumulation?

Sanam Roder-DeWan, Ojaswi Pandey**, Aakash Mohpal***
(*) Harvard University (**) World Bank Group

Top-line messages: The research is ongoing and currently points to five main preliminary results:

1. The prevalence of NCDs among children is non-trivial and rising. Globally, NCDs accounted for 10 percent of all deaths in children under 5 years of age in 1990 and 18 percent among children aged 5 to 14 years. By 2017, these figures had increased to 14 percent and 23 percent, respectively.

2. Yet much of the existing research evaluating the impacts of poor health on educational attainment and subsequent labor market outcomes has focused on issues of nutrition and early childhood development (low birthweight, stunting, and psychosocial stimulation) and common acute conditions (parasitic infections and deworming).

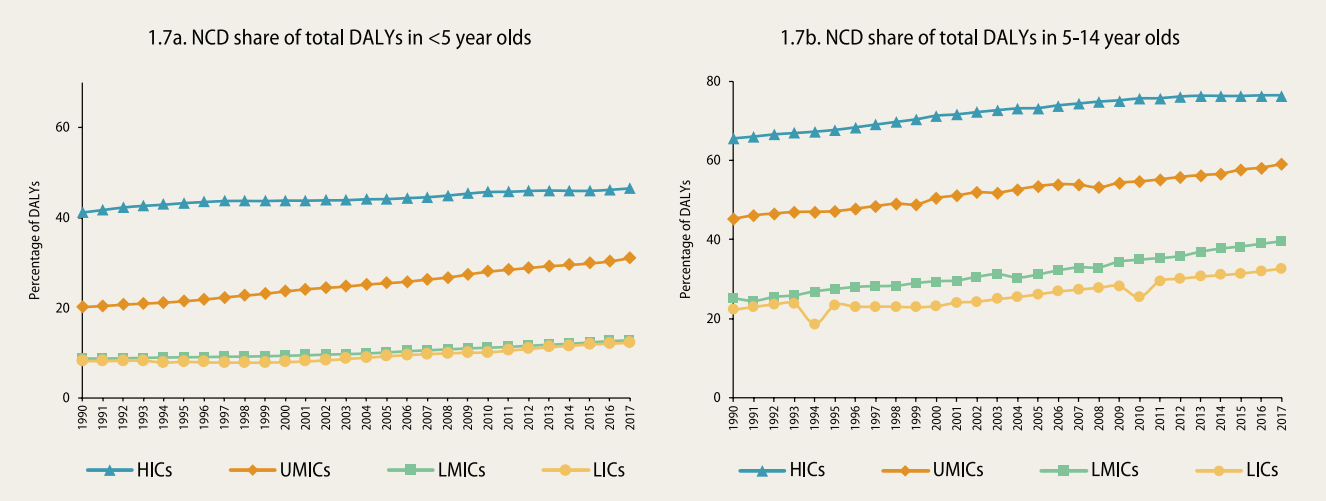
3. Preliminary analysis of survey data from the UK and India shows that NCDs in childhood are correlated with lower test scores and lower educational attainment. The impacts of NCDs in childhood appear to accumulate into adult life. Experiencing NCDs in childhood is correlated with lower employment and earnings.

4. Education does appear to mitigate some of the adverse associations between NCDs and labor market outcomes. Nevertheless, productivity losses in adults who had NCDs as children appear to be large and warrant attention.

5. These preliminary associations underscore the need to pay attention to NCDs in children, identifying interventions to mitigate their adverse effects. The observed associations also highlight the need for further research to causally identify and quantify the impacts of NCDs on education and subsequent labor market outcomes.

Study background and aims: The overarching objective of the research is to understand the relationships between NCDs in children and their parents, educational attainment, and wealth accumulation. Education positively impacts health, and good health and nutrition can improve both the quantity and quality of education (Behrman 1996; Pradhan et al. 2018). There is, without doubt, reverse causality between health, education, and wealth, and this has generated substantial research attempting to disentangle causal impacts (Strauss and Thomas 1998; Glewwe and Miguel 2008). However, the literature has mostly focused on in utero and early childhood conditions, nutrition in infants and children, communicable diseases such as parasit-

FIGURE 1.7 Substantial NCD burdens among children in low- and middle-income countries



Note: 15.5% of DALYs for children <5 years globally (7a) and 42.4% for children ages 5 to 14 years (7b) are from NCDs. Even in LICs, NCDs accounted for 13.2% of DALYs for children <5 years old and 32.5% for 5- to 14-year-olds. In HICs, the corresponding figures are 44.4% and 72.3%.

ic infections, vision problems in adolescents, and energy supplementation in adults. NCDs constitute 62 percent of DALYs worldwide and 42.4 percent of DALYs among those aged 5-14 years. However, little direct evidence exists evaluating the impact of NCDs on educational attainment and wealth accumulation (Figures 1.7a and 1.7b).

This study looks specifically at the impact of NCDs (of child and parent) on educational attainment in childhood and on the ability to accumulate wealth, maintain savings, and avoid poverty in adulthood. The paper is broadly premised on a life-course approach that links early life experiences, starting in the preconception phase, to a variety of outcomes throughout life (WHO 2013; Baird et al. 2017). The researchers hypothesize that an NCD shock in childhood creates cumulative disadvantage both through lower educational attainment and through additional, independent health pathways that compromise adult capacity to accumulate human capital.

Methods: To test this hypothesis, the ongoing research began with a literature review on the potential pathways through which NCDs and education may jointly affect human capital accumulation. The study is now proceeding to analyze survey data from four countries (India, Indonesia, Mexico, and the UK) to investigate the prevalence of NCDs among children and how NCDs in children may affect school enrollment, educational attainment, and labor market outcomes. Extensions of the work also look at whether education can mitigate the adverse effects of NCDs on labor market outcomes. A final piece of analysis considers the impacts of NCDs in adults (parents) on the education of children in households. Since NCDs impose a significant economic burden on households in the form of workplace absenteeism, reduced employment, and lower incomes, it is possible that children who grow up in households where adults are chronically ill face greater challenges in accumulating education.

Given that among the countries and data sets selected, NCDs in children are reported only in the UK and India, the first part of the analysis is restricted to these data. The UK data is a cohort study of 17,000 children born in 1958 who were followed to age 55 (National Childhood Development Study). The India data is a nationally representative panel household survey with two rounds – 2005 and 2012 (Indian Human Development Survey). Data from Mexico and Indonesia are panel surveys and are used only to assess the impacts of NCDs in parents on the educational accumulation of the children. Currently, analysis is well advanced for India and the UK; analysis for the other countries is in earlier stages.

Research assessing the effects of health on education faces formidable econometric identification challenges (Behrman 1996; Glewwe and Miguel 2008). This study attempts to address the methodological challenges by using a panel data household fixed effects estimation strategy. The panel data helps remove time-invariant individual and household level unobservable characteristics, while the household fixed effects ensure that all the identifying vari-

ation comes from siblings in the household (which to some extent controls for genetic variation). Nevertheless, while these methods provide an improvement over analysis of cross-sectional data, as is well attested in the literature, such methods do not overcome all econometric identification issues. Addressing all identification issues is beyond the scope of the paper. Therefore, the results should be interpreted as correlations and not as causal parameters.

Key results: While analyses are still in progress, suggestive early findings have emerged. These include:

- In the UK, the prevalence of NCDs in children aged 7 years in 1965 was high. 6.6 percent of children suffered from chronic respiratory illnesses, 2.4 percent had a heart disease, and 15 percent suffered from neurological, developmental, or mental health disorders. Finally, 13.7 percent of children reported having visual difficulties, and 4.8 percent had hearing difficulties.

- In India, the figures are much lower. In 2012, 0.12 percent of children aged 0-14 years reported having chronic respiratory diseases, 0.34 percent suffered from neurological, developmental, and mental health disorders, 0.30 percent had vision difficulties, and 1.63 percent had hearing difficulties. The low prevalence of NCDs may partly reflect poor access and diagnostic quality in the health sector, as well as the nature of the survey, which relies on recall data (as opposed to direct measurement in the UK).

- NCDs in childhood are strongly associated with school absenteeism in the UK. Children with NCDs report 0.9 percentage points lower attendance rates at age 7 and 0.07 percentage points lower attendance at age 11, compared to their counterparts. In India, most of the effects are seen on the extensive margin. NCDs in childhood are correlated with a 15-percentage-point lower school enrollment rate (estimations with household fixed effects). Conditional on going to school, there is no significant correlation with absenteeism.

- In both countries, having NCDs is associated with lower educational performance. In the UK, NCDs are correlated with 11 percent lower math scores at age 7, and with 16 percent lower math scores at age 11. Similarly, NCDs are correlated with 10 percent lower reading scores at age 7 and 11 percent lower scores at age 11. In India, having NCDs is correlated with a reduction of 0.75 standard deviation in overall test scores.

- Having NCDs in childhood is associated with lower educational attainment in both the UK and India. In the UK, NCDs in childhood are associated with 1.7 fewer years of completed education at age 23 (compared to the average of 8.6 years, statistically significant at 1 percent). In India, the effects are even larger, considering the average duration of education is 7.9 years. Having NCDs at ages 15-24 in India is correlated with 1.3 to 1.8 fewer years of education seven years later (measured at ages 22-31).

- NCDs also have a significant detrimental effect on labor market participation and outcomes. In the UK, people who had NCDs as children are 3.3 percentage points less likely to be employed at age 23 and 4.9 percentage points less likely to be employed at age 50. Education does appear to play a mitigating role. The coefficient on the interaction term of having NCDs as children and years of schooling is positive, suggesting that children with NCDs who acquire more education are less likely to be unemployed.

- Results from India are similar to those observed in the UK. Youth aged 15-24 who had NCDs are 8 to 11 percentage points less likely to be employed seven years later (at ages 22-31). Adults aged 25-44 are also 7 percentage points less likely to be employed seven years later (at ages 32-51).

- NCDs in childhood are associated with lower adult height in both countries studied. Children with NCDs in the UK grow up to be 0.64cm shorter at age 23 than their counterparts (the mean is 169.7cm). Children in India with NCDs are 0.66 to 2.57cm shorter, compared to their counterparts (the mean is 142.6cm).

- These emerging correlations suggest that NCDs in childhood and adolescence may substantially lower subsequent adult productivity through their impact on education.

Discussion and future work: Results to date underscore the urgent need to take NCDs in childhood seriously, as they could have a large detrimental impact on human capital. Preliminary findings, although correlational, suggest that policies to mit-

igate the potential adverse impacts of NCDs in children on educational outcomes could substantially improve future productivity, when today's children reach adolescence and adulthood. The research also looks at intergenerational impacts of NCDs and the potential role of education in this relationship. Specifically, it seeks to understand if education can mitigate the transmission of adverse impacts of NCDs in adults to children in the household. This component of the research is ongoing.

Limitations and caveats: While the preliminary findings point to the possibility of large adverse educational and labor market impacts of NCDs in children, these findings are subject to several caveats and need to be interpreted with caution.

- First, the estimates are correlational and do not represent causal parameters. The panel data household fixed effects approach in India alleviates this concern to some extent, but still leaves room for criticism (see Glewwe and Miguel (2008) for a review of this literature). In addition, given the low prevalence of NCDs, we are also left with little variation.

- Part of the reason for the low prevalence of NCDs in the India data is probably that the data are self-reported. Self-reported data are subject to recall bias and measurement error. It is also possible that the reported positive cases are those of the most-affected children, which could lead to large and upward-biased estimates.

- While data in both countries have high follow-up rates, we have not yet attempted to account for attrition over survey rounds, which could lead to biased estimates. Preliminary analysis of the data from both the UK and India shows that those with NCDs are more likely to drop out of the survey, which will lead to downward-biased estimates.

- So far, we have grouped all NCDs into a single category. However, the biomedical literature suggests that different NCDs could have very different effects on educational attainment (for example, mental disorders vs. type I diabetes). More work is needed to parse out the effects of specific NCDs of interest.

Future work:

- Assess the impacts of NCDs in parents on the educational accumulation of children. This is also where the data from Mexico and Indonesia will be analyzed.

- Consider specific categories of NCDs, as opposed to grouping them all together.

- Survey the literature for additional methods to overcome the endogeneity problem and use best available practice for panel data.

Highlights from workshop discussion: The lead discussant for the paper was Professor **Sue Horton** (University of Waterloo). Professor Horton urged the researchers to be circumspect in formulating results and not "overpromise," as some of the language used in presenting early findings had appeared to suggest a demonstration of causality. (The researchers have subsequently worked to address these concerns.) Professor Horton suggested that the researchers might experiment with alternative models to incorporate additional factors potentially affecting outcomes, considering patterns among siblings, exogenous shocks, and other factors. Professor Horton recalled the important work done at Sweden's Karolinska Institute on multi-directional interactions between parents and children with regard to NCDs.

Some participants emphasized the relevance of the life-course literature, with its attention to critical windows of vulnerability – certain periods that are more sensitive to shocks. Colleagues endorsed the value of carefully separating out the different kinds of NCDs, noting that the policy implications for distinct disease types may be very different. (The researchers have again taken this guidance on board.) Finally, some participants urged that the researchers ultimately not decline to offer their own causal interpretations, even though, with the available data, they cannot establish the magnitude of impacts.

Key messages from research papers and workshop discussions

With the facilitation of the co-chairs, workshop participants reflected on the learning that had emerged over the course of the event, both from the research papers and presentations and from group discussions. Each participant was invited to formulate key learning points in writing. The ideas were then reviewed, grouped under a series of emerging thematic headings, and further discussed. Key topics and messages that garnered substantial consensus included the following:

Enhancing human capital through NCD control will yield economic benefits for countries

Countries can reap substantial economic benefits by strengthening their human-capital base through action on NCDs. New research for this initiative suggests the magnitude of possible gains and shows that countries may obtain benefits within relatively short timeframes (1-5 years). Key mechanisms driving the gains include improvements in effective labor supply and longevity.

Better human capital means higher productivity, short- and long-term

Most economic benefits of improved NCD prevention and control will stem from productivity gains. Some benefits will be felt rapidly, as survival and productivity rise among current workers. This initiative is finding evidence that, by reducing NCDs in children and caregivers, countries will also improve human capital and boost productivity in future generations, through improved educational outcomes.

The price of inaction will be high

Successfully controlling NCDs will bring countries major fiscal rewards through human capital gains. Conversely, if countries fail to adequately protect their human capital from NCD epidemics, the economic consequences will be severe—including soaring health expenditures and foregone government revenues. Khadka's and Verguet's "poor-performing" scenario has helped to quantify this threat. The up-front investments needed to manage NCD burdens may be substantial, but they are dwarfed by the costs that loom, if necessary action is postponed (Bertram et al. 2018; Nugent et al. 2018).

Tackling NCDs can reduce poverty and inequality and promote social stability

Analyzing 283 studies, Niessen and colleagues (2018) found overwhelming support for a positive association between low incomes, low socioeconomic and/or educational status, and NCDs, including: tobacco use, obesity, hypertension, cancer, and diabetes. Global health equity gaps are likely to widen further as the share of premature death and disability caused by NCDs rises in LICs and LMICs. Tackling NCDs is an effective way to improve human capital among the least well off, reduce inequalities, reinforce social stability, and ensure that countries fully harness talent from their whole populations, an advantage for competitiveness.

The power of a life-course approach

The focus on specific needs and interventions for adult survival underscores the power of an approach to health tuned to the stages of the life course. This includes gestation, infancy, childhood, and adolescence, with their specific windows of vulnerability and opportunity for developmental processes, as well as the diverse stages of adult life. A life-course perspective is implicit in the analysis of human capital and further enhances human capital's value as a frame for analysis and action on NCDs.

Intergenerational effects

As they affect multiple stages of the life course, so NCD impacts also cascade from one generation to the next. By definition, non-communicable diseases are not transmitted by infectious "bugs" from person to person. But NCDs' negative economic and social effects can spread within households and permeate neighborhoods and communities (Jan et al. 2018). Indeed, one reason why NCDs are so important, in addition to their direct impact on income and well-being, is that adults who are compromised by NCDs may have trouble executing their intergenerational responsibilities to children and the elderly. In this way, NCDs cause human capital losses that perpetuate themselves across generations.

Increased efficacy through action across sectors

DCP3 and other research efforts have highlighted the promise of intersectoral action in NCD prevention and control. NCD prevention strategies, in particular, are vital to build and protect human capital. Priorities include improving child and adult nutrition, promoting healthy mobility, and using excise tax measures to discourage consumption of health-damaging products, most prominently tobacco. For these and many other approaches, collaboration across government sectors is essential for high-impact action on NCDs. Where feasible, a whole-of-government approach may be the most effective way to make progress. Alignment and pooling of know-how among WHO, the World Bank, and other partners at country level may facilitate the delivery of successful intersectoral policies and the evaluation of their impacts.

Toward an "adult survival revolution"?

As this initiative's commissioned studies are disseminated and enrich the NCD and human capital knowledge base, they may help to drive what some workshop participants termed an urgently needed

"adult survival revolution." UNICEF under James P. Grant spearheaded the Child Survival Revolution in the 1980s and 90s, with remarkable impact. Now, some call for a similar global campaign to focus sustained action on improving adult survival, in particular through prevention and control of NCDs.

The idea of a revolution in adult survival and wellbeing could capture the imagination and creativity of leaders around the world, and the human capital lens could enable this transformation.

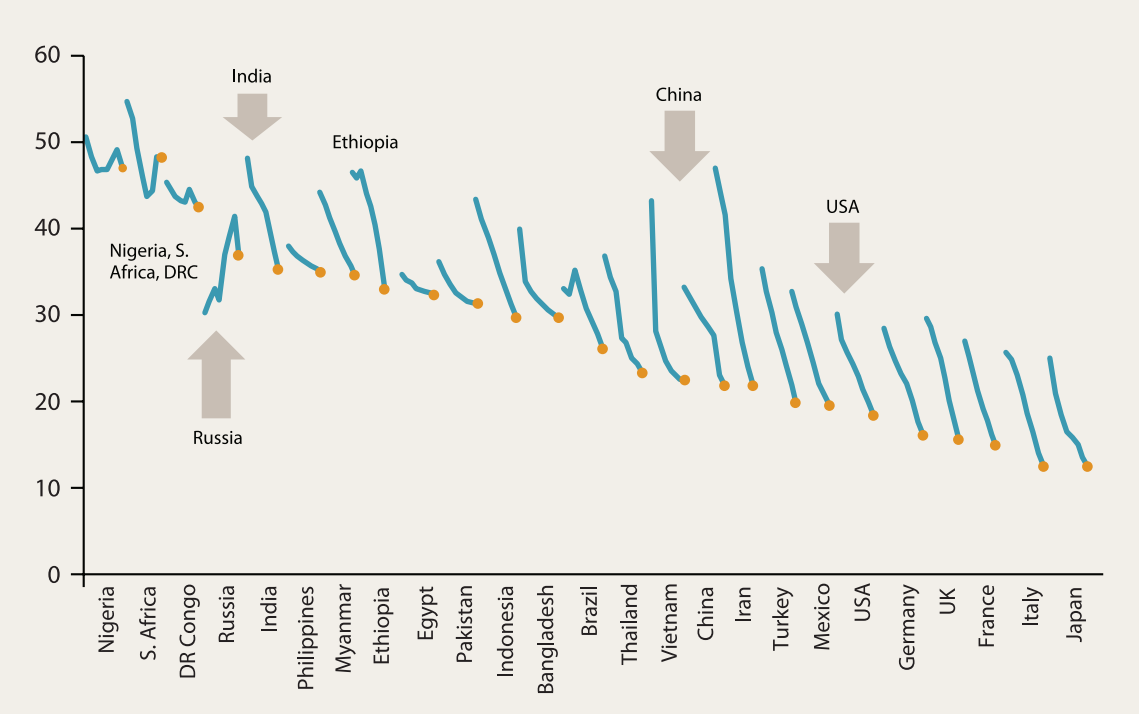
Workshop Day 2, afternoon session

The workshop's final session was co-chaired by **Sir George Alleyne** (PAHO) and **Daniel Dulitzky** (World Bank). Main discussion topics included measurement issues linked to NCDs and human capital; directions for a future research agenda; and the implications of project findings for key stakeholders, including national governments, multilateral agencies, civil society, and the private sector.

Refining measurement tools and strategies

The case for alternate metrics of adult mortality. The analysis of adult mortality from Wu, Jha, and colleagues in Paper 4 provided an entry point for measurement discussions. Given global mortality trends, Wu and Jha argued that the main measure of adult survival now included in the human capital index—the likelihood that a current 15-year-old will die before age 60 ("45q15")—may be suboptimal. The researchers cited evidence that many countries have registered sustained reductions in the likelihood of adults' dying between ages 50 and 69 (Figure 1.8). Global life expectancy is now almost 70, such that a large global population of older adults needs to be taken into account in analyzing health and human capital—beyond what the 45q15 measure can accommodate. On this basis, Wu and Jha proposed, possible future versions of the HCI might consider complementing 45q15 with the 40q30 metric: the likelihood of dying between ages 30 and 69.

FIGURE 1.8 **Trends in the risk of dying between ages 50 and 69 in 25 countries, 1970-2010**



Source: Norheim et al. (2015).

The HCI continues to evolve. Workshop participants appreciated that the HCI is not set in stone and that future enhancements may be possible and desirable. Some argued that, given the acknowledged difficulties in measuring human capital, a valuable activity for the World Bank would be convening a series of broadly inclusive discussions among global experts and stakeholders to systematically work through human capital measurement issues, particularly as they relate to NCDs.

It was acknowledged that, regarding NCDs in the HCI, current concerns are less about the relevance of NCDs than the problem of obtaining a robust, single metric of NCDs, and the possibility of this being reliably sourced in all countries. Some participants emphasized that the HCI is an advocacy tool, not a perfected scientific instrument. It is a means of organizing and communicating information that continues to evolve. The current version, if used strategically, can help get countries and key institutions thinking about NCD investments.

A new metric—the economic burden of disease. Participants observed that research contributions presented to the workshop were helping establish the conceptual and methodologic foundations of what could be a major advance in global health measurement: a rigorous, comprehensive assessment of the global "economic burden of disease." Such a measure would complement the established epidemiologic burden of disease, and would provide crucial information to policy makers.

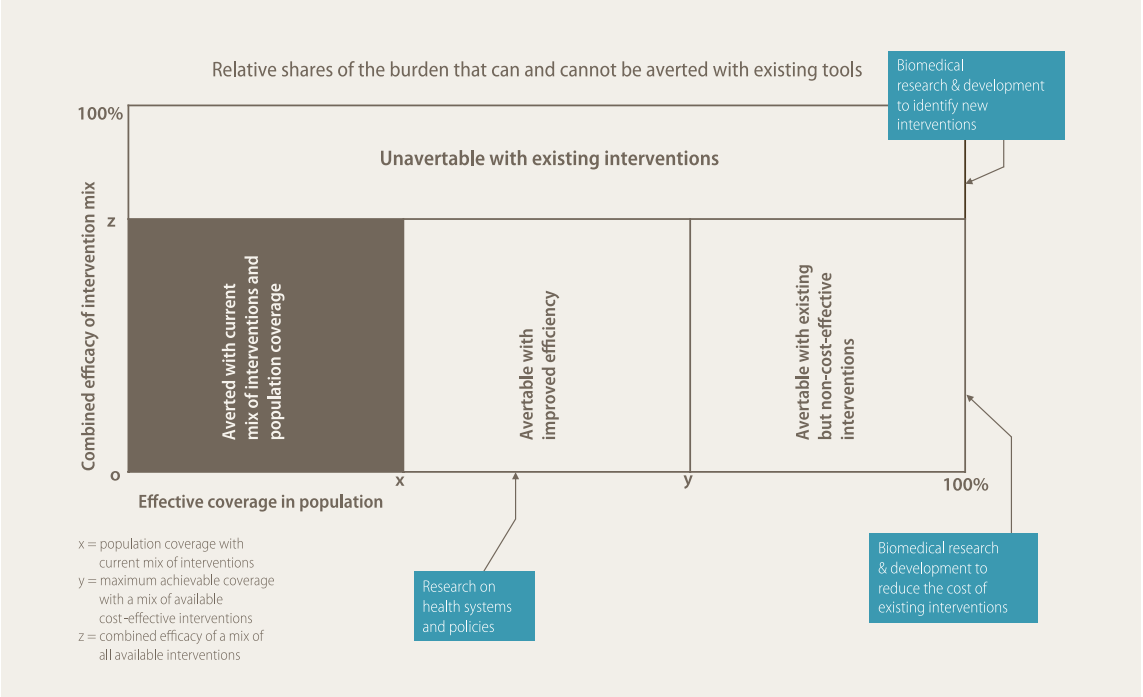
Strengthening measurement systems at country level. The discussion confirmed broad agreement among workshop participants on key principles connected with NCD measurement in countries. NCD data systems should be country-owned and country-led, and reliance on modeling should decrease. An important goal is to nurture NCD measurement systems at country level that are fully integrated with national statistical systems.

Toward a future research agenda

Act now, and keep learning. Participants agreed that countries do not need to await extensive further research before ramping up their action on NCDs. Through resources such as the DCP3 and the WHO Best Buys, an accessible evidence base exists that can guide foundational policy, programming, and implementation choices. Ultimately, however, more research of several types will be needed, to ensure that countries and partners get the best results as they work to strengthen human capital through NCD control.

A systematic approach to setting research priorities. To chart directions for research, proven tools can be adopted, notably the evaluation framework originally developed by Jamison and colleagues for WHO's Ad Hoc Committee on Health Research Relating to Future Intervention Options (1996) and subsequently refined (Jamison 2009) (Figure 1.9).

FIGURE 1.9 Framework for analyzing health research needs



Source: WHO Ad Hoc Committee (1996). For a revised version, see Jamison (2009).

The framework summarizes a systematic process that can enable analysts to identify and evaluate research lines potentially suited to optimize existing interventions, along with those that may yield new interventions to tackle the segments of disease burdens that cannot be averted with current tools.

Emerging research directions. While awaiting systematic analyses, participants anticipated possible broad directions for a future research agenda. Not intended to be exhaustive, the discussion aimed to surface some areas of early promise for subsequent systematic assessment:

- **Measure human-capital gains from NCD action at country level**. Studies sponsored by this initiative plausibly predict substantial economic benefits for countries that effectively prevent and control major NCDs. These analyses call for further empirical verification. In partnership with countries, research should proceed to analyze the impact of NCD prevention and control on Human Capital Index results in a set of countries with reliable data.

- **Clarify NCD effects on productivity**. The negative impacts of NCDs on productivity offer a potent line of argument for engaging ministers of finance and private sector partners. Targeted research can better track and quantify these impacts and map their pathways. The focus is on implementation research and research into the communication mechanisms to ensure reception by policy makers.

- **Put a price tag on passivity**. Additional research can sharpen assessments of the cost of inaction or of maintaining the status quo. Important to this effort will be improved measurement tools to capture the impact of non-fatal outcomes and long-term care.

- **Continue the quest for better metrics**. Collaborative work should move forward to establish robust measurement of the global economic burden of disease. In parallel, WHO and partners could lead a consensus process to construct improved NCD metrics.

- **Close the research gap in mental health**. Mental health conditions and effective strategies to address them have been chronically neglected in research. This applies in particular to mental health challenges in low-income settings. The human capital lens can help spur a new wave of research to: (1) better understand the health and economic impacts of mental health conditions (including their reflection in countries' HCI performance); and (2) accelerate the design, deployment, and evaluation of effective interventions.

RECOMMENDATIONS FOR KEY STAKEHOLDERS

*During the workshop's concluding discussions, with the facilitation of Co-Chairs **Sir George Alleyne** and **Daniel Dulitzky**, participants framed a series of action recommendations for stakeholders in NCDs and human capital.*

National governments

Develop a comprehensive national strategy to reduce the impact of NCDs and the disability they cause on human capital and the labor market, incorporating:

- A whole-of-government approach
- Tailored actions across the life course
- An equity lens
- Link to educational outcomes

Act on the evidence that investments in NCD awareness, prevention, and management can:

- Increase GDP and productivity
- Reduce health spending growth
- Decrease health inequity
- Increase social security

Commit to build decentralized data systems for country-level monitoring of NCDs and tracking of their human-capital impacts

WHO and World Bank (joint action)

- Expand the scope of investment cases to assess the impact of NCD control on human capital
- Launch a new agenda of institutional collaboration on NCDs and human capital, driven from the highest levels of both organizations and anchored in joint work in countries
- Move swiftly to identify a group of countries that want to be forerunners in the NCD/human capital effort; work with countries to develop initial plans, mobilize resources, and jumpstart action
- Engage additional partners and jointly establish a TDR/CGIAR-type research program for NCD interventions, to "bend the cost curve"

WHO

- Adopt and share ownership of the human capital index (HCI). Ensure that all WHO country representatives are fully briefed on the concept of human capital and can inform ministers of health on how prevention and control of NCDs affect a country's human capital
- Disease divisions should use a common template to demonstrate how their work contributes to countries' human capital
- Highlight NCD prevention and control in universal health coverage (UHC). Advocate impact on human capital as a criterion for including conditions in countries' essential UHC benefits packages. Ensure countries know that this criterion argues powerfully for incorporating NCDs and related services in benefits packages

World Bank

- Present the investment case for NCD action in Human Capital Project work at country level
- Help countries to "know their NCD burden"; link with projections and impact on labor productivity and economic growth
- In developing a next iteration of the HCI, host consultations to surface the best approaches for incorporating life-course perspectives, with a focus on NCDs
- Strengthen the analytical underpinnings of multi-sectoral lending operations by systematically assessing NCD impacts on human capital and economic growth
- Support countries to develop robust data systems for tracking and measuring progress on NCDs and integrating NCD data into broader health management information systems

Private sector

- Collaborate in documenting the effects of NCDs on human capital and productivity at the firm level, including issues such as absentee- and presenteeism. Collaborate with academic researchers to design and test interventions to protect and enhance workers' human capital against NCD risks
- Reward "bottom-up" innovation from within firms that generates promising strategies to protect human capital and boost productivity in the context of NCDs
- Individual business leaders, firms, and industry or regional alliances: participate in multisectoral initiatives to reduce NCD impacts on human capital, including Human Capital Project efforts at country level

Civil society

- Advocate for a sustained NCD/human capital focus in the work of WHO, the World Bank, and other multilateral agencies, as well as in national government policies
- Use social media to popularize the concept of preventing and controlling NCDs to protect and enhance human capital. Engage people living with NCDs as leading voices in this effort
- Utilize data on human capital in calls for accountability at country level.

CONCLUSIONS AND WAY FORWARD

Rising burdens of NCDs threaten countries' human capital—their most precious resource for economic development in a fiercely competitive world, where cognitive skills, productivity, and adaptability are the watchwords of success. NCDs compromise countries' present stock of human capital—notably through their impact on adult life expectancy and productivity. Research also suggests that NCDs in children or among their caregivers jeopardize future human capital formation, through potential negative impacts on educational performance. This undermines the talent and productivity of rising generations, denying them the chance to achieve.

This also means that the stakes for countries in successful NCD prevention and control are high, and the potential rewards immense. New research summarized in this chapter shows that tackling NCDs now can bring countries strong economic gains in relatively short timeframes, for example by boosting effective labor supply and longevity. Additional research for this initiative is finding evidence that effective NCD action can also drive improvements in future productivity and economic growth through better educational outcomes. As these findings are confirmed and shared, more and more countries will be able to seize the opportunities.

The human capital lens holds power to transform global action on NCDs. Viewed through this lens, in particular by finance ministries, NCDs cease to appear as a parochial worry for the health sector. They show themselves for what they are: a potent threat to countries' economic future—and an opportunity for countries to reap exceptional economic benefits while improving health.

Following the Toronto workshop described in this chapter, the NCDs and Human Capital Research Initiative entered its concluding phase. In July 2019, a summary of its findings was submitted to the WHO Director-General's High-Level Commission on NCDs. Initiative results and recommendations were reflected in the final report of the High-Level Commission's Working Group 2, on universal health coverage (UHC). One of the Working Group's top policy recommendation urged countries to adopt "impact on human capital" as a criterion in setting essential health benefits packages. This means giving an important place to the prevention and control of NCDs and mental health conditions. Through the Working Group 2 report, early results from this initiative informed the High-Level Commission's final recommendations to the WHO Director-General, and the messages he carried to the September 2019 United Nations High-Level Meeting on UHC.

Investigators completed their analyses and write-ups for the NCDs and Human Capital Research Initiative in the closing months of 2019. Results were later published in peer-reviewed journals and/or incorporated into ongoing research programs, notably at the University of Toronto, WHO, and the World Bank. The research summarized in this chapter has informed the World Bank's Healthy Longevity Initiative (HLI). Several of the investigators whose work is presented in these pages have extended their inquiries and produced additional scientific outputs under the HLI.

An unprecedented window exists for the World Bank, WHO, and other partners to join forces in supporting country efforts to build and protect human capital through NCD prevention and control. The human capital agenda offers a clear rationale for such partnership and provides a natural platform for collaboration at country level and globally. The deadly interaction between NCDs and COVID-19, and the health and economic losses that people and countries have suffered as a result, make this agenda more urgent than ever. Joining forces to advance country gains in human capital, the World Bank, WHO, and partners can power an adult survival revolution and youth capability transformation that will drive gains in productivity, longevity, and quality of life where they are needed most.

REFERENCES

Initiative commissioned studies

1. Arcand, J.-L., and D. Rinaldo. 2019. "Health capital, economic growth and the burden of disease." Draft paper and PowerPoint presentation. Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop. Toronto, University of Toronto Dalla Lana School of Public Health, July 9-10, 2019.
2. Han, S., J.A. Lauer, and J.-L. Arcand. 2019. "The human capital impacts of investing in interventions to reach the SDG-related targets for non-communicable diseases: an analysis of 10 low- and lower middle-income countries." Draft paper and PowerPoint presentation. Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop. Toronto, University of Toronto Dalla Lana School of Public Health, July 9-10, 2019.
3. Khadka, A., and S. Verguet. 2019. "Estimating the longevity benefits of non-communicable disease mortality reductions in low-income countries over 2017-2030: findings from a modeling study." Draft paper and PowerPoint presentation. Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop. Toronto, University of Toronto Dalla Lana School of Public Health, July 9-10, 2019.
4. Roder-DeWan, S., O. Pandey, and A. Mohpal. 2019. "NCDs, education, and human capital: how do NCDs interact with education to affect human capital accumulation?" Draft paper and PowerPoint presentation. Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop. Toronto, University of Toronto Dalla Lana School of Public Health, July 9-10, 2019.
5. Wu, D., J. Veillard, D. Watkins, R. Hum, D.T. Jamison, and P. Jha. 2019. "Measurement and determinants of NCDs and impact on adult survival." Draft paper and PowerPoint presentation. Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop. Toronto, University of Toronto Dalla Lana School of Public Health, July 9-10, 2019.

Additional references

1. Ad Hoc Committee on Health Research Relating to Future Intervention Options. 1996. "Investing in health research and development." Geneva: World Health Organization.
2. Baird, J., C. Jacob, M. Barker, et al. 2017. "Developmental Origins of Health and Disease: A Lifecourse Approach to the Prevention of Non-Communicable Diseases." *Healthcare* 5(1): doi: 10.3390/healthcare5010014.
3. Behrman, J. 1996. "The Impact of Health and Nutrition on Education." *The World Bank Research Observer* 11(1).
4. Bertram, M.Y., K. Sweeny, J.A. Lauer, et al. 2018. "Investing in non-communicable diseases: estimation of the economic and social benefits of scaled-up systems and services." *Lancet* 391: 2071–78.
5. Dasgupta, P., R. Rodin, and F. Chaloupka. 2017. "Economic evaluation of childhood obesity: conceptual framework." WHO Commission on Ending Childhood Obesity. Working paper. World Health Organization, Geneva.
6. Deaton, Angus. 2006. "Global patterns of income and health: facts, interpretations, and policies." Technical report. National Bureau of Economic Research, Cambridge, MA.
7. Flabbi, L. and R. Gatti. 2018. "A primer on human capital." Policy Research Working Papers. World Bank, Washington, DC.
8. Glewwe, P., and E. Miguel. 2008. "The Impact of Child Health and Nutrition on Education in Less Developed Countries." *Handbook of Development Economics* 4.
9. Grossman, M. 1972. "On the Concept of Health Capital and the Demand for Health." *Journal of Political Economy* 80 (2): 223-255.
10. IHME. 2018. *Global Burden of Disease 2017*. Seattle, WA: Institute for Health Metrics and Evaluation. http://www.healthdata.org/gbd/gbd-2017-resources.
11. Jamison, D.T. 2009. "Cost effectiveness analysis: concepts and applications." In *The Oxford Textbook of Public Health*, 5th edition, vol. 2, edited by R. Detels, R. Beaglehole, M. Lansang, and M. Gulliford, 767-782. Oxford: Oxford University Press.
12. Jamison, D.T., L.J. Lau, and J. Wang. 2005. "Health's contribution to economic growth in an environment of partially endogenous technical progress." In *Health and economic growth: findings and policy implications,* edited by G. Lopez-Casanovas, B. Rivera, and L. Currais, 67-91. Cambridge, MA: MIT Press.
13. Jan, S., T.-L. Laba, B. Essue, et al. 2018. "Action to address the household economic burden of non-communicable diseases." *Lancet* 391: 2047–58.
14. Norheim OF, Jha P, Admasu K, Godal T, Hum RJ, Kruk ME, Gómez-Dantés O, Mathers CD, Pan H, Sepúlveda J, Suraweera W, Verguet S, Woldemariam AT, Yamey G, Jamison DT, Peto R. 2015. "Avoiding 40% of the premature deaths in each country, 2010-30: review of national mortality trends to help quantify the UN sustainable development goal for health." *Lancet* 385(9964): 239-doi: 10.1016/S0140-6736(14)61591-9. Epub 2014 Sep 18.
15. Nugent, R., M.Y. Bertram, S. Jan, et al. 2018. "Investing in non-communicable disease prevention and management to advance the Sustainable Development Goals." *Lancet* 391: 2029–35.
16. Pradhan, E., E.M. Suzuki, S. Martínez, M. Schäferhoff, and D. Jamison. 2017. "The effects of education quantity and quality on child and adult mortality: their magnitude and their value." In *Dis-ease Control Priorities*, 3rd edition, volume 8, *Child and adolescent health and development*, edited by D. Bundy, N. de Silva, S.E. Hor-ton, D.T. Jamison, and G.C. Patton. Washington, DC: World Bank.
17. Pradhan, E., E. Suzuki, S. Martinez, M. Schäferhoff, and D. Jamison. 2018. "The Effects of Education Quantity and Quality on Child and Adult Mortality: Their Magnitude and Value." In *Optimizing Education Outcomes: High-Return Investments in School Health for Increased Participation and Learning*, edited by D. Bundy, N. de Silva, S.E. Horton, D.T. Jamison, and G.C. Patton. Washington, DC: World Bank.
18. Strauss, J., and D. Thomas. 1998. "Health, Nutrition and Economic Development." *Journal of Economic Literature* 36(2).
19. Watkins, D.A., D.T. Jamison, A. Mills, R. Atun, K. Danforth, et al.

2018. "Universal Health Coverage and Essential Packages of Care." In *Disease Control Priorities*, 3rd edition, volume 9, *Disease Control Priorities*, *Improving Health and Reducing Poverty*, edited by D. T. Jamison, H. Gelband, S. Horton, P. Jha, R. Laxminarayan, C. N. Mock, and R. Nugent. Washington, DC: World Bank.

20. WHO. 2013. *Global Action Plan for the Prevention and Control of Noncommunicable Diseases: 2013-2020.* Geneva: World Health Organization.
21. WHO. 2018. *Time to deliver: report of the WHO Independent High-level Commission on Noncommunicable Diseases*. Geneva: World Health Organization.
22. Wu, D., E. P. Banzon, H. Gelband, et al. 2019. "Health-care investments for the urban populations, Bangladesh and India" *Bulletin of the World Health Organization* 98(1): 19–29.

ANNEX 1.1

Toronto workshop agenda

AGENDA

Non-Communicable Diseases
and Human Capital
Analytic Work and Key Messaging Workshop -
July 9-10, 2019

University of Toronto
Dalla Lana School of Public Health (DLSPH)
Health Sciences Building, 155 College Street, Room HS208 (2nd Floor)

Monday, July 8th - Arrival of Participants
Hotel: Hilton Toronto,
145 Richmond Street West
Toronto ON M5H 2L2; Telephone: 416.869.3456

Time	Description
DAY 1: Tuesday, July 9th AM Session: 8:15-9:00	*Breakfast and Registration*
9:00-9:15	Co-Chairs: Daniel Dulitzky (WB) and Prabhat Jha (U of T) Welcome and Overview of meeting objectives
9:15-9:45 9:45-10:00	Keynote Speaker: Sir George Alleyne (PAHO) Health, NCDs and Human Capital Questions and Answers (All)
10:00-10:45	Paper 1: NCDs and labour market returns – Jeremy A. Lauer (WHO)
10:45-11:30	Paper 2: NCDs and labour market returns, cross country regression analyses – Jean-Louis Arcand (Graduate Institute, Geneva)
11:30-12:00 12:00-12:30	Discussants for Papers 1 and 2: Prabhat Jha and Sue Horton (U of Waterloo) Questions and Answers (All)
12:30-1:30	*Lunch and Coffee*
PM Session:	Co-Chairs: Erica Di Ruggiero (U of T) and Daniel Dulitzky
13:30-14:15 14:15-14:45 14:45-15:15	Paper 3: NCDs and longevity – A long view: Stephane Verguet (Harvard) Discussant: Dean Jamison (UCSF) Questions and Answers (All)
15:15-16:00 16:00-16:30 16:30-17:30	Paper 4: NCD mechanisms to impact human capital – Daphne Wu (U of T), Dean T. Jamison & Prabhat Jha Discussants: Alexey Kulikov (WHO) and Jeremy Veillard (WB) Questions and Answers (All)
18:00-20:00	Evening Reception and Dinner – Location: U of T Faculty Club 41 Willocks Street Vivek Goel, Vice President U of T; Remarks on Human Capital and Knowledge Generation
Day 2: Wed. July 10th AM Session: 7:30-8:30	*Breakfast*
08:30-09:00	Key Messages from Day 1: Sir George Alleyne (Health perspective) & Dean Jamison (Economics perspective)
	Co-Chairs: Tim Evans (McGill, by phone) and Rachel Nugent (RTI)
9:00-9:45 9:45-10:15 10:15-10:45	Paper 5: NCDs and education effects – Aakash Mohpal (WB) Discussants: Sue Horton Questions and Answers (All)

Time	Description
Day 2: Wed. July 10th AM Session: 7:30-8:30 *(continued)*	*Breakfast*
Toron 10:45-11:00	*Coffee Break*
11:00-12:30	Key Messages and narrative from research papers: Alexander (Alec) Irwin (WB) and All
12:30-1:30	*Lunch*
PM Session:	Co-Chairs: Sir George Alleyne and Daniel Dulitzky
13:30-14:15	Implications of research findings for WB operations: Miriam Schneidman, Jeremy Veillard and Ayo Akala (WB)
14:15-15:00	Implications of research findings for WHO: Alexey Kulikov and Adriana Blanco (PAHO)
15:00-15:30	Next steps and timelines for analytical work and dissemination including Fall 2019 UN Meetings
15:30-16:00	Conclusions and final thoughts: Daniel Dulitzky, Prabhat Jha, Sir George Alleyne
16:00	Meeting concludes, departure for most participants
16:00-17:00	Writing workshop for researchers and writer (researchers and Alec Irwin only).

ANNEX 1.2

Toronto workshop, list of participants

Francisca Akala	World Bank
George Alleyne	PAHO
Jean-Louis Arcand	The Graduate Institute, Geneva
Adriana Blanco	PAHO
Sarbani Chakraborty	Access Accelerated
Pedro Conceicao	UNDP
Erica Di Ruggiero	University of Toronto
Daniel Dulitzky	World Bank
Timothy Evans	World Bank / McGill University
Vivek Goel	University of Toronto
Sue Horton	University of Waterloo
Alexander Irwin	Independent consultant
Dean Jamison	University of California at San Francisco
Prabhat Jha	University of Toronto
Alexey Kulikov	WHO
Jeremy Lauer	WHO
Aakash Mohpal	World Bank
Rachel Nugent	Research Triangle Institute
Miriam Schneidman	World Bank
Daniel Sellen	University of Toronto
Jeremy Veillard	World Bank
Stephane Verguet	Harvard T.H. Chan School of Public Health
Daphne Wu	University of Toronto

2

Towards a Framework for Impact Pathways between NCDs, Human Capital and Healthy Longevity, Economic and Wellbeing Outcomes

Philip O'Keefe[a] and Victoria Haldane[b]

[a] Australian Research Council Centre of Excellence for Population Ageing Research, University of New South Wales
[b] Institute of Health Policy, Management and Evaluation, University of Toronto

INTRODUCTION

This chapter aims to outline a framework for examining the impact pathways between non-communicable diseases (NCDs), human capital (HC), and end outcomes - primarily healthy longevity, inclusive growth, and well-being. It supports the discussion of the various dimensions and their interactions with evidence from a selection of low- and middle-income countries and summarizes policies which may influence those pathways. While the pathways and their linkages with policy are complex, the framework aims to be as simple as possible, but sufficiently open to accommodate multiple factors.

The emphasis to date of the Human Capital Project (HCP) and Index (HCI) has been largely on the years up to age 18. The Healthy Longevity Initiative (HLI) complements this work by taking a whole life course approach, with an emphasis on adulthood and, particularly, later years of life. The HLI also aims to complement the HCP by developing the links between human capital and a wider definition of wellbeing above and beyond the health and work domains. As such, the HLI can be considered in part an effort to extend the HCP across the life course, something the HCP itself is aiming for as it evolves.[1]

In that context, the role of NCDs as important influencers of human capital outcomes in adult life becomes more prominent than a sharp focus only on the earlier years of life.

While already an important social policy priority, the need for raising the profile of the healthy longevity agenda has been made more pressing by the disproportionate and ongoing impacts of the COVID-19 pandemic on people living with NCDs. Indeed, not only do those with NCDs such as diabetes, hypertension, and cardiovascular diseases, and Chronic Obstructive Pulmonary Disease (COPD) have greater risks of morbidity and mortality from COVID-19, but they are also impacted by disruptions in health service delivery and ongoing care. Further, public health and social measures, while necessary to mitigate transmission of the virus, may disadvantage or exacerbate inequities for those with NCDs or older age groups. For example, physical distancing or 'shielding' of older adults or those with NCDs has implications for their well-being, productivity, and human capital trajectories (De Pue et al. 2021).

The structure of the chapter is as follows. First, it outlines the major factors which would need to be considered in any framework, including defining key concepts and highlighting some cross-cutting themes. It then outlines a trajectory of human capital across the life course, before briefly summarizing literature on human capital and growth. It then discusses the relationship between human capital and both growth and country wealth before a more detailed consideration of the key channels through which NCDs may impact inclusive growth. A discussion of distributional and gender considerations follows. It then briefly discusses the impacts of health, and more specifically NCDs, on wellbeing, emphasizing the intrinsic importance of good health above and beyond its instrumental value. In the final section, there is a summary of policies and interventions that are likely to help minimize and manage NCDs and their impact on HC accumulation, deployment, and protection, and thus positively influence the end outcomes of concern. The chapter does not aim to go into depth in specific subject areas, which are covered thoroughly in the background research on HLI presented in this compendium, including on economic burden of NCDs, whole-of-government and whole-of-society approaches to NCD prevention and management, gender, and behavioral aspects of NCD policy, and labor market policies to promote longer productive working lives.

1 The HCP has recently introduced Human Capital Complementary Indicators (HCCI) which are a wider set of HD indicators beyond the HCI components that take greater account of adult outcomes. HCCI vary by country but typically include labor force participation rates by gender, youth unemployment/NEET rates, and life expectancy at birth. https://www.worldbank.org/en/publication/human-capital.

FACTORS IN DEVELOPING A FRAMEWORK, SOME DEFINITIONS, AND CROSS-CUTTING THEMES

In thinking about impacts of NCDs and human capital on the end outcomes of healthy longevity, inclusive growth and wellbeing, the discussion aims to incorporate several dimensions. These include structural factors, which may relate to levels of development, stage of demographic transition, and cultural and social norms. Overlaid on those big picture contextual factors is the policy and institutional environment which will play an important role in shaping the accumulation, deployment and protection of human capital, the extent to which NCDs may compromise human capital, and how human capital feeds through to healthy longevity, inclusive growth, and wellbeing. Behavioral factors also play an important intermediating role between structural and policy factors and end outcomes. In addition, as important as the link between NCDs and HC is, the channels of influence of NCDs on the end outcomes considered in this chapter are not only through HC (see Figure 2.2). For the individual, the life course perspective on how these dimensions come together over time (and across generations) is also an important element of the discussion. In considering these factors, it is useful first to define a few terms. The ***core concepts and their definitions*** *for the purposes of our research are:*

- **Healthy longevity** is produced across the life course and means avoiding death and serious disability in middle age, enabling a high level of mental and social functioning through middle and older ages, and includes a socially connected and reasonably pain-free, short period of time before death.

- **For NCDs**, we focus primarily on cardiovascular disease and diabetes, respiratory diseases, cancers, and mental health.

- **Human capital** as understood within the HCP is, "…the knowledge, skills, and health that people accumulate throughout their lives, enabling them to realize their potential as productive members of society."[2] The education/skills element of HC (often called knowledge capital) is usually proxied by years of schooling (quantity), or where data are available educational outcomes (quality) represented usually by test scores, and skills by years of work experience to proxy on-the-job skill acquisition. Increasingly, some quality-adjusted measure which captures actual learning is preferred (e.g., Hanushek and Woessman 2020), reflected for example in the HCP use of quality-adjusted years of schooling based on harmonized international test scores (Angrist et al. 2021) and other measures such as "learning poverty"[3]. The health element of human capital is commonly analyzed through life expectancy, or by some combination of mortality and morbidity indicators. In terms of measuring returns to human capital, present value of future earnings is the most commonly used measure. This means that the standard measure of returns will have in-built bias towards men in the large majority of developing societies due to lower female participation in market work and gender wage gaps.

- **Wellbeing** as used in the chapter is a subjective concept from psychology with three distinct dimensions: evaluative wellbeing (or life satisfaction), hedonic - or affective - wellbeing (feelings such as anger, happiness, sadness etc.), and eudemonic wellbeing (sense of meaning or purpose) (Steptoe, Deaton, and Stone 2015). It is a key end goal of good health and human capital, as it is of growth and the overall development process.

While the HCP, like many other sources and consistent with the foundational work of Gary Becker, includes health within the definition of human capital, this is not universally the case. The OECD for example defines human capital as "…the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and

2 Health is both an element of human capital as well as an input to producing other forms of human capital (Bleakley 2010), and the same is true for education and skills as influencers of the health element of human capital (Grossman 2015; Heckman et al. 2016).

3 This is a recent concept from the World Bank and UNESCO Institute for Statistics. "Learning poverty means being unable to read and understand a simple text by age 10. The indicator brings together schooling and learning indicators: it begins with the share of children who have not achieved minimum reading proficiency (as measured in schools) and is adjusted by the proportion of children who are out of school (and are assumed not to be able to read proficiently)." https://www.worldbank.org/en/topic/education/brief/what-is-learning-poverty.

economic well-being" (OECD 2019).[4] While health could be included in "attributes", it is at best hidden in such a definition, which is more akin to knowledge capital. Beyond the definitional, a considerable amount of literature speaks to only the knowledge and skills dimension of human capital when discussing the concept and its economic implications, effectively eliding knowledge capital with human capital.

Cross-cutting themes: In the discussion that follows, there are several cross-cutting themes which recur and are useful to highlight at the outset:

- First, that there are *multi-directional relationships* between NCDs and HC, and between them and healthy longevity, inclusive growth, and wellbeing. Crudely, HC and NCDs have a two-way impact on each other, and human capital elements may be affected by levels and rates of growth, healthy longevity, and wellbeing. Given these complex relationships, there has been sustained debate on the extent to which relationships between these variables are causal or only correlates, though progress has been made on clarifying some dimensions of the question.

- A second insight is that, in addition to the individual trajectory of human capital and NCDs, there are important *inter-generational dimensions*. The interactions between the NCD and human capital profiles of parents and their children are significant. This applies not just in transmission of HC and direct well-being effects of health from parents to children when the latter are young. It also applies as parents age and their co-morbidities and disability require increased care from adult children, impacting the returns to their human capital, and their mental health and self-reported quality of life (Lambert et al. 2017; Yiengprugsawan et al. 2022).

- A third important consideration is *distributional*. Within countries, there are clear socioeconomic gradients for incidence of NCDs, with their impact on both HC and directly on well-being. This is separable from the well-known socio-economic gradients for HC overall. Poorer people on average have higher incidence of most common NCDs (Dalstra et al. 2005; Oshio and Kan 2019), lower educational attainment and on-job skills acquisition, and returns to human capital that diverge further from their peers over their shorter life cycle (Deaton and Paxson 1998). While most evidence on socioeconomic status (SES) gradients is from developed countries, increased evidence from developing countries suggests that sharp socioeconomic gradients can also be seen for both prevalence and risk factors in developing countries. In fact, both income and education gradients for NCDs have been found to be even more pronounced in low-income countries than in middle-income countries (Hosseinpoor et al. 2012; Malta et al. 2013; Williams et al. 2018; Allen et al. 2017; Sommer et al. 2015). Apart from SES, an important dimension of inequality when considering NCDs, human capital and healthy longevity is gender (see section on inequality).

- A fourth insight is that the economic impacts of improved health will vary by the *stage of demographic transition*, which in turn is closely related to the level of economic development. Reductions in NCD prevalence will help improve longevity in all countries, but there are variations across stages of demographic transition and levels of development at what stage that translates to lower fertility, increased HC investment in children, and other factors. The differential impacts across stages of demographic transition are observed in overall growth, savings rate effects, and other factors.[5]

- Finally, the *structural and institutional environment* of countries matters for the scale (and even direction) of the relationships between human capital, NCDs, healthy longevity, growth, and wellbeing. This includes institutional factors of a more foundational nature, such as culture and attitudes, but also underlying institutions such as legal systems or protection of property rights (Ac-

4 Measurement of all these attributes will be incomplete, especially when looking at a wide range of developing countries. As a result, as OECD notes, "…there is no comparable and consistent measure across countries reflecting all these elements available." (OECD 2019).

5 The stages of demographic transition used are from the Global Monitoring Report 2015 of World Bank. They are: (i) pre-dividend countries with high-fertility (all LICs); (ii) early-dividend countries where fertility rates have started to fall and changing age structures are conducive to growth (a mixture of LICs and LMICs); (iii) late-dividend countries which have had rapid fertility decline and working age population share will shrink over coming decades (mostly UMICs); and (iv) post-dividend countries with high elderly shares and fertility rates below replacement for several decades (mostly HICs).

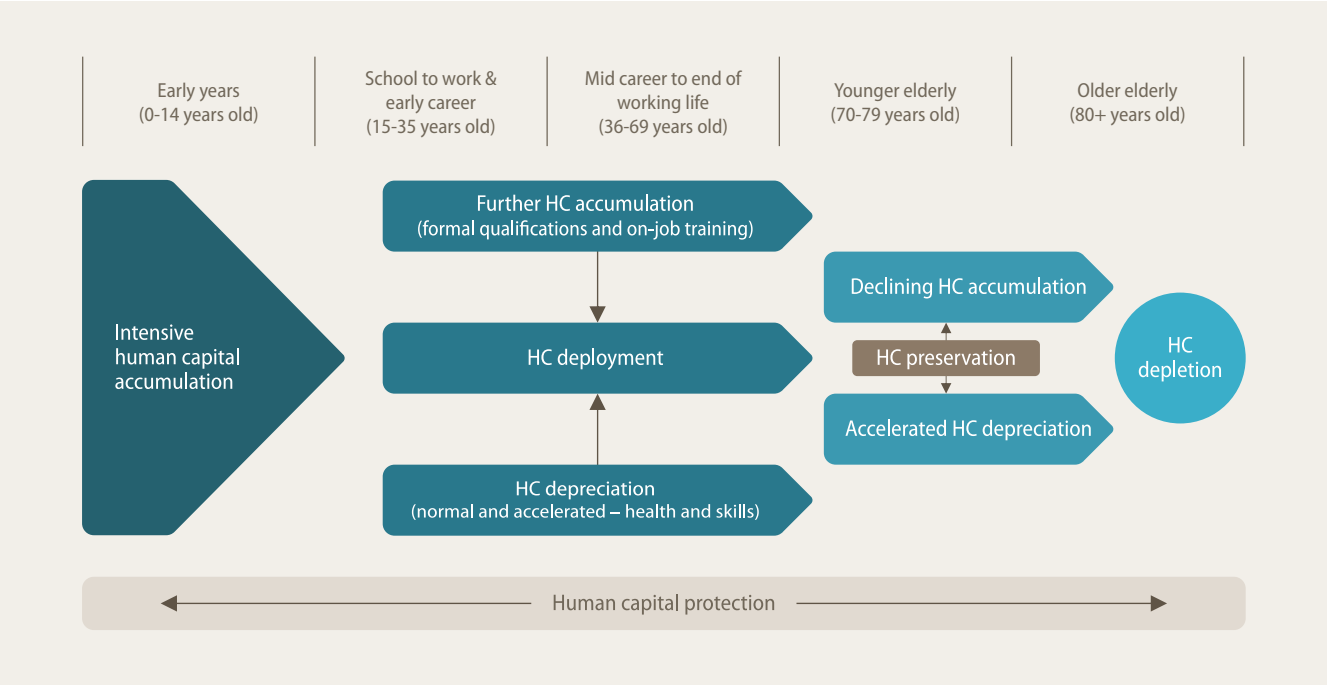
emoglu, Gallego, and Robinson 2014). These are examples of the structural and social factors in the outer circle of Figure 2.1. But it also includes more proximate policies and institutions such as social security systems and labor market policies and institutions, which have differing impacts on the returns to human capital across and within countries and the degree of protection provided to a given stock of human capital. Another is the built environment and the extent to which that facilitates or constrains labor force and social participation for those with functional limitations. It may also include wider issues not traditionally considered in the social sectors such as climate change. Apart from the aggregate influence of structural factors, they also play a role in promoting and sustaining inequalities and discrimination in accumulation, deployment, and protection of human capital, e.g., along gender or racial lines.

- A final important point is that there are significant *wellbeing benefits* from investments in health capital which do not show up in standard measures of returns to HC, which rely primarily on labor earnings. Such non-pecuniary benefits, starting with the intrinsic value of being alive and in good health, have direct bearing on individual and societal wellbeing which are independent outcomes of concern. These have received less attention in the literature, though this is changing in recent years (Steptoe 2019). A starting point of the HLI and this chapter is that health at the individual level, and the (increasingly NCD-driven) burden of disease at societal level, are themselves important measures of wellbeing, over and above their impacts on other outcomes such as productivity and growth. While a good deal of the discussion that follows looks at evidence on the economic impacts of NCDs, this fundamental point on human wellbeing should not be lost sight of. Indeed, wellbeing is a key underlying objective of the development, including economic growth, process. The wellbeing impacts of health are discussed later in this chapter.

The life course trajectory of human capital

Given the life course emphasis of the HLI, it is useful to think of a "normal" human capital trajectory across the life course (Figure 2.1). The broad dimensions of the HC trajectory are formation (also called accumulation), deployment (which in this chapter refers both to utilization of HC and extending the years over which HC is deployed), and protection. Like other forms of capital, HC is also subject to depreciation, a process which may be accelerated by NCDs or structural factors such as rapid technological change. The formation of human capital is most intensive during childhood and adolescence, but also includes ongoing accumulation of HC in adulthood (for example through on-job skill acquisition). Deployment is considered here first as realizing returns to HC but extending the period of deployment – for example through minimizing NCDs, or policies to extend productive working lives – is also important. Protecting HC may take various forms, the most pertinent for the HLI being preventing or reducing the burden of NCDs, but also including policies such as social protection programs which facilitate HC formation or prevent and mitigate the depreciation of HC. Protective policies may also permit a longer period of deployment of human capital, with resultant economic and other benefits. The final stage of the life cycle is one of declining HC accumulation, and more rapid depreciation of human capital, though even at that stage interventions to delay rapid depreciation have an important role to play.

FIGURE 2.1 Human capital life course trajectory



Source: Original figure for this publication

Good health, and particularly reducing the incidence and consequences of NCDs, will be a key driver of slowing human capital depreciation across this cycle. Economic benefits include both standard returns to human capital, which focus on earnings, and the non-market contributions of older people, including their indirect contributions through facilitating the accumulation and deployment of human capital by other family members, e.g., through provision of care to grandchildren.

The human capital life course trajectory is more commonly thought of with respect to knowledge capital, with poor health impacting its accumulation, deployment, and depreciation. However, economists also describe health capital in similar terms, with health as a form of investment of labor and commodities in healthcare with returns in the labor market and beyond (Mushkin 1964; Becker 1964) and viewed as "a durable capital stock that produces an output of healthy time" (Grossman 1972; Arrow, Dasgupta, and Mumford 2014). It depreciates with age, either with natural decline or on a more accelerated basis due to illness and mortality over the life course.[6] Recent work aims to calculate dollar values of national health capital, finding that health capital per capita has increased faster than GDP per capita globally (Arcand and Rinaldo 2019).

Whether looking at human capital narrowly as knowledge capital, or more broadly also to include health dimensions, NCDs can negatively impact human capital at all stages of the trajectory. Conversely their prevention, early detection and effective management can help maximize the accumulation and deployment of HC and avoid or delay its depreciation. The impact channels and evidence on them are discussed in the following sections of the chapter. In short, NCDs in childhood and adolescence (both NCDs of children themselves and the NCDs of parents impacting their children) will negatively impact human capital formation, with consequent negative impacts on its deployment in adult life. NCDs that manifest in adulthood will not impact initial HC formation (or "HC stock at entry" to the labor market), but may impact HC deployment,

6 Health is also viewed as interacting with other forms of capital. One dimension is the role of social capital (or social connectedness) as an important determinant of health (Turner 2003), and another strand of research focuses on the role of cultural capital in shaping the interactions of people with the healthcare system (Shim 2010).

may compromise its further accumulation during working life, and will accelerate its depreciation. During working age, the NCDs of older parents may also negatively impact HC deployment of working age adult children through care responsibilities that lessen labor market participation and opportunities for on-job skill acquisition. NCDs of working age parents may also have additional negative effects on HC accumulation for partners, children, and grandchildren. They will also compromise the ability of older parents to provide care to others. And later in life, NCDs are likely increasingly to accelerate health (and knowledge) capital depreciation. This depreciation may in turn be delayed or mitigated through a range of medical/technological interventions, good nutrition, social connectedness, and other factors, so that human capital preservation is a further important dimension to consider as life progresses.[7] The various impacts of NCDs across the life course will ultimately compromise economic growth, through the human capital channel and macro and fiscal channels. They will also compromise individual wellbeing, both directly and indirectly.

The stylized trajectory of Figure 2.1 comes with a number of caveats, some relevant to comparisons across countries and others to groups of people within countries. First, in developing economies the "normal" life course may be considerably shorter, with the stages of younger and older old age absent or more truncated. Global life expectancy at birth was just over 73 years in 2019 and had risen by six years in the first two decades of the century (WHO 2019) but in many countries it is considerably lower – s low as the early-mid 50s for some LICs. At the same time, global life expectancy at 60 was 83 years in 2019 – a highly relevant complementary indicator when discussing longevity – and healthy years of life expectancy have grown steadily over much of the world (Salomon et al. 2012). A second caveat which distinguishes developed and developing countries is that under-development and/or under-coverage of public pension systems in poorer countries will usually result in a period of HC deployment which extends till much closer to death, as people are obliged to work until they lack the capacity to do so. This is the case even though the physical environments and labor policies that developed countries offer for people with NCD-related conditions and disabilities may allow for longer *productive* working lives than are possible in less enabling environments. A third caveat is that the characterization of older age as largely a period of decline is overly simplistic, increasingly so as healthy years of life expectancy rise and people at any given older age tend to have better average cognitive performance over time, as healthy longevity rises.[8] A growing body of evidence also finds that frailty and cognitive decline are more malleable at older ages than historically assumed. In addition, a facilitating external environment can contribute to higher functioning at any given level of morbidity. Related to this point, a fourth qualification is that most estimates of HC returns fail to value non-market contributions, which will truncate or dilute the HC deployment period, failing to value activities such as informal care provision, volunteer work, etc. A final point, related to the fourth, is that this "normal" pattern has a gender bias to the extent that women are unable to engage fully in market activities during their adult lives. This last bias shows up in most estimates of human capital wealth, with World Bank for example estimating that women account for less than 40 percent of global human capital wealth due to lower labor force participation, lower hours of work when participating, and gender wage gaps (World Bank 2018). Gender aspects are discussed in section on inequality.

7 There is also growing frontier research into not only human capital preservation but active reversal of the ageing processes which contribute to health and cognitive decline (e.g., stem cell and methylation research). While important work, it is not considered here due to the likely lack of current relevance for the developing world.

8 The US National Academies of Medicine's Global Roadmap for Healthy Longevity has a useful summary on the evolution of health and cognitive performance at older ages (NAM 2022).

HUMAN CAPITAL, GROWTH, AND COUNTRY WEALTH

There is a huge literature on the determinants of economic growth and the role of human capital in the growth process. Within this, there is ongoing debate between those who view human capital – largely with a focus on the skills dimension - as foundational for economic growth and those who view it as proximate (North and Thomas 1973). While some authors argue that human capital itself is foundational in the growth process (Easterlin 1981; Glaeser et al. 2004; Gennaili et al. 2013), others argue that the foundations of growth are institutional (or found in other structural factors such as geography or culture), and that human capital is a proximate determinant of growth which is determined by institutions (e.g., Acemoglu, Gallego and Robinson, 2014).[9] Estimates of the level of human capital's contribution to growth vary significantly between the two approaches, with those arguing that human capital is a proximate cause finding much lower returns to human capital (and at levels which are aligned with findings from microeconomic studies).[10] Nonetheless, both approaches find significant impacts of higher human capital on growth. It is also important to emphasize the limitations of focusing solely on growth in country income or wealth, which neglect wider dimensions of wellbeing which are important in considering the benefits of good health and education.

Related to the large literature on human capital and growth is research on the cross-country shares of factors of production in country *wealth*. This is a useful complement to a focus on economic growth by looking at changes in the underlying asset bases of countries, including accumulation, investment, depreciation, and depletion of different elements of national wealth. As a result, it focuses squarely on the sustainability of growth, and also has a relationship to other work under HLI on the economic burden of disease. A recent example of the research on the role of human capital in country wealth is the *Changing Wealth of Nations* (CWON) from the World Bank (Lange, Wodon, and Carey 2018, and World Bank 2021).[11] The importance of human capital in the wealth of countries is striking and rises sharply across levels of development. Globally in 2014, human capital accounted for 64 percent of global wealth. In addition, the correlation of life expectancy to the per capita growth in human capital is stronger than any other factor (Lange, Wodon, and Carey 2018).[12] But the variation across levels of development is striking, with the human capital share of wealth for LICs, LMICs, UMICs and HICs at 41, 51, 58, and 70 percent respectively, emphasizing the increasing importance of human capital in national wealth as countries grow richer. At the same time, the contribution of human capital to *growth* in national wealth between 1990 and 2014 was highest in LICs and UMICs, at around 80 percent in LICs as against 60 percent or lower in other income groupings.

The World Bank estimate of human capital in national wealth is consistent with other global estimates which seek to look beyond economic growth alone. One example is the estimates in the various Inclusive Wealth Reports (IWR) from UNEP which also aim to look at all sources of wealth in an economy, including inter-generational dimensions. Not dissimilar to the CWON estimates, the 2018 IWR estimates that human capital accounted for 59 percent of average national wealth over the period 1990-2014. Of that total, 33 percent was estimated to be education-induced capital and 26 percent to be health-induced capital.

A final important point to note before getting into the discussion of human capital, NCDs, healthy longevity and growth is that there will be significant wellbeing benefits from investments in knowledge and health capital which do not show up in standard measures of returns to HC which rely primarily on labor earnings. These will have direct bearing on individual and societal wellbeing which is an end outcome of concern. The wellbeing impacts are discussed in the section on welfare effects.

The following sections review the literature first on the relationship between NCDs, longevity and growth, and then between education and skills and

9 The debate helps clarify that human capital, like many other things, has important underlying institutional determinants. And those institutional determinants at a given point in time have their own determinants, including lagged human capital, as e.g., the effect of education on political institutions that affect future human capital. This is the societal counterpart of the intra-family inter-generational above.

10 Acemoglu et al. argue that the much higher estimates on returns to human capital in studies which treat it as foundational are driven by omitted variable bias, with the human capital variable reflecting some of the effect of institutions or proxying some unknown variables.

11 The components of national wealth used in the report are produced capital and urban land, natural capital, human capital, and net foreign assets.

12 The other factors modelled include schooling levels, labor force share and growth rate, population growth, government spending, public investment, trade, and inflation.

growth. The channels for NCD impacts on growth are then discussed, notably the savings channel, fiscal channel, and HC channel. The following section then summarizes evidence of the reverse impact of education and work on health and health behaviors, bringing out the bidirectional influences of NCDs and HC.

The relationship of NCDs, longevity and growth

There is a substantial literature on the impacts of health on levels and rates of growth, using macroeconomic, growth accounting, and microeconomic approaches (Jack and Lewis 2009). Two caveats to bear in mind in assessing the literature on the relationship between NCDs and growth are, first, that much of the work has been done on overall health rather than NCDs per se, and second that a good deal of the research does not control thoroughly for underlying non-health determinants of growth (the latter applying similarly on the relationships between preventable mortality or several disability and growth). While the first is a clear limitation, the indicator most often used in macro-level work is life expectancy. While rising longevity is driven by a combination of prevention and control of communicable and non-communicable diseases, increasingly the burden of mortality is NCD-dominated, so that the gap between the economic impact of *overall* health status and *NCD-only* health impacts is falling rapidly over time and is already low in MICs and above. The other point to note is that the relationship may be bidirectional. On the second caveat of failure to control for non-health determinants of growth, important examples would be institutional or structural determinants (see above re Easterly and Acemoglu critiques), failure to control for is likely to upwardly bias estimates of the contribution of health to growth.

In work taking a macroeconomic approach, there has been considerable debate on the direction of causality between better health and higher country income, and to what extent health causes growth (Lewis and Jack (2009) have a useful summary of the diverse strands of literature in this debate). There are real challenges in demonstrating the channels and strength of the health to country income relationship, with technical challenges and variation in identification strategies, and differences in the scale and even direction of estimated impacts of health on growth. Nonetheless, a summary of the literature by Bloom, Kunh, and Prettner (2018) concludes that "...the bulk of research identifies a positive, if often weak, causal link…" between health and growth. At the same time, cross-country work by Kotschy and Bloom (2023) points to the negative impacts of societal ageing on growth rates as the demographic transition progresses.

There is growing evidence that the impact of improved societal health (proxied by increased longevity) on human capital accumulation and ultimately growth differs to according to what stage countries are in the demographic transition to lower fertility rates, and again post-transition according to whether they have reached a very high level of longevity (Cervellati and Sunde 2009, 2015; Bhargava et al. 2001; Hansen 2013; Desbordes 2011). The relationship between life expectancy and GDP per capita exhibits an inverse U-shape and countries tend to follow that curve over time. Bloom, Kunh, and Prettner (2018) summarizes the intuition of this literature as follows: "In pre-transition economies, greater longevity is not associated with greater educational attainment or a reduction in the birth rate. As such, increased survival rates translate into a higher net rate of reproduction", which tends to be a drag on growth. In contrast, "… in post-transition economies, greater longevity is associated with increases in various measures of education and consequently reductions in fertility". However, at very high levels of life expectancy, the relationship to growth seems to become negative again, as large amounts are spent "unproductively" in economic growth terms using expensive medical technology on people beyond working years.

A second approach to exploring the causal nexus between health and growth has been growth accounting, which informs the macro approach with microeconomic estimates of the impact of health on individual productivity and may provide a firmer methodological foundation for understanding the impacts of improved health on growth. The work of Weil (2005) and others (Ashraf, Lester, and Weil 2009 Hsieh and Klenow 2010) find positive, but considerably lower, impacts of health on growth than some of the macro work such as Bloom and others. The HCI builds on the literature on the relationship between health and productivity through incorporation of the adult survival rate from age 15 to 60 as one of its components and estimates that a 10 percent increase in adult survival to age 60 results in a 6.5 percent increase in labor productivity (Kraay, 2018).

The third approach of microeconomic studies looks at household level health factors and their effects on income. This is based on a clear relationship between individual health and incomes but does not capture externalities or general equilibrium effects. Microeconomic studies find positive effects of good

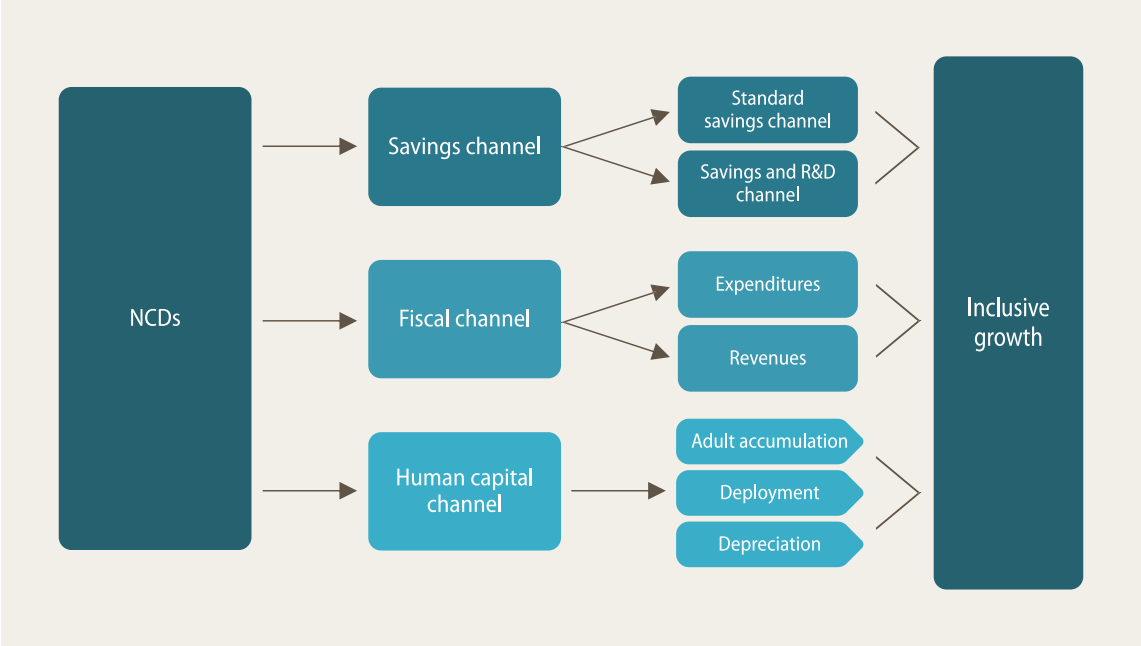
health and nutrition on growth, most notably in early childhood with high economic rates of return on investments. Nonetheless, microeconomic estimates find impacts are "1-2 orders of magnitude smaller than cross-country studies" (Bleakley 2010).

More directly, analyses on the macro-level impacts of NCDs support a negative relationship between NCD prevalence and economic growth. A 2010 study by Stuckler et al. calculating gaps in Millennium Development Goals (MDG) achievement estimated that each 10 percent increase in NCD-related death in a population was associated with a 0.5 percent reduction in annual economic growth. Put in a positive light, Han et al. (2019) in a study of 10 LIC and LMIC countries that a basic package of NCD interventions for the "big four" plus mental health would result in GDP being 0.5 percent higher annually (or 0.7 percent higher per capita) over a five-year time horizon. Looking at specific NCD categories, in HICs, Suhrcke and Urban (2010) and Hyclak, Skeels, and Taylor (2016) find a negative causal effect of cardiovascular disease on subsequent economic growth for 1960–2000 and 2000–2012 respectively. Bloom, et al. (2014) project substantial negative impacts on output in China and India from five major NCDs, primarily through negative effects on labor supply and capital accumulation. Similarly, research from Singapore has projected that the growing prevalence and increasingly early onset of type 2 diabetes amongst the working-age population will have significant impacts on overall economic growth and employment through negative effects on labor force participation (Png et al. 2016). Global studies of diabetes also point to negative impacts on growth; however, the drivers of these vary between HICs where negative effects on labor force participation drive impact, as compared to MICs and LICs where premature mortality from diabetes drives the negative effects on growth (Bommer et al. 2017). Studies of the impact of cancer on growth have similarly shown a negative effect through impacts on workforce participation and productivity (Beaglehole et al. 2011). Estimating the impact of common mental illness on growth is challenging particularly in LMICs, in large part due to a paucity of data. However, there is growing evidence of the negative effect of mental illness on work force participation and productivity, and in turn GDP (Knapp and Wong 2020; Kilian and Becker 2007).

Impact channels between NCDs, human capital and inclusive growth

Looking beyond the overall NCD to growth relationship above, this section reviews in more depth the evidence on the diverse impact channels of NCDs on productivity and growth. It starts with the savings and fiscal channels, then looks in depth at the NCD-HC-productivity and growth linkages across the life course. Figure 2.2 illustrates these channels and their constituent elements.

FIGURE 2.2 Impact channels between NCDs and inclusive growth



Source: Original figure for this publication

i. The savings and investment channel

NCDs may impact savings behavior, which in turn will impact investments in physical capital, a key contributor to economic growth. The net impact on savings of increased longevity comes down to whether behavioral or compositional effects dominate. The behavioral effect is that increased longevity encourages higher savings at all ages as people anticipate longer post-work lives and hence periods of dissaving (Bloom, Canning, and Graham 2003; Kinugasa and Mason 2007; Lee, Mason, and Miller 2000; Doshi 1994).[13] This beneficial impact on savings will be compounded in the earlier stages of demographic transition by favorable dependency ratios. On the other hand, as the population stabilizes with a higher share of elderly people, the positive behavioral effect of people saving more across the life cycle may be offset - and eventually dominated - by the higher share of people in the overall population who are dissaving at older ages (the compositional effect). Apart from these general effects, there may also be more specific effects of NCDs on household savings behavior. Intuitively, if lower prevalence of NCDs increases productive working years, and working years are ones of positive net savings, this effect may itself contribute to higher aggregate savings. In contrast, there is evidence of the dissaving and financial stress impact of smoking (Greenhalgh et al. 2022), but also that smoking in LMICs lowers household level investments in human capital, on average across studies lowering education spending by around 8 percent (Do and Bautista 2015).

For pre-demographic dividend developing countries, the net positive savings effects of increased longevity can be substantial and can persist for 50 years or more, as the experience of East Asia demonstrates (Horioka and Terada-Hagiwara 2012; Li, Zhang, and Zhang 2007).[14] The empirical analysis of Bloom, Canning and Graham (2003) suggests that the positive effect on savings of increased longevity dominates the deterioration in the dependency ratio for a group of 69 largely developing countries, though how different institutional and policy factors mediate impacts is not well understood.[15] In terms of net effects on growth, any potential negative effect on savings from increased societal longevity could be offset by increased labor supply, extending the pay-off period for earlier investments in human capital and reducing the period of dissaving.[16]

An additional – though less direct and more speculative - channel is the impact of increased longevity on technological progress, which has increasingly been recognized as an important source of growth since the work of Romer and others (Romer 1990; Aghion and Howitt 1998). In such models, increased longevity positively impacts technological progress (and ultimately long-run growth) through higher savings which in turn drive down equilibrium interest rates and increase incentives to invest in R&D. An additional way of looking at the impact on R&D investment, linked to how addressing NCDs increases human capital, is that parents who invest more in the education and health of their children help create a deeper human capital stock which is ultimately a key input to the R&D sector (Baldanzi, Bucci, and Prettner 2017).

ii. The fiscal channel

While much of the discussion on the impact of health and education on growth and productivity focuses on individual or household level effects, NCDs may also have fiscal impacts, both on the expenditure and revenue sides. Higher NCD incidence is likely most obviously to increase the need for public spending on healthcare services, and also aged care services in countries where those are financed in part by governments. How much healthcare spending on NCDs increases relative to outcomes will be a function of the efficiency of that spending (on which there has been major efforts to refine "best buys" and cost-effectiveness of interventions by WHO and others). Those cost-effective

13 Though Bloom, Canning, and Graham (2003) find that the increased savings effect may be non-linear across the life cycle and was most pronounced up to age 65 in the early 2000s, suggesting that the positive impact of increased longevity on savings rates will be more pronounced in countries with initially lower life expectancy. The life cycle hypothesis underlying this effect may also be diluted where there are adequate and high coverage public retirement income systems.

14 Though the caveat on non-health determinants of growth and savings probably applies unusually strongly to East Asia.

15 There is also a gender dimension to this given the disproportionate burden on women for care of older frail parents and/or children with NCDs. To the extent this compromises their ability to undertake market work, it would result in lower income and ultimately savings.

16 This effect may be constrained in more formalized economies by mandated retirement ages or other incentives for retirement at particular ages.

interventions, in particular to take steps from early in the life cycle to reduce the incidence of NCDs, represent an important effort to bend the cost curve downward. To the extent that NCDs nonetheless increase public expenditure and budget deficits, that results in increases in public debt and requires higher interest payments to those purchasing the government bonds that finance the deficit (i.e., higher bond yields). It may also lead to crowding-out of private sector investment. While fiscal deficits need not be negative for growth if debt finances productivity-enhancing investments in physical or human capital (and are a standard part of a Keynesian arsenal), the experience of 2022 has demonstrated that persistent rapid increases in fiscal deficits and resultant public debt may have serious consequences for growth, inflation, and capital markets.

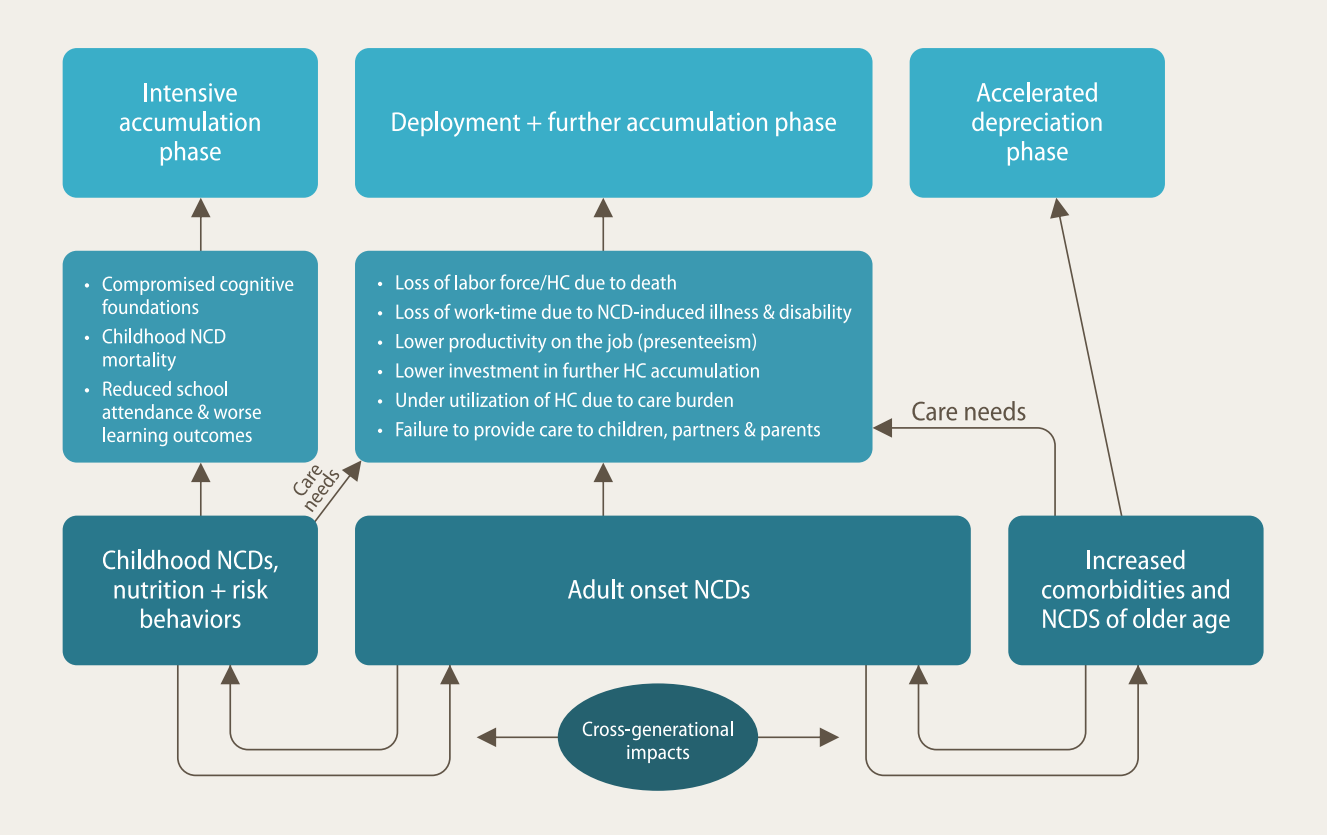
The other fiscal channel is on the revenue side. The budgetary impact of a package of NCD prevention programs can be significantly mitigated by including taxes on tobacco products, alcohol, and sugar-sweetened beverages (SSB), which produce revenues as well as longer term contributions to health and to productivity and growth (Summan et al. 2020). As discussed in more detail below, tobacco taxes, in particular, have been shown to be highly effective in reducing smoking, so reducing illness and death from a range of respiratory and cardiac diseases and cancers. There is also increasingly strong evidence for the revenue and health benefits of taxing alcohol and SSB (The Task Force on Fiscal Policy for Health 2019). For the longer term, to the extent that NCDs compromise workforce participation, that will reduce revenues from labor income, either entirely where people fail to enter or withdraw prematurely from the labor force, or at the margin where they are working fewer hours over time. To the extent that NCDs compromise productivity while at work rather than participation or hours worked, the negative revenue impact is likely to come through the firm profits and corporate tax channel rather than labor taxes.

iii. The human capital channel

There has long been an intuition that greater longevity leads to investment in more years of schooling in the anticipation of a longer dividend period on the initial years of educational investment – the so-called "horizon effect" (Ben-Porath 1967). Increased longevity is of course driven by a combination of communicable and non-communicable diseases, but increasingly the burden of disease is NCD-dominated. While micro-level analysis has found a robust causal relationship between increased life expectancy and higher human capital (e.g., Jayachandran and Lleras-Muney 2009), macro analysis differs between those who confirmed a similar positive causal relationship at the macro-level (Lorentzen, McMillan and Wacziarg 2008; Bloom, Canning and Sevilla 2004) and those who argue that increased population growth in response to increased longevity results in a negative causal relationship once changes in *per capita* income levels are taken into account (Acemoglu and Johnson 2007). In any event, global life expectancy has been on a steady increase for decades, from around 51 years at birth in 1960 to 73 years by 2019 (with a small drop due to the COVID-19 pandemic after that). It is instructive to look at the impact of NCDs on human capital across the life course. This allows us to understand how NCDs impact different aspects of the human capital trajectory (formation/accumulation, deployment, depreciation, and depletion, with protection a common element across the life course) and with differing intensity. Annex Table 2A.1 is a stylized mapping of life course stages, human capital trajectory, NCD patterns and impacts of NCD patterns on human capital across the life course.

The following sections discuss these relationships across the life cycle in more detail. They are summarized below in Figure 2.3 across the NCD and human capital life trajectories. Two important points to note are: (i) there are important interactions of NCD status and HC outcomes across generations in addition to the direct impacts of NCD on the human capital of individuals; and (ii) there is often a two-way relationship between NCDs and human capital which can make causal channels hard to determine with confidence.

FIGURE 2.3 Impact channels between NCDs and human capital across the life cycle



Source: Original figure for this publication

a. Gestation, early years, and childhood (Conception - 14 years)

For both NCDs and human capital formation and its trajectory over the life course, pregnancy and early years of life are critical, both in the short-term and the long-term. While for most people NCDs only manifest in adulthood, pregnancy and infancy crucially influence the risks of NCDs in childhood and adult life, with attendant impacts on human capital accumulation deployment and depreciation (Heidari-Beni 2019; Shrimpton and Rokx 2012).

Starting prior to birth, inter-uterine growth restriction (IUGR) affects 10–15 percent of all pregnancies worldwide, and may be of maternal, placental, or fetal origin. Whatever the causes of IUGR, it is increasingly clear that it makes affected infants more susceptible to a host of NCDs later in life, including cardiovascular and renal diseases, metabolic disorders including non-alcoholic fatty liver disease, metabolic syndrome and type 2 diabetes and chronic lung disease in adulthood (Armengaud et al. 2021; Kruger and Levitt 2017). Distinct from IUGR, low birthweight is associated with an increased risk of NCDs in childhood and in adult life, including for the latter diabetes, hypertension, cardiovascular disease, and neurological disorders.[17] In addition, "… the associations between low birthweight and NCDs can be transmitted across generations, even in the absence of further adverse exposures, such as maternal malnutrition" (Nyirenda and Byass 2019).

In the early years after birth (particularly up to age 3 but for this discussion 0-5 years old), NCDs and HC exhibit a mixture of short- and longer-term impacts and inter-relationships. The first short-term issue is the incidence of childhood NCDs. This is a

17 The relationship between low birthweight and diseases in adulthood is known as the Developmental Origins of Health and Disease (DOHaD) hypothesis (Hanson and Gluckman 2014).

significant and growing health burden in itself, with around 20 percent of childhood deaths and around 42 percent of DALYs due to NCDs (WHO 2016; Proimos and Klein 2012; Gore et al. 2011; Patterson et al. 2019 re childhood and adolescent diabetes; Chatenoud et al. 2010 and Bertuccio et al. 2020 re childhood cancers; McCoy et al. 2005 re asthma). This represents an enormous loss of human potential globally.

Childhood under-nutrition has major well-documented impacts on both NCDs across the life course and human capital formation and deployment. Over the long-term, early under-nutrition significantly increases susceptibility to NCDs in adulthood, including CVD, type 2 diabetes, obesity, and hypertension (Karokochuk et al. 2018; Shrimpton and Rockx 2012; Black et al. 2013; Victora et al. 2008). It also has strong negative impacts on neurological development and cognitive performance, compromising the foundations for learning in childhood and potentially over the life course (Nyaradi et al. 2013).

Increasingly, interventions for promoting better childhood nutrition need to focus on the double burden of malnutrition, i.e., not only undernutrition but also childhood overweight and obesity which has become a growing epidemic in developing countries due to changes in food systems, lifestyles, and other factors (Abdullah 2015; Popkin et al. 2020). Childhood obesity is a direct cause of childhood NCDs and co-morbidities which usually manifest in adulthood (Pizzi and Vroman 2013; Finkelstein, Graham, and Malhotra 2014). It may also contribute to poor socialization and poor learning. Like under-nutrition, it is also a strong predictor of both obesity and a range of NCDs in adulthood, with associated health costs and lost productivity. Finally, there are inter-generational effects with parental obesity linked to obesity of children (WHO 2015 for a summary of evidence).

As children move into school years (around 5-14 years old for this discussion), the interactions between nutritional status and the educational dimension of human capital formation become more evident and are well documented. The literature on childhood NCDs and educational performance is thinner but shows clear negative effects. Work for this project finds that in India and the UK NCDs are correlated with lower school enrolment, for some countries attendance, and strongly impact educational attainment, the key human capital outcome. Children with NCDs were also found to be less likely to be employed as adults and to work less when they are employed, thus influencing future earnings and on-job human capital accumulation. This echoes work on negative impacts on educational indicators for specific NCDs such as diabetes, asthma and epilepsy (Wodrich and Cunningham 2008; Meng et al. 2013), and of mental health conditions such as ADHD (Currie and Stabile 2006).

Apart from the health and nutritional status of children themselves, there are important associations between parental health and HC status and the health, cognitive and educational outcomes of children. There is an important gender dimension of improved adult health in women and strong inter-generational spillover effects on children's health, as well as an interaction of child health with education (Bhalotra and Rawlins 2011; Field et al. 2013). There is a well-developed literature on the correlations between overall maternal health and various child development outcomes, including birth weight, survival, cognitive development, schooling performance, adult health, and productivity (Bloom, Kuhn and Prettner 2015). While the impacts of paternal health on children's outcomes are less studied, there are obvious channels such as loss of household income on children's dietary diversity and nutrition, as well as documented negative impacts on children's health from paternal risk factors such as smoking (Oldereid et al. 2018).

While the literature on the impact of NCDs specifically on child health and human development outcomes is somewhat thinner, available studies on parental NCDs and child outcomes are consistent in finding negative impacts of maternal NCDs on child health and human capital development (see Onarheim et al. 2016 for a systematic review). Jayachandran and Lleras-Muney (2009) also provide evidence from Sri Lanka that increases in female adult survival rates led to differential increases in the education of girls over boys. The picture on mental health is somewhat more mixed, though meta-analysis of studies from developing countries finds that maternal depression is associated with early childhood underweight and stunting in early years – and thus with NCD likelihood in adult life (Surkan et al. 2011), and in high income countries has negative effects for offspring health, behavior, and psychosocial functioning (Propper, Rigg, and Burgess 2007).[18] For more

18 Paternal mental health during pregnancy, early years and adolescence also appears to affect the development of children, but contextual mediators strongly affect the strength of the association (Sweeney and Macbeth, 2016).

acute mental illnesses, the negative effects on child mortality and morbidity are clear (Webb et al. 2005). There is also a longer-run macro channel of impact through fertility and education, with the transition from a low equilibrium "poverty trap" of high fertility and low educational investment in pre-dividend countries to a new situation of declining fertility and increased educational investments in early dividend countries and beyond (Bloom, Kuhn and Prettner 2015; Onarheim et al. 2016; Victora et al. 2008).

In the formative years of life, the role of social assistance in both promoting human capital accumulation and protecting it has increased markedly in the developing world over recent decades. In terms of promoting human capital accumulation, there is solid and growing evidence of the positive impacts of social assistance transfer programs (both food and increasingly cash) on a range of human development/capital outcomes. This includes vaccination, use of maternal and child health services, child and maternal dietary diversity and other nutritional outcomes, and school attendance (Bastagli, Hagen-Zanker, and Sturge 2016; O'Keefe et al. 2022).[19] These beneficial impacts have been found in both unconditional and conditional transfer programs.[20] Given that such programs are often targeted on the basis of need, the benefits in most cases accrue in a progressive manner, though exclusion errors in targeting often limit programs having as widespread an impact as intended. In terms of protecting human capital, transfer programs have similarly helped to reduce negative coping mechanisms such as school drop-out and child labor.

b. Impacts of NCDs during school-to-work transition and working ages (15 – 65 or 69 years)

In addition to the evidence on childhood NCDs and their impacts, NCDs which manifest in adulthood negatively impact labor force participation (and thus returns on a given stock of human capital), as well as further human capital accumulation during working life. Reductions in NCD-related mortality and morbidity in adulthood will thus raise the returns to the productivity of educational investments (Mushkin 1964; Bleakley 2010; Bouncekkine, de la Croix and Licandro 2002). NCDs in adulthood may also accelerate depreciation of human capital in different ways. Some of these impacts are fairly self-evident and others less so. Mushkin categorizes the three impacts of poor health on labor product as due to death (resulting in loss of workers altogether), disability (lost work time) and debility (loss of productive capacity at work). The relative likelihood and intensity of different impacts will vary over the life course for the individual and over time for the society as the average age of workforces increases. Figure 3 summarizes some of the key channels in which NCDs may negatively impact accumulation, deployment, and depreciation of knowledge capital across the HC trajectory. These are discussed in turn in this section. Annex 2.1 provides a more detailed mapping of the human capital trajectory and its interactions with NCDs across the life cycle.

This is also a domain where structural factors and labor market policies and institutions will matter a great deal. For example, a health condition which may be completely disabling so far as ability to work and earn in one society may have more limited or even negligible impacts in societies which have accommodative workplaces and labor practices, or in occupations which are less physically demanding. To the extent that NCDs impact physical capacity, their impacts may for example be expected to be more acute in low-income countries with greater prevalence of manual labor in agriculture.

- The most obvious impact is the ***labor supply and human capital loss from premature mortality due to NCDs***.[21] Given that over 40 percent of

19 See also Handa et al. (2018), Baird et al. (2014), García and Saavedra (2017), Petrosino et al. (2014), Snilstveit et al. (2016) for cash transfers.

20 There is long-running debate on the pros and cons of conditioning transfer programs. While there is evidence that conditioning has in some countries resulted in somewhat better human development outcomes than UCTs, in many developing countries there are issues of supply side availability of services, administrative capacity to monitor compliance with co-responsibilities and other factors which caution against strict enforcement of compliance. These supply-side challenges have led to increased interest in "cash-plus" transfer programs where the transfer is accompanied by social and behavioral change programs and other complementary interventions, but where participation of beneficiaries is nudged rather than strictly enforced.

21 WHO estimates around 42 percent of NCD deaths occur before 70 years old, an age at which substantial shares of the labor force continue to work in low-income countries in particular. Of these, an estimated 1·7 million (4 percent of NCD deaths) occurred in people younger than 30 years of age, and 15·2 million (38 percent) in people aged between 30 years and 70 years (Bennett et al. 2018). For the EU, OECD estimates that premature death due to NCDs corresponds to a rate of about 200 per 100,000 population in the age group 15-64 (OECD, 2016). See also Sweeney et al. (2015) for estimates of the economic cost of premature NCD mortality for 12 largely developing countries.

NCD deaths occur before age 70, they represent a major loss in total labor supply and thus human capital globally. The relative importance of this impact channel is increasing over time as the average age of labor forces rises. The economic impact of premature mortality is also projected to increase more quickly over time relative to impacts from morbidity (Sweeny, Rasmussen, and Sheehan 2015). The value of that lost labor output (HC deployment) will vary according to labor force participation rates and un- and under-employment rates (with significant gender differentials also) but is an obvious drag on productive potential and a reduction in returns to the human capital of workers who die prematurely from NCDs. There is also an economic impact of not being able to provide care for children, partners, and older parents.

- The next channel is ***reduced returns to human capital from NCD-based morbidity and disability*** resulting in reduced labor input and/or worker productivity. Available estimates suggest that this is a notably higher economic impact than premature mortality from NCDs, though this is less likely to be the case in some of the poorest countries with the highest premature mortality rates and lower productivity workforces (e.g., Sweeny, Rasmussen, and Sheehan 2015). Reduced returns to HC may take the form of complete non-participation in the labor force (or early withdrawal), unemployment, lower hours worked, absenteeism and "presenteeism" (being at work but less productive due to NCDs), delayed return to work, and, for formal sector workers, sick leave. These impacts may be measured in terms of DALY totals or shares lost, or monetized output losses. While evidence is largely from developed countries, the economic losses through this channel appear to be substantial.[22] There also appear to be gender differences in how specific NCDs impact labor market outcomes, with for example high BMI having more negative impact on women's labor market outcomes than for men, and diabetes having higher negative impacts for men (Chakraborty, Wu, and Jha 2024). Focusing first on non-participation and unemployment, perhaps the best documented NCD group is mental health and substance abuse, with strong relationships between poor mental health and unemployment. Across the OECD, people with mild to moderate mental illness, such as anxiety or depression, are twice as likely to be unemployed, and that can rise to as high as seven times with severe mental illnesses. The stigma around mental health has been shown to impact hiring and job loss, and to involve a self-stigma element which constrains job search (Brouwters 2020). Substance abuse both increases the chances of being unemployed and is more likely to occur among those who are unemployed, creating a vicious cycle (Henkel 2011). Apart from mental health and substance abuse, the limited number of studies from developing countries also show negative labor market impacts of specific NCDs such as diabetes (e.g., in Mexico, there was a 7.7 and 6.3 percent reduction in probability of being employed for men and women respectively for those with self-reported diabetes, though no significant impact on hours worked or wages, Seuring et al. 2019).

  Variations in approach and accounting make rigorous comparison or aggregation challenging, and the limited developing country evidence points to significant diversity in the impacts of different NCDs on labor force productivity across countries. The economic impacts of presenteeism in particular have proven difficult to measure and compare, with differing methodologies, variable impacts according to welfare regimes and other factors leading to highly variable estimates of impacts (Mattke et al. 2007; Cancelliere et al. 2011).[23] A literature review concludes that "the biggest problem remains the lack of an established and validated method to derive monetary estimates of the cost of lost productivity" (Garrow 2016), and Schultz et al. 2009 caution against assigning dollar amounts to presenteeism losses. Accepting these substantial caveats, one study for 12 mostly developing countries finds the economic impacts of NCDs due to absenteeism and presenteeism in 2020 to be between 0.9 and 1.6 percent of GDP annually for absenteeism, and between 2.6 and 3.7 percent of GDP annually for presenteeism (Sweeny, Rasmussen, and Sheehan 2015).

  The gender dimension of these impacts is also

22 One systematic review found that g less than 4 percent of studies from developing countries (Chaker et al. 2015).

23 Mattke et al. (2007) describe three broad approaches to measuring presenteeism: assessment of perceived impairment by employees; comparative productivity, performance, and efficiency measures; and estimates of unproductive time while at work.

important to note. Globally in developing countries, labor force participation rates of women are significantly lower in paid employment than those of men. The participation gap is exacerbated by the gender wage gap. One accounting effect of this is that reduction in measured returns to human capital from NCDs among women overall will be systematically lower than for men. At the same time, Bloom et al. 2015 show that healthier women are more likely to be in formal sector employment, with higher earnings and productivity than either informal work or no market work. An important second order effect is that women in formal employment tend to have fewer and better-educated children, so the economic and social benefits of averting NCDs are inter-generational. The gender inequalities in different dimensions of human capital are discussed in detail in section on inequality below.

- A third channel is the ***reduction in further accumulation of human capital*** during working life from both the *direct* impact of NCDs on labor input and quality of labor input (and hence work experience and on-the-job learning), and the *indirect* behavioral impacts on subsequent effort to accumulate human capital and changes to saving and other behaviors (Capatina et al. 2020; Smith 2004; Hokayem and Ziliak 2014). Firstly, with respect to the direct impact, substantial human capital accumulation occurs on the job, through learning-by-doing and/or structured training and skill upgrading (see Program for International Assessment of Adult Competencies (PIACC) publications of various years[24]; Ma, Nakab, and Vidart 2022). Secondly, the indirect effect on further human capital accumulation has been less studied but appears to be substantial. The logic is that those experiencing poor health or significant health shocks will anticipate reduced future labor supply and thus lower future returns to their current human capital investments, disincentivizing such investments. The extent to which health shocks from NCDs impact earnings over the life course is also likely to vary according to the chronicity and the unpredictability of symptoms of different NCDs (Heckman and MaCurdy 1980). Estimates for the US show that around 40 percent of the loss in remaining lifetime earnings from a major persistent health shock is due to the indirect effects of reduced human capital accumulation after the shock (Capatina et al. 2020). Just as interestingly, the same analysis finds that two thirds of the impact of health shocks on inequality of subsequent lifetime earnings is due to the behavioral effects rather than the direct impact of the health shock itself.[25] Both direct and indirect impacts would be expected to have a compounded effect where NCDs induce multiple health shocks over time.

- NCDs can also contribute to accelerated ***depreciation of human capital.*** This may be primary/direct, where NCDs in the working age person result in long spells of unemployment or withdrawal from the labor force. While not easy to measure, carefully done work finds evidence of skill depreciation from periods out of work (Dinerstein, Megalokonomou, and Yannelis et al. 2020; Laureys 2021). With respect to health capital, the impact of NCDs and poor health is obvious. Alternatively, the impact may be secondary/indirect, whereby absenteeism and presenteeism accelerate the normal depreciation in human capital that has been observed to happen over time for healthy workers.

- Depending on the severity of NCDs during normal working age, there may be negative ***spillover effects on other adult family members and children***. For children, this is discussed above, and there are clear negative spillovers of parental NCDs on children's human capital development. For prime age adults reducing work or withdrawing from the labor force due to NCDs, the net impacts are less clear. There may be an added worker effect where other adult(s) in the household who were not in the labor force prior to the NCD shock take on market work to offset the loss of income from the withdrawal of the breadwinner (Lundberg 1985) but this depends on care needs and options.

c. Later life (66 or 70 years – death)

The later stages of life present a quite distinct trajectory of both NCDs and HC, and their inter-relationships. From the NCD perspective, prevalence increases, and co-morbidities are more frequent. ADL/IADLs are increasingly compromised for

24 Full database of publications available at: https://www.oecd.org/skills/piaac/publications/

25 Though the analysis factors in access to social insurance in the US, which may have differential impacts on low skill workers than high skilled.

many and may become disabling conditions beyond a certain point. The risk of age-related NCDs such as dementia also increases sharply, as well as depression related to social isolation. From the human capital perspective, the educational/skills element of human capital accumulation decelerates (and eventually stops) and depreciation accelerates, while returns on human capital according to standard measures diminish or cease with withdrawal from the labor force (though this reflects the limitations of standards measures of returns to human capital rather than implying that older people outside the workforce make no contribution to their households or society).[26] Protection of the health dimension of HC becomes ever more important, aiming for compression of morbidity.

The inequality dimension is also on average more acute, as the cumulative deficits of a lifetime for those at lower ends of the socio-economic gradient come home to roost in the shape of higher co-morbidities and shorter life expectancy and lower incomes (Deaton and Paxson 1998; OECD 2017), but also commonly having to "work till one drops" out of financial necessity, lack of old age financial protection from formal pension schemes and inadequacy of social assistance benefits, and lack of affordable formal aged care or other unpaid care options. In poorer countries, a positive factor is high multi-generational co-residence, which facilitates mutual caregiving across generations, though tends to decline steadily as countries get richer (Evans and Palacios 2015).

The inter-generational element of the human capital and NCD interaction is crucial at this life stage. The most common negative impact of advancing NCDs is diversion of adult children/children-in-law from market work in order to provide care. The obligation for care falls disproportionately on women and has diverse impacts on their labor market participation depending on prior status and the extent to which care demands have major impacts on capacity for market work or are more modest and manageable (Moreira da Silva 2019). But there is significant potential for lower returns to the existing stock of human capital of adult family members and stalled accumulation of further human capital. The impacts can be direct (care needs and time for the older parent) and/or indirect (older parents no longer able to care for grandchildren and the care responsibility falling again to the "sandwich generation" parent). These social dynamics are well understood anecdotally, but for developing countries have only in recent years been better researched with the spread of HRS-style household surveys which quantify time and opportunity costs and benefits of informal care provision (e.g., CHARLS in China, SAGE surveys[27] in India and other countries).[28] The gender dimensions of care burden and the resulting under-utilization of women's human capital is discussed more in section on inequality below.

Impacts of human capital and work on NCDs, overall health and health behaviors

There is more debate about the extent of causality in the other direction – from human capital (accumulation, deployment and depreciation) to NCDs. There is less evidence on the effects of education on NCDs specifically in developing countries, but more evidence of education gradients and impacts on general health and NCD-related risk behaviors. The excellent summary by Grossman (2015) concludes, "...many studies suggest that years of formal schooling completed is the most important correlate of good health. There is much less consensus as to whether this correlation reflects causality from more schooling to better health" (Heckman and Karapakula (2019); Heckman, Humphries and Veramendi (2016); Conti, Heckman and Urzua (2010); Cutler and Llera-Muney (2006). He reviews the literature which addresses these challenges in various ways: by introducing omitted variables; by examining environmental factors (in twin studies); and through use of instrumental variables. As a starting point, there are consistent education gradients with respect

26 The standard measures of economic output have well-known limitations in this regard, with non-market contributions of older people (such as caring for grandchildren or volunteering) not being valued either directly or implicitly in terms of their positive impacts on the labor force participation of adult children. The HLI program will examine this in the context of women's non-market work and its valuation. The insights from this will also be relevant to the non-market contributions of older persons.

27 WHO Study on Global Ageing and Adult Health (SAGE). https://www.who.int/data/data-collection-tools/study-on-global-ageing-and-adult-health.

28 ILO estimates that on average women around the world perform 4 hours and 25 minutes of unpaid care work every day compared with 1 hour and 23 minutes for men (Pozzan and Cattaneo 2020).

to NCD risk behaviors such as smoking, including in developing countries such as China and Kenya (Jin et al. 2022; Donfouet et al. 2021). Inclusion of omitted variables does not significantly reduce the size of impacts of schooling on self-reported health and NCD risk behaviors such as smoking (e.g., Conti and Heckman 2010; Conti et al. 2010; Conti and Hansmann 2013; Van der Pol 2011; Savelyev 2014). Twin studies have mixed findings, while instrumental variable analysis for developing countries also has mixed findings on a causal relationship but with variation across different measures of health and health behaviors and for some studies gender (Clark and Royer, 2013; Braakmann 2011; Fabrice and Jones 2011; Buckles et al. 2013; Atella and Kopinska 2014). To take the important example of smoking, it would be hard to argue that less smoking causes more education rather than the other way around. For conditions such as obesity, the relationship in developing countries may be more complex.

There is also a literature on how income, wealth, and employment shocks (all elements of returns to human capital) affect adult health, primarily NCD conditions (Capatina et al. 2020). The literature finds that job losses result in negative impacts on health in the longer run, including worse health behaviors, self-reported health and mental health, and mortality (Smith 1999 and 2004; Black et al. 2015; Eliason and Storrie 2009; Adda, Banks, and von Gaudecker 2009). Looking at NCD risk factors, a systematic review of low and lower-middle income countries found that in most studies low SES groups had higher tobacco and alcohol use, and consumed less fruit, vegetables, fish, and fiber than high SES groups (Allen et al. 2017). Reviews of health literature finds similarly strong relationships between unemployment and various indicators of mental health (mixed symptoms of distress, depression, anxiety, psychosomatic symptoms, subjective well-being, and self-esteem), as well as general and physical health (McKee-Ryan et al. 2005; Paul et al. 2009; Norström et al. 2014), with the effects appearing to be causal.[29] Those who are unemployed are also more likely to engage in NCD risk behaviors such as over-consumption of alcohol, tobacco consumption and substance abuse (Henkel 2011). Conversely, being in work, or returning to work, appears to have a protective effect for depression, general mental health, and self-rated health (Schuring et al. 2012; Van der Noordt 2014; Modini et al. 2016).

Finally, there is an expanding literature – largely from richer countries - on the health effects of retirement or continued work. The findings across studies are not definitive (Van der Heide et al. 2013), but on balance meta-analysis finds positive effects on mortality, cognition, and some other health conditions of extending working lives beyond normal retirement ages (Sewdas et al. 2020; Rohwedder and Willis 2010), confirming country level studies (e.g., Wu et al. 2016; Kachan et al. 2015). Other studies have linked working past retirement age with a reduced risk of dementia and heart attack. Studies are not unanimous, though. Meta-analysis suggests that retirement may result in improvements in mental health, though was contradictory on impacts on general and physical health (Van der Heide et al. 2013). The review also found little analysis of potentially variable impacts across types of work (white versus blue-collar) or on variation according to whether retirement was voluntary or not. Yet again, two-way causality is likely to be a factor: those who work longer may be healthier; but those who are healthier have both the capacity and desire to work more (for income and non-income reasons).

Protecting human capital

As shown in Figure 2, in addition to the life course impacts of NCDs on human capital accumulation, deployment and depreciation, a further important aspect of the human capital trajectory is *protection* of human capital across the life cycle. This will primarily be in the face of various types of shocks, including idiosyncratic and covariate health shocks, external shocks such as weather-related or economic crises, or employment-related shocks such as job loss. It also includes consumption smoothing across the life course into older age through pension or social assistance systems. The main focus of discussion below is on health shocks, in particular NCD-induced health shocks, and financial protection in the face of them.

While the range of measures of catastrophic health expenditure (CHE) and the non-health elements included (or often not included) in their calculation makes cross-study comparisons challeng-

29 As with other areas, there may also be reverse causality.

ing, nearly all studies show worryingly high levels of CHE.[30] In many developing countries, illness and death is one of the most common drivers of poverty (McIntyre et al. 2006), and health and weather-related shocks are recurrent and their impacts cumulative across the life course (e.g., for Africa, see Nikoloski, Christiaensen, and Hill 2018). One study by Wagstaff et al. (2018) using spending data from 133 countries found that over 800 million people in 2010 incurred CHE, and that the share of total households incurring spending of at least 10 percent of household consumption rose steadily to almost 12 percent in 2010, and approached 15 percent in Latin America and the Caribbean (LAC) region.[31] At the individual country level, there was a wide range in incidence of CHE, from under one percent in some richer countries to over 40 percent. Alternative estimates for developing countries using a different measure of CHE (40 percent of capacity to pay) find that the incidence of CHE was 30 percent of households in LMICs, 17 percent in UMICs and 15 percent in LICs (Haakenstad et al. 2022).[32]

While the literature on the household financial burden of seeking and receiving NCD care in developing countries is expanding steadily, it remains more limited for LICs and for specific conditions such as COPD (Jaspers et al. 2015; Eze et al. 2022; Kankeu et al. 2013; Jan et al. 2018, Essue et al. 2017). Nonetheless, the evidence is consistent that the negative financial impacts on households from NCDs are substantial across the developing world, with major deficits in financial protection. Recent work from developing countries, which carefully distinguishes CHE from NCDs and communicable diseases, finds that CHE from NCDs tends to increase with the share of NCDs in the overall burden of disease, though with major exceptions such as China and South Africa, mediated by the health system. NCD CHE rates were also consistently higher in lower wealth quintiles within countries (Haakenstad et al. 2022). There is also evidence that risk factors such as smoking can be significant contributors to CHE and driving families into poverty (Verguet et al. 2015; Global Tobacco Economics Consortium 2018). Where systems are built around insurance, those who are uninsured are 2-7 time more likely to experience CHE (Jan et al. 2018), though similar differences might also be expected where systems are general revenue financed but fail to cover segments of the population.

The figures above are also likely to underestimate the impacts of NCDs on human capital, as many households may avoid or delay seeking care due to the financial burden, or services may simply not be available. In addition, lost labor income from time spent accessing care may not be properly accounted for, nor in many studies costs such as transport for accessing care (e.g., see Jan et al. 2018 on studies which include transport costs, which in India for example is the major cost item of seeking care).

In terms of financial protection against CHE, the push towards universal health coverage (UHC) across the developing world has been a crucial development of recent years. However, the realization of UHC continues to encounter challenges, in terms of the proportion of population covered by services, the share of health expenditures which are prepaid, and the range of NCD-related health services included in UHC packages (Wagstaff and Neelsen 2020; Watkins et al. 2017). Even where people are in principle covered by SHI or entitled to services under general revenues financed systems, financial protection is often shallow due to limited service packages, co-payment requirements and/or informal payments, or other factors such as costs of accessing health services. Comparative analysis of a UHC index combining service coverage and degree of financial protection finds a mixed picture across developing countries with respect to financial protection. Some countries (e.g., Ghana, Indonesia, and Viet Nam) have increased both financial protection

30 Catastrophic health spending is defined as a proportion of total household expenditure - usually between 10 and 40 percent of total consumption - or 40 percent of non-food consumption. Impoverishing health spending is defined as taking a household below a defined poverty threshold. Jan et al. (2018) provide a useful comparison of studies on CHE shares using a range of measures.

31 For sub-Saharan Africa, Eze at al. (2022) find that the incidence of CHE continued to rise from 2010-20. These measures are not for NCD-related health expenditures specifically. Haakenstad et al. 2020 find that across 39 countries around 45 percent of CHE cases could not be linked to a specific cause.

32 The result for LICs appears counter-intuitive, given the greater likelihood of households being poor in the first place. While the authors do not speculate, it may be that those in the poorest countries are more likely to forego health treatment and spending altogether due to income and supply side constraints. Somewhat distinct from these results, Wagstaff and Neelsen found that GDP per capita was positively and significantly associated with CHE, and higher inequality had a positive association with CHE at all country income levels (Wagstaff and Neelson 2020, noting that low service coverage in LICs may drive the former finding).

and service coverage, while financial protection in others has declined (Wagstaff and Neelsen 2020).

The impacts of health spending by households on human capital are both direct and indirect (Jan et al. 2018). The most direct negative effect will be on household non-health consumption. This may impact human capital in various ways, including reduced nutrition (impacting human capital formation early in life and its preservation later in life); negative coping strategies such as withdrawal of children from school due to household budget constraints and increased participation in child labor; and selling assets and/or running down savings (both likely to have impacts on productivity, and hence reduce returns to human capital). When an adult female in the household has an NCD which compromises her capacity for unpaid work/care responsibilities, this is also more likely to be redistributed to other females in the household, often girls. Reduced household income from health spending may also result in failure to seek care when needed subsequently, directly impacting the health dimension of human capital. At the same time, there is evidence from a number of developing countries that illness of one family member often induces increased work effort from others to mitigate the income shock, including migration (Nikoloski, Christiaensen, and Hill (2018) for Africa, for example). Estimates of the scale of the so-called added worker effect tend to focus on participation of non-ill adults rather than net income impacts. A study from Korea for example found onset of chronic illness of a husband reduced the probability of the wife exiting the labor force by 9.2 percentage points, and the effect was more pronounced for chronic than acute conditions (Kim et al. 2018). This is consistent with work from Brazil on informal worker household which finds a significant added worker effect from health-induced work absence (Reis 2007). Work from Chile has found more nuanced impacts, with the added worker effect observed for some chronic conditions (e.g., arthritis) but not others (hypertension and asthma), and variable according to the age of the ill and well spouses (Acuna et al. 2019). The studies highlight the importance of considering the specific health condition and its implications for whether spouses are able to work or need to focus on providing care.

Apart from social health insurance, unemployment, disability, and work injury insurance programs can play important roles in providing financial protection and protecting human capital. Like SHI, to the extent that these other forms of social insurance protect incomes in the face of shocks, they should mitigate both direct consumption impacts on human capital and negative coping mechanisms which compromise it. However, unlike SHI where subsidized approaches have become increasingly popular in developing countries, coverage of these programs tends to be confined to formal sector workers who are often a minority of the labor force. These major coverage gaps were highlighted during the COVID-19 pandemic. Coverage of non-health forms of social insurance is also much more likely to exhibit income and gender bias due to coverage being focused on the individual rather than the household. The exception to this coverage deficit in many developing countries is disability transfers under social assistance programs which are targeted on the basis of severity of disability and in some countries also according to poverty/vulnerability (World Bank 2018), though adequacy is often modest.

INEQUALITY AND GENDER DIMENSIONS OF NCD AND HUMAN CAPITAL PATHWAYS

In thinking through the pathways discussed in previous sections, it is vital to consider distributional aspects. Inequalities may have several layers, from differentials in NCD incidence by different characteristics, to differences in human capital deployment/returns in the labor market, to differences in access to and provision of care, to financial protection. There are also likely to be important intersections between different dimensions of inequality, e.g., between gender and poverty. This section focuses on two important sources of inequality and their relationship to NCDs and human capital: socio-economic status (SES) and gender.

With respect to SES, the first clear inequality is between income and life expectancy, both across countries and across households within countries. Across countries, there is a strong relationship between GDP per capita (PPP) and life expectancy.[33] While there are outliers on the up- and downsides, and consid-

33 Clio Infra Project. Life Expectancy at Birth (total). Available at: https://clio-infra.eu/Indicators/LifeExpectancyatBirthTotal.html

erable improvements in developing country life expectancy over time, the overall pattern of rising life expectancy with country income is strong. Similarly, the likelihood of death from specific NCDs remains substantially higher in lower income countries versus richer ones (e.g., a woman in a LMIC has around twice the annual likelihood of dying from CVD than her peer in a HIC, Yusuf et al. 2014).

Within countries, the income gradient of life expectancy across individuals has been shown in a number of developed countries (e.g., Chetty 2016; Galama et al. 2018; Lleras-Murney 2022; Mortensen et al. 2016). The evidence from developing countries is thinner, but available multi-country studies show a clear relationship between lower income, especially very low income, and higher mortality, though the direction of causation between health status and income is less clear (Banerjee and Duflo 2010). Interestingly, one study of China, Costa Rica, Indonesia, Mexico, South Africa, and South Korea found more nuanced relationships between education levels and adult mortality than in richer countries, with the exception of a consistent advantage for the tertiary educated (Sudharsanan et al. 2020).

As in richer countries, the available evidence from developing countries shows clear socio-economic inequalities in incidence of both NCDs and risk factors, though evidence remains incomplete and the quality of studies on the issue mixed (Hosseinpoor et al. 2012; Williams et al. 2018; Allen et al. 2017; Sommer et al. 2015). The simplistic notion that NCD are rich people's diseases in developing countries thus appears not to be borne out by the evidence and suggests that inequalities in prevalence and risk factors should be take into account in policy. For example, a majority of studies in one systematic review found higher incidence of cancer, CVD and multiple NCDs for low SES households, while obesity in contrast was higher among the better off (Williams et al. 2018). However, for all conditions examined, the results were not uniform across countries (and in some cases also within larger countries like India) and studies in terms of SES and NCD incidence, suggesting a need for further research. In an earlier review, angina, arthritis, asthma, depression and NCD comorbidity were associated with lower SES and education within countries, while for diabetes the association was in the opposite direction (Hosseinpoor et al. 2012). Looking across developing countries, all these inequalities were more pronounced in LICs relative to MICs. A review of systematic reviews across LICs, MICs and HICs also found on balance an association between SES and NCD incidence (Sommer et al. 2015).

Looking at NCD risk factors in developing countries, a systematic review of low and lower-middle income countries found that in most country studies low SES groups had significantly higher prevalence of tobacco and alcohol use, and consumed less fruit, vegetables, fish, and fibre than high SES groups (Allen et al. 2017). At the same time, high SES groups were less physically active and consumed more fats, salt, and processed foods. The Sommer et al. review also found an association between SES and NCD risk factors, with low SES increasing the risk of developing CVD, lung and gastric cancer, type 2 diabetes, and COPD.

Apart from incidence and risk factors, other aspects which may impact human capital often exhibit SES inequality. One as noted above is coverage of social insurance. Those in the informal sector and with lower SES status are more likely either to lack SHI coverage, or – where SHI participation is subsidized for poor households or those outside the formal sector – to have SHI packages which may be more limited than those in formal sector or civil service schemes or more rationed in terms of service access. In almost all developing countries, low SES informal workers (and those outside the labor force altogether) are highly likely to be outside unemployment, disability, work injury and other social insurance programs, except to the extent that those risks have some protection under social assistance systems (though even then, the adequacy of cover will be less than in social insurance systems). The risks of uninsured income shocks from these sources and negative coping strategies that may compromise human capital are accordingly higher.

With respect to gender, there are multiple layers of gendered differences with respect to NCDs and human capital which are important to consider (Bonita and Beaglehole 2014; Knaul et al. 2021; Langer et al. 2015). There are several underlying differences in NCD incidence and risk factors, but also a range of other inequalities which may also impact human capital accumulation, deployment and protection. With respect to NCD incidence and risk factors, NCDs dominate the disease burden globally for both genders (and for women account for around two thirds of deaths annually), but there are some differences in the gender-specific patterns of NCD incidence and risk factors. For example, male smoking rates (and lung cancer deaths) are substantially higher than women globally, and

harmful alcohol consumption tends to be lower among women, while obesity is higher for women than men in most countries, and women disproportionately suffer and die from Alzheimer's and other dementias (WHO 2022). Of particular note is the widespread prevalence globally of gender-based violence as a risk factor which drives higher incidence of mental health disorders, other conditions such as head trauma and consequent cognitive impacts, and higher rates of behavioral risk factors for NCDs (Devries et al. (2013) estimate around one third of women globally experience intimate partner violence). The combination of lower age-specific death rates for women from NCDs and their greater longevity means that around 88 percent as many women as men die annually from NCDs (WHO 2022).

A second source of inequality relates to the gender patterns of unpaid care provision. While NCDs represent a major health burden for all genders, the burden of informal care falls disproportionately on women. Globally, around 76 percent of all unpaid care work (including household work, direct personal care, and volunteer work) is undertaken by women, though is not typically valued in national accounts nor in most estimates of returns to human capital.[34] That share can run to over 90 percent in some countries (e.g., India, Pakistan, Cambodia, and Mali). The gender differentials in unpaid care work are in all regions and at all levels of income, though they are higher in LICs and MICs than HICs on average. Almost half of women outside the labor market in MICs and over a third in LICs cite unpaid care duties - broadly defined - as the main reason (ILO 2018; Charmes 2019; Folbre 2015). Thus, there is a massive underutilization of women's human capital due to caring duties using standard valuations to returns to human capital. Based on data from 53 countries across income levels, ILO estimates that women's unpaid care work would amount to 6.6 percent of global GDP. Using a more focused definition of the value of women's contribution to health work globally, Langer et al. (for the Lancet Commission on Women and Health) estimate unpaid health-related care work of women at between 1.1 and 3.1 percent of GDP globally, depending on the valuation method used, and with the GDP share in LICs and LMICS around 50 percent higher than in UMICs and HICs. In addition to unpaid care work, there is a strong gender dimension to paid healthcare work also, with women over-represented in health sector workforces across the world, though often in lower skilled and lower paid jobs (or not paid at all, as with community health volunteers in many developing countries). Whether paid or unpaid, the dual role of women as both consumers of healthcare and aged care and providers is notably more pronounced than for men (Langer et al. 2015).

A related but less obvious gender dimension in terms of health outcomes is the disproportionate burden on women of household tasks which are not directly care-related. A number of the most time-intensive tasks of women in households such as cooking, cleaning, and fetching water (often called elements of "reproductive labor") have very direct health and nutritional benefits for households, lowering their likelihood of both communicable and non-communicable diseases. The wellbeing and economic benefits of this labor are almost never measured but are likely to be substantial. One such analysis for Mexico is instructive, suggesting that proper accounting for the health benefits of mixed household work which also promotes better health in the household would significantly multiply the economic contribution of women's direct unpaid care work. For Mexico, the total value of women's unpaid contribution to health increased from 0.5 percent of GDP to 2 percent once the health-promoting value of mixed work was accounted for, valuing time at minimum wage (Langer et al. 2015).

Broader but related to the points above, a major source of gender difference relates to measurement of deployment and returns to human capital. The lower labor force participation rates of women in market work and the common failure to value their non-market work results in a major downward bias in returns to women's human capital. To the extent that NCDs compromise labor force outcomes, these factors will also result in major under-estimation of the negative impacts of NCDs on the human capital of women and societies and on growth. Even where women are working in the labor market, the gender wage gap will also contribute to lower estimated impacts of a given

34 ILO estimates that the bulk of unpaid care work is household duties other than direct personal care, though acknowledged that multi-tasking across regular household duties and care specifically makes precise estimates of shares of type of unpaid care difficult to unpick even with time use surveys. As noted by Langer et al. (2015) "...four methods are typically used [to value unpaid care], each with advantages and disadvantages: opportunity cost; proxy good; contingent valuation; and conjoint analysis".

burden of NCDs for women relative to men.

A further source of gender inequality with respect to NCDs relates to access to healthcare and patterns of care provided. This is an area with a thinner evidence based in developing countries. Overall, there appear to be gendered patterns of access to care, and the nature and quality of care provided if accessed, shaped by social determinants including gender inequality, poverty and cultural factors (Langer et al. 2015). The first source of gender difference relates to women's lack of control of household resources in many developing countries and the likelihood of this impacting their access to care relative to men. This may reflect either higher poverty rates of female-headed households, or within male-headed households lack of prioritization of women in whatever is spent on healthcare. While extending and deepening financial protection for health will benefit all people, lower financial barriers are thus likely to benefit women disproportionately (and those benefits to be outsized for poorer women). Another factor with respect to access is social and cultural factors which limit women's access to care where there are strong norms around women being treated by men and there are insufficient female providers as evidence from Afghanistan has shown for example (Save the Children 2008).

Apart from failure to access care when available, there may be gender biases or gaps in the definition of publicly financed basic packages of care. For example, it has been common in basic packages to prioritize sexual and reproductive health interventions for women, which may come at the cost of NCD-focused interventions for prevention or management (Bonita and Beaglehole 2014). An example would be failure to include mammography in basic packages in some countries. While such neglect may not be intentional, it may be reflective of lack of prioritization of research on women's NCD incidence and risk factors to strengthen the evidence base upon which disease control priorities are formulated at global and national levels.

Similar issues arise relating to care received when care is accessed. First, even where women do seek care, this may be more likely to be delayed and timeliness of care compromised (see for example, Liakos and Parikh (2018) for the US). While the evidence is largely from developed countries, there appear to be gender differences in diagnosis and management by doctors, with women being asked fewer diagnostic questions, and given fewer diagnostic tests, though unpicking how differences may be driven by biological differences, provider bias or other factors is not easy and evidence from developing countries is very thin (Chang et al. 2007). To the extent such differential treatment exists, it may, as noted, reflect in part an ongoing prioritization of sexual and reproductive health as the dominant concern in women's health (Langer et al. 2015; Bonita and Beaglehole, 2014).

As in many areas of social policy, the gender inequalities in NCD incidence, access to care and NCD management, financial protection and other factors often co-exist with other sources of deprivation, and the various factors are likely to be reinforcing. This may include race or ethnicity, language, illiteracy, disability status, poverty, sexual orientation, and other factors. This inter-sectionality of deficits or risks applies to all population groups but are likely to be more pronounced for women.

As with NCD and health-related issues noted above, there are clear gender differentials in both education and labor market participation and outcomes, though the picture on education has become somewhat more nuanced in recent decades (Evans, Akmal, and Jakiela 2020; Saavedra et al. 2021). Historically, gender gaps in girls' school enrollment were observed in nearly all developing countries and remain in many. The positive news is that the median gender gap in enrollment reduced globally between 1960 and 2010 from 1.2 years to 0.8 years, and that around two thirds of all countries have achieved gender parity in primary enrollment. At the same time, the Barro-Lee data set for 146 countries finds that while 104 countries reduced their gender gap in that period, it increased in 42 countries (Evans, Akmal, and Jakiela 2020). While a significant number of those are fragile states, India is one which saw an increase.

Looking below high-level averages, the picture remains concerning, however. In countries affected by fragility, conflict and violence girls remain 2.5 times more likely to be out of school than boys. Also, in low-income countries the school completion rates of girls at both primary and secondary levels remain below that of boys (63 percent for girls against 67 percent for boys at primary level, and 36 percent versus 44 percent at secondary level – Saavedra et al. 2021). These deficits are more pronounced in economic terms, given that the average rate of return to an additional year of schooling is higher for girls, at around 12 percent against 10 percent for boys. Across developing countries girls who have multiple disadvantages such as coming from poor households, living with disabilities, or coming from minorities or rural areas are furthest behind. Inter-

estingly though, the learning poverty rates of girls in low- and middle-income countries are on average actually lower than for boys (55 versus 59 percent), and in many developing countries tertiary enrollment rates are slightly higher for young women than young men.[35] At the same time, there remain strong gendered patterns in subject mix and more general biases in schools and classrooms which often reinforce more limited expectations for girls (e.g., the substantial under-representation of girls in STEM subjects). While the situation has therefore improved in many developing countries over time and become more nuanced, the averages also conceal significant regional and other variations, and gender equality in education remains an unrealized goal for significant numbers of developing countries and for significant shares of girls within countries.

When considering deployment of human capital, there remain often substantial gender gaps in labor force participation in much of the developing world, and the gaps are particularly pronounced in South Asia (SAR) and Middle East and North Africa (MENA). Globally, female labor force participation is around 20 percentage points lower than for men overall, and over 40 percentage points lower in MENA and SAR regions. Even in the developing regions with the highest labor force participation such as EAP, there remains a participation gap between women and men in terms of market work, which increases for higher skilled and upper level and leadership positions, including in the health sector (Knaul et al. 2021). As a result, the gender gaps at the intensive human capital accumulation phase in many countries are exacerbated during the deployment and further accumulation stages. In terms of returns to human capital, the participation gap is exacerbated by the gender pay gap in all countries, and the gap is sharply higher for women with children (Terada-Hagiwara et al. 2018; Si et al. 2021).[36]

Gender differentials in terms of labor force participation and wages are in turn reflected in differential gender coverage and adequacy of contributory pension, unemployment, disability, and work injury social insurances. While SHI tends to be provided on a household basis, the other social insurances attach to the individual worker and overwhelmingly in developing countries to workers in the formal sector. To the extent that women have lower overall labor force participation and higher rates of informal sector employment when they are doing market work, they have lesser financial protection against these non-health risks and in old age. Even where they are working in employment where non-health insurances are provided, they are likely to have shallower coverage of protection during working life (due to vesting periods and breaks in work history due to child rearing for many women), lower contribution densities across their working lives for pensions, resulting in often significantly lower pensions in later life, and lower adequacy of non-health insurances in general reflecting the gender wage gap. Where women do not work but their spouses do, the prevalence and adequacy of survivor pensions for female spouses is also mixed across the developing world (Chłoń-Domińczak 2015).

35 Learning poverty is a concept popularized by the World Bank which focuses on the ability of children aged ten to read and comprehend a simple paragraph, as well as shares of children out of school altogether.

36 In response, Target 8.5 of the 2030 Sustainable Development Goals calls for "equal pay for work of equal value."

WELLBEING EFFECTS OF ADDRESSING NCDS

While the bulk of literature discussed above is on the links between economic growth or productivity and health, longevity and education/skills, it is important also to take account of the direct impacts of health, and NCDs more specifically, on non-economic measures of wellbeing at the individual and societal levels. This is a rapidly growing area of research, with different measures of life satisfaction used, including life satisfaction, quality of life, health-related quality of life, and happiness.[37] In economist speak, good health has consumption value in terms of improved quality of life, over and above its contribution to individual and societal welfare through its investment value and impacts on productivity, growth, and individual earnings. Alternatively, one can look at health (and education) as functions which contribute directly to capabilities which are the basis for the well-being, freedom and dignity of people, over and above their narrow human capital contribution to production (Sen 1997; Nussbaum 2011). They are both the result of capabilities and prerequisites for capabilities.[38] In recent years, the literature on the relationship between health status and different measures of wellbeing has been growing (Deaton 2008; Steptoe et al. 2015; Steptoe 2019).[39] As noted earlier, wellbeing has different dimensions: evaluative wellbeing (or life satisfaction), hedonic - or affective - wellbeing (feelings such as anger, happiness, sadness etc.), and eudemonic wellbeing (sense of meaning or purpose). Interestingly, measures of wellbeing across the life course vary across regions, with richer English-speaking countries exhibiting a U-shaped pattern of lowest life satisfaction around mid-40s, while former Soviet and LAC countries see a steady increase in dissatisfaction with age, and Africa shows no strong age pattern (Steptoe et al. 2015, using Gallup data from 160 countries).

Evidence is growing that subjective measures of wellbeing matter for health, and that health – and specifically NCD status - impacts subjective measures of wellbeing in a bidirectional relationship. Poor health has been shown to reduce subjective wellbeing (and conversely, positive health behaviors such as physical activity positively affect wellbeing), and lower subjective wellbeing increases the risks of premature mortality and a range of NCDs, including coronary heart disease, diabetes, and other chronic conditions (Chida and Steptoe 2008; Windle et al. 2010; Steptoe et al. 2015, Steptoe 2006). Just as interestingly, newer research suggests that positive subjective wellbeing may be a *protective* factor for health and is associated with longer lives and lower morbidity. A brief summary of the literature from prospective epidemiological studies, retrospective assessments of eudemonic wellbeing, and momentary hedonic measures is in Steptoe et al. 2015.[40] A growing body of literature suggests that being happier (often measured by absence of depression or distress) is good for health. A major meta-analysis finds that it reduces all-cause mortality (Martin Maria et al. 2017). And a range of studies find similar positive impacts on specific NCD conditions (Davidson, Mostofsky, and Whang 2010; Boehm and Kubzansky 2012), including coronary heart disease (Carney and Freedland 2017), stroke (Li et al. 2015) and type 2 diabetes (Hackett and Steptoe 2017). Depression also predicts increased mortality among people with COPD, diabetes, CHD, stroke, and some cancers (studies summarized in Steptoe 2019). For NCDs specifically, studies also show increases in depression after diagnoses of various conditions, including

37 While the focus here is primarily on the WHO Quality of Life and happiness measures, there has been a proliferation of initiatives which aim to go beyond GDP as the dominant measure of human wellbeing, including the OECD's Better Life Initiative, and the work of the Stiglitz/Sen/Fitoussi Commission which is informing quality of life measures by the EU. The UN Human Development Index inspired by Sen has a similar motivation.

38 Nussbaum also contrasts *internal* capabilities (which are personal), and *combined* capabilities that are "defined as internal capabilities together with the social/political/economic conditions in which functioning can actually be chosen". Combined capability "combines internal preparedness with external opportunity in a complicated way, so that measurement is likely to be no easy task." (Nussbaum 2011).

39 While not the focus of this chapter, this is also true for the studies on the wellbeing effects of education, which look at both direct impacts on wellbeing (for which findings are inconsistent across studies, and weaker than for health when positive) and impacts on non-pecuniary factors which are associated with better quality of life, within the labor market (e.g., job satisfaction, positive mental health impacts of lower unemployment probability, or social status), and outside it (e.g., better health behaviours, marriage market outcomes, childrens' educational performance, fertility behaviour for women, parenting behaviour, and variables such as levels of trust and social capital. See Oreopoulos and Slavanes 2011; Grossman 2006; Vila 2000; Helliwell and Putnam 1999; Powdthavee et al. 2015; Blackstone and Van Rensselaer 2019.

40 While more evidence is available from prospective studies to date, with their potential shortcomings including confounding factors and reverse causality, retrospective work points to similar conclusions.

diabetes, coronary heart disease, some cancers, and chronic kidney disease (Satin et al. 2009; Hedayati et al. 2010; Meijer et al. 2011). Even more interestingly, studies have found that the association between happiness, mortality and specific conditions seems to hold even after controlling for negative emotions (Tilvis et al. 2012; Steptoe and Wardle 2012).

Broader measures of quality of life and its linkage to health have also been a growing focus of WHO. The WHO Quality of Life (WHOQOL) method aims to measure an individual's "perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns", aiming for a composite (and decomposable) measure which provides a measure of quality of life that goes well beyond traditional measures of health and self-perceived health (WHO 2012). The WHOQOL instrument was developed across 15 centers globally (including in some developing countries) in an effort to reflect culturally diverse perceptions of quality of life and asks 100 questions across a range of domains of wellbeing (physical, psychological, level of independence, social relations, environment, spirituality/religion, and personal beliefs), as well as an overall measure of wellbeing and health. The instrument has also been adapted to the WHOQOL-BREF, which is a shortened form of the instrument better suited to inclusion in surveys which may be measuring multiple things beyond quality of life.

The research from developing countries which relates NCD incidence to WHOQOL measures is relatively nascent but growing. Studies from middle-income and lower-income countries have found negative associations between a range of specific NCDs and lower QOL using the QOL-BREF measure (Lee et al. 2015; Arokiasamy et al. 2015), and cross-country work on middle-income countries has also analyzed how multi-morbidity NCD dyads negatively impact QOL (Sum et al. 2019, for example finding that diabetes, stroke and depression had the largest negative impacts on mean QOL scores, while depression in combination with other NCDs had particularly strong negative effects). A study from Brazil also found that the negative impacts of NCDs on QOL scores were more pronounced for older people, and those with low income levels, low education, and Black people, suggesting that the socioeconomic differentials which are apparent for NCDs themselves may be exacerbated when considering wider measures of life quality (Höfelmann et al. 2017).

Using a simpler measure of wellbeing, several rounds of the World Happiness Report find that better health is strongly associated with happiness. A range of factors are positively associated with higher life satisfaction, including income (notably relative income) and employment, education and family life, and mental and physical health (Helliwell, Layard, and Sachs 2017; Clark et al. 2017. However, mental health has a particularly strong impact, in Western countries studied more than income, employment or physical illness, and second only to income in the developing country analyzed (Indonesia). There is a similar ranking when one focuses on the drivers of misery rather than satisfaction, with elimination of depressive and anxiety disorders the single most impactful intervention in simulations (and the most cost-effective). Childhood factors such as emotional health and conduct are also strong predictors of adult happiness (Layard et al. 2014), and childrens' emotional health is in turn impacted by parental health, particularly the mental health of the mother (Helliwell, Layard, and Sachs 2017). The findings are consistent with country-specific studies, which also point to the importance of the health measures used, with conditions which affect daily functioning more closely associated with impacts on happiness (e.g., Angner et al. 2013). Looked at from a health capital perspective, Arrow et al. (2014) estimate that the direct well-being impact of better health (that is not mediated through production of good and services as measured in GDP) is likely larger than their indirect effects through production.

POLICIES AND INTERVENTIONS FOR NCDS AND HEALTHY LONGEVITY

A wide range of policies can impact human capital across the life course, as well as the likelihood of developing NCDs which negatively impact healthy longevity. This section looks at policies that have the greatest potential to impact NCDs and healthy longevity across the life course. These can contribute to achieving the UN SDG Target 3.4 of reducing premature mortality from NCDs by a third between 2015 and 2030. Across the life course we focus on policies and interventions to improve NCD outcomes and support healthy longevity, including for nutrition, NCD prevention and management, as well as interventions for long-term care, the built environment and tax, air pollution and traffic accident reduction. The policies and interventions considered here are those with the most direct impacts on NCDs: the full spectrum of policy areas includes education, labor, and social protection, to name a few (which are summarized in Annex Tables 2A.2 and 2A.3). This is a menu, and countries would need to choose judiciously what combination of policies and interventions were cost-effective and consistent with financial and capacity constraints. Evidence to guide these choices is provided in several of the chapters on HLI research presented in this compendium, in particular on the economic burden of NCDs and cost-effectiveness of different interventions. Within a number of these areas, tax and fiscal policies can play a useful role. There is also a common need for better data and measurement tools, as well as research to inform policy development and evaluate outcomes.

i. Nutrition

Nutrition policies are the most foundational for human capital, NCDs and healthy longevity given their important short and long-term impacts. The policy menu of nutritional interventions focuses primarily on women of child-bearing age and young children and combines both direct nutritional interventions and multi-sectoral policies which address the underlying determinants of poor nutrition (Bhutta et al. 2008 for a meta-review of studies on different interventions for maternal and child nutrition and their effectiveness; Von Salmuth et al. 2021; IFPRI 2016; Shekar et al. 2017). The direct nutritional interventions include strengthening supply-side interventions, including micro-nutrient supplementation (e.g., Vitamin A, zinc and iron for children and folate for pregnant women); pre-school and school feeding programs (Verguet et al. 2020); social and behavioral change and parenting programs, including breastfeeding and complementary feeding education; and management of severe acute malnutrition following WHO guidelines. World Bank costing of a core package of nutrition-specific interventions in 2017 suggested a cost of around US$ 70 billion over a decade to address childhood stunting and wasting, maternal anemia and promotion of exclusive breastfeeding. Apart from averting an estimated 3.7 million child deaths annually, the economic returns per dollar invested were between $4 and $35, "making investing in early nutrition one of the best value-for-money development actions" (Shekar et al. 2017).

There have also been considerable investments in complementary interventions, including agricultural programs to promote more diverse food cultivation and adoption, food systems, WASH interventions, women's empowerment programs, and increasingly conditional or "cash-plus" cash transfers which help address the demand side and income constraints to better nutrition.[41] While more research is needed to understand the cost-effectiveness and interactions of these interventions, there is emerging consensus on a core set of maternal and child nutrition interventions which will impact childhood and particularly adult NCDs and provide the cognitive foundations for better learning and human capital acquisition and deployment. There is also growing attention to obesity in childhood, both as an NCD itself and as a pre-disposing condition for many NCDs later in life.

While most attention in development literature is understandably focused on young people, the importance of nutrition for good physical and mental functioning of older people has received increasing attention in recent years. Poor diet and associated micronutrient deficiencies have been linked to increased morbidity, hospitalization, and mortality in older people, including to a range of NCDs, includ-

41 For example, Manley at el. (2020) in a systematic review and meta-analysis of the impact of cash transfers on child nutrition find transfers programs had significant positive impacts on dietary diversity, animal-sourced food consumption, linear growth and stunting reduction, though program design matters for the degree of impact.

ing heart disease, cancer, osteoporosis and weak immune systems in general (Kaur et al. 2015). There is a host of reasons for inadequate nutrition in older people, from affordability to loss of enjoyment in eating, physical difficulties in eating for physical or cognitive reasons, mobility constraints in acquiring food, and motivation and depression.[42] Studies in developing countries have found rates of malnutrition among older people which often rival those of children, with one cross-country synthesis for Africa for example finding malnutrition rates between 10 and 36 percent and 13.1 and 27 percent for men and women respectively (Charlton and Rose 2001). In terms of interventions to address poor nutrition at older ages, there are direct measures such as supplementation to address common deficiencies (e.g., calcium, amino acids, iron, zinc and vitamin B), but also addressing the access, mobility and other social causes of poor nutrition is at least as important (Roberts et al. 2019).

In addition to nutritional interventions for *under*-nutrition at different ages, a growing concern in the developing world is the double burden of malnutrition with the rapid increase in obesity (Popkin et al. 2020). This has two dimensions. First is the direct prevalence of obesity itself and associated NCD risks, including increasingly in childhood. According to WHO, in 2016, more than 1.9 billion adults were overweight, and of these, over 650 million were obese, or 13 percent of the global adult population. Obesity is associated with a range of NCDs, including cardiovascular diseases, diabetes, some cancers (endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon) and musculoskeletal disorders. In addition, over 340 million children and adolescents were overweight or obese in 2020. Most of the world's population now lives in countries where overweight and obesity kills more people than under-nutrition (WHO 2021). The levels and rates of increase in childhood obesity in developing countries are particularly alarming, and associated with a range of NCDs, including type 2 diabetes, the early-onset metabolic syndrome, subclinical inflammation, dyslipidemia, coronary artery diseases, and adulthood obesity (Gupta et al. 2012). Second is growing evidence on the increased likelihood of adult obesity as a result of under-nutrition in childhood (Heidari-Beni 2019). For the second dimension, the interventions for pregnant women and children are common to those noted above. For the explosion of obesity at all ages, but particularly childhood, the main areas for attention relate to diet and lack of physical activity, both at the individual level - including limiting consumption of fats and sugars, increasing intake of fruits, vegetables, legumes, whole grains and nuts, and increasing physical activity – and at industry and societal levels reducing the fat, sugar and salt content of processed foods, increasing availability and affordability of health foods, better regulating marketing of obesity-inducing food and taxing them more (see below), and promoting regular physical activity at the societal and workplace level.

ii. Preventing, delaying, and managing NCDs across the life course

There has been intensive work on the package of policies and interventions that can best address the NCD epidemic, including how to do so as cost effectively as possible. These are thoroughly summarized in Disease Control Priorities (DCP), including mental and neurological disorders (DCP 3rd edition, 2017; Lancet 2017) and WHO "best buys" for addressing the risk factors for NCDs (tobacco and alcohol use, unhealthy diets, and physical inactivity) and managing the "big four" NCD categories (CVD, diabetes, cancers, and chronic respiratory diseases (WHO 2017). While already crucial, there has also been increased attention to NCDs as pre-disposing for severe impacts from COVID-19 (Nikoloski et al. 2021), as was also seen in the SARS and MERA outbreaks (Chan et al. 2003; Arabi et al. 2017).

Broadly, effective policies to reduce exposure and incidence of and manage NCDs stretch across a range of areas, many within the health sector, but also quite a number beyond it. They include:

- Strategies to reduce exposure to NCD risk factors, including taxes and other interventions to control tobacco, alcohol, sugar, trans-fat and salt intake use (see below); nutritional and dietary policies (see above); vaccinations to reduce risks of hepatitis B and liver cancer; and measures to reduce indoor and outdoor air pollution.

- Strategies to manage key NCD risks such as screening and management for cholesterol and BP, diabetes, and cancers; promotion of self-man-

42 www.mayoclinic.org/healthy-lifestyle/caregivers/in-depth/senior-health/art-20044699.

agement through education and support services, including promoting medication adherence; and widespread availability of palliative care.

- Development or refinement of layered strategies for mental, neurological, and substance use including community-level interventions in life-skills and building social and emotional competencies; promoting self-management; strengthening primary care and outreach services; and strengthening general and specialist care for severe and emergency cases and integration with other health care channels.

- Building an effective coordinate care strategy which is built on a central role for primary care with affordable access to care and availability of essential medications.

- Strategies to get better value from health systems, including moving from line item and fee-for-service payments to combination of capitation for primary care and global budgets with case mix-adjusted for hospitals; strategic pharma purchasing with reference pricing; transparent and evidence-based processes for prioritizing medical interventions and technology; and building strategic purchasing capacity.

- Strategies within the health system to slow functional decline among older people, including for weakening eyesight, hearing and bones/joints.

- Strategies outside the health system to prepare for and mitigate functional decline in old age, including access to affordable assistive devices, access to social participation, recreation and public spaces, workplace health promotion programs, and improvement/adaptation in workplaces environments (see below).

The Lancet 2017 summaries of the DCP (3rd edition) spell out in more detail the priority interventions for different groups of NCDs, with a model list of 21 interventions (the Lancet papers on DCP3; Bundy et al. 2017 for childhood and adolescent conditions; Black et al. 2013 for reproductive, maternal, newborn and childhood interventions; and Debas et al. 2015 for essential surgeries).[43] The interventions all aim to: (i) provide good value for money; (ii) be feasible to implement in low- and middle-income countries; and (iii) address a significant disease burden, drawing on systematic reviews of economic evaluations, epidemiological data, clinical effectiveness studies, and expert judgment. The key priorities identified were:

- For *cancer control and management*, a range of interventions for prevention, detection, diagnosis, surgery, other treatments, and palliative care (Gelband et al. 2015). These include "prevention of tobacco-related cancer and virus-related liver and cervical cancers (including vaccinations), diagnosis and treatment of early breast cancer, cervical cancer, and selected childhood cancers; and widespread availability of palliative care, including opioids".

- For *cardiovascular, respiratory, and related disorders*, Prabhakaran et al. 2017 provide a costed essential package of interventions to reduce risk of and manage CVRDs, including tobacco taxation, salt reduction interventions, bans on trans-fats, availability of essential medications, and strengthening of primary care.

- For *mental, neurological and substance abuse (MNS) disorders*, "a variety of interventions, including drugs, psychological treatments, and social interventions, can prevent and treat MNS disorders. At the population-level, best practices include legislative measures to restrict access to means of self-harm or suicide and to reduce the availability of and demand for alcohol. At the community-level, best practices include life-skills training in schools to build social and emotional competencies. For healthcare, three channels are identified: self-management, primary care, and community outreach; hospital care, including both specialist services and first-level hospitals for those with severe, refractory, or emergency presentations; and promoting the integration of mental healthcare in other channels of healthcare (Patel and Chatterji 2015).

In addition to the looking at the cost-effectiveness of policies and interventions to address NCDs, chapter 15 by Watkins et al. in this compendium incorporates additional factors to take into account

43 https://www.thelancet.com/disease-control-priorities-3

as countries at different levels of development prioritize their essential health packages. These include the degree of financial protection and equity considerations, features of health system performance, and fiscal space. They also provide a costed set of priority interventions which allows for variation in the Incremental Cost-Effectiveness Ratio (ICER) of specific interventions across regions.[44] Overall, the authors note that UHC approaches to date have often emphasized high coverage with low OOP spending and low cost, an approach which may not accommodate well within essential health packages the broad nature of NCDs and may fail to exploit the synergies of shared platforms. At the same time, they find that a package if high priority NCD interventions can be implemented across developing regions at a reasonable incremental cost with major gains in deaths and DALYS averted.

Apart from condition-specific interventions, global and national attention is needed for global public goods which are necessary for preventing and managing NCDs. In particular, promoting an R&D structure for relevant drugs, diagnostics, vaccines, and related products which balances legal protections and financial incentives for research and production with health needs and global equity is an ongoing challenge.

In addition to the general interventions for NCDs across the life course (and where the higher rates of NCDs and co-morbidities of older people make interventions especially pertinent for older people), there is a range of interventions which target older people and have the potential to prolong life and compress morbidity at older ages. Some of these will be focused on individuals and some ideally take a population-focused approach. These have been framed around the "4Ps": predictive, preventive, personalized and participatory. This would include population-based public health interventions such as education on self-management of health, including maintaining proper nutrition and exercise at older ages (Izquierdo et al. 2021). It also includes enhanced screening of the evolving capacity of older people based on a biopsychosocial assessment, which would include not only general NCDs, but frailty, social isolation, dementia, and other factors that are most pronounced at older ages (Stuck et al. 1993). While there will be a growing need for specialized geriatric care skills as societies age, inevitably – and especially in developing countries – frontline care will fall to non-specialists and non-medical people, making the integration of basic preventive and management geriatric care into GP, nursing, social work and related disciplines particularly important.

There have also been rapid advances in dementia risk reduction and care, reflected in the 2019 WHO guidelines for risk reduction of cognitive decline and dementia and evidence that "multidomain approaches targeting simultaneously multiple risk factors and tailored at both individual and population level, are likely to be most effective and feasible in dementia risk reduction" (Stephen et al. 2021). Apart from dementia specifically, there has been a proliferation in recent years of research on delaying, and even reversing, normal cognitive decline in healthy older adults - so-called cognitive aging – through combinations of exercise, diet, sleep, mental stimulation, and social interaction (Blazer et al. 2015; Dumas 2017). Similarly, palliative care in both residential and outpatient settings, and using digital technologies, has led to improvements in patients' and caregivers' wellbeing at end-of-life and often cost-effective (Naoum et al. 2021; WHO 2020). Despite that, WHO estimates that only around 14 percent of those needing palliative care globally each year (most of them in developing countries and almost 90 percent of them suffering from one or more of the "big four" NCDs) have access to such care (WHO 2020).

iii. Long-term care

Closely related to aspects of healthcare, long-term care is an area which has gained growing attention from policymakers in recent years and where there are direct and indirect impacts on health, human capital, wellbeing, and productivity. In developing (and, to a significant extent, developed) countries, this continues to be an area dominated by informal provision of care to frail elderly people by families and other private arrangements. However, the economic and social cases for expanded public sector involvement are compelling. In direct terms, extending the period in which older people can live safely in their own homes through access to decent quality home- and community-based care improves wellbeing of care recipients (who consistently prefer those forms of care to residential care), increases the return on earlier investments in the health capital

44 The geographic disaggregation is China; Eurasia and Mediterranean; India; LAC; and Sub-Saharan Africa.

of both cared and carers, and is likely to be more cost-effective through delaying costly residential care (Low et al. 2011; You et al. 2012). Long-term care has also been seen to be a significant and growing source of employment across the world given the major shortages in care workers in both developing and most developed countries. Realizing the employment effects also often requires attention to migration policies, with immigration of care workers from younger and poorer countries a win-win for sending and receiving countries (OECD 2020).[45] In indirect terms, there are demonstrated positive impacts on the wellbeing of informal carers from formal care interventions which supplement informal care, and potential for extending the working lives and/or intensity of market work of adult children and in-laws (particularly women).

While these benefits for health, human capital, budgets, and output are clear, long-term care is a sector where there remains enormous diversity in terms of institutional boundaries between health and social care services, in the mix of services, levels of public spending, and public/private roles even in developed countries. In developing countries, formal care systems remain largely in their infancy, though a growing number are in the initial stages of developing them (see Glinskaya et al. 2018 for discussion of China), with particular challenges in working through the appropriate institutional arrangements and financing models. For most developing countries, the starting point is likely to be developing a national long term care strategy which delineates the roles of state, market, communities, and households and is built around an "ageing in place" approach which also promotes a continuum of care across home, community-based and health facility settings. For countries which are further along in development of their long-term care sectors, there is a range of issues which need to be addressed as the formal LTC sector matures, including institutional mandates, defining packages of publicly-financed LTC and who is eligible for them, financing, contracting and provider payment mechanisms, and human resources (Yiengprugsawan and Piggott (2022) and O'Keefe and Yiengprugsawan (2023) on the experience of emerging Asia for example).

iv. The built and community environment

While much of the literature on NCDs tends to focus on the underlying diseases, it is vital also to think about how NCDs play out in terms of *functional* capacity. As WHO has emphasized in its World Report on Ageing and Health in 2015 (summarized in Beard et al. 2016), functional capacity is an outcome of the interaction of intrinsic capacity ("the composite of all the physical and mental capacities of an individual") and the external environment within which people live. That external environment has many dimensions, but a crucial one is the built environment within which people live.[46] As noted, a common underlying disease or condition may have very different impacts on a person's functioning depending on whether their built environment is accommodative or hindering. This social model of disability is highly relevant to the impact of NCDs on people's ability to live a full and satisfying life. For the built environment, promoting universal design for buildings and public spaces, appropriate housing, multi-generational spaces, more accessible and inclusive public transport systems, effective spatial planning to facilitate access, and other features of the physical environment is crucial to maximizing the potential of people with NCDs as producers, satisfied citizens, and contributing family members (Das et al. 2022).[47] While this will likely involve retrofitting on the stock of such infrastructure (which may benefit from financial incentives beyond the public sector), it will be far more cost-effective to build in universal design at the design stage, requiring incorporation in planning and approval processes.

45 At the same time, the relatively low productivity of the sector makes it important to assess the net increase in output and returns to care worker human capital, which will also have a strong gender dimension given the preponderance of female workers.

46 Built environment has varying definitions but at a basic level covers the man-made or modified structures and spaces that provide people with living, working, services and recreational spaces, including man-made parks and green spaces and utilities and transport systems which provide the supporting infrastructure to utilize it. See for example US EPA: https://www.epa.gov/smm/basic-information-about-built-environment.

47 Universal design is built on seven guiding principles: Equitable Use; Flexibility in Use; Simple and Intuitive Use; Perceptible Information; Tolerance for Error; Low Physical Effort; Size and Space for Approach and Use. The original principles have been supplemented by 8 goals of universal design, namely: Body Fit, Comfort, Awareness, Understanding, Wellness, Social Integration, Personalization, Cultural Appropriateness. https://universaldesign.ie/What-is-Universal-Design.

Beyond the level of individual infrastructure or specific systems such as public transport, the focus in more advanced policy settings is on whole-of-community approaches to creating environments which are accommodative of people with functional limitations. The focus is often elderly people, but such initiatives are beneficial for anyone with functional limitations. This can be seen in planning and areas-based approach in countries such as Singapore and Japan, usually in the context of building age-friendly communities.

v. Cross-cutting policies directly impacting NCDs and their management

While many cross-sectoral policies influence NCDs and human capital more broadly, four are worth highlighting as especially salient. The first ***is taxation policy and tax treatment of tobacco, alcohol, and sweetened beverages (SSBs)***. While the political economy of increases taxes on all three is always challenging (Elliott et al. 2020, the benefits in reducing risk behaviors and ultimately NCDs are very well documented (Jha et al. 2014). The impact in terms of mortality and morbidity, costs to households and reduction in other beneficial forms of consumption, costs to health systems in treating tobacco-related disease are enormous. WHO estimates over 8 million deaths globally per year from tobacco, of whom around 1.2 million are non-smokers, and that around 80 percent of the world's 1.3 million tobacco users are in LICs and MICs.[48] The Asian Development Bank (ADB) estimates for Asia also suggest that productivity losses from tobacco and alcohol use combined run to around 2 percent of GDP annually (Lane (2022) for ADB). At the same time, taxes on tobacco in most developing countries average less than half of the price of products, as against around two thirds or higher in many HICs (Verguet et al. 2015; Lane 2022). WHO estimates that an increase in tobacco prices by 10 percent decreases consumption by about 5 percent in low- and middle-income countries. In addition, despite assumptions to the contrary, raising taxes appears to benefit the poor more due to their price elasticities, so is equitable as well (see Verguet et al. 2015 for China). Similarly, evidence from countries such as Mexico, South Africa, and Chile shows the positive health impacts of raising taxes on sugar-sweetened beverages (SSBs) (Basto-Abro et al. 2019; Stacey et al. 2021). The case for raising tobacco, alcohol and SSB taxes in most LICs and MICs is therefore clear, despite the arguments of industry that illicit trade increases. This has been happening in developing countries, most commonly through increases in excise taxes. A CGD study (Lane, Glassman, and Smitham 2021) found 124 policy commitments in 43 countries in IMF and World Bank programs on the taxation of alcohol, tobacco, and SSBs, with more than half relating to tobacco products and one third to alcoholic beverages.

Of course, taxes are not the only instrument in seeking to modify these risk factors, albeit they are the most effective in the case of tobacco. For example, the *WHO Framework Convention on Tobacco Control* recommends a multi-prong approach labelled "MPOWER" i.e., **M**onitor tobacco use and prevention policies; **P**rotect people from tobacco use (particularly through smoke-free indoor public places); **O**ffer help to quit tobacco use; **W**arn about the dangers of tobacco; **E**nforce bans on tobacco advertising, promotion, and sponsorship; and **R**aise taxes on tobacco. Ekpu and Brown (2015) provide an excellent summary of interventions to reduce smoking and their economic cost and benefits. Similar mixes of policies are relevant for alcohol and SSBs.

A second area of direct relevance to NCDs is ***policies to reduce air pollution***. According to WHO's World Global Ambient Air Quality Database nine in 10 people globally breathe highly polluted air, and in 2019, 99 percent of the world's population was living in places where the WHO air quality guidelines levels were not met.[49] The health impacts of outdoor air pollution are exacerbated by household air pollution from burning fuel inside houses, notably for women. The combined impacts of outdoor and household air pollution are about 7 million premature deaths each year from NCDs (almost 90 percent of them in developing countries) including from heart disease, chronic obstructive pulmonary disease, lung cancer, acute respiratory infections, and stroke.[50] Exposure also has an equity dimension, with people in developing countries more exposed to both types of pollution, and poor and marginal-

48 https://www.who.int/news-room/fact-sheets/detail/tobacco.

49 https://www.who.int/publications/m/item/who-air-quality-database-2022.

50 https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/exposure-air-pollution.

ized communities within those countries more exposed that their better-off fellow citizens. WHO also notes the specific impacts on women and children, with air pollution increasing low birth weight, preterm birth and small for gestational age births, and evidence suggesting that air pollution may affect diabetes and neurological development in children. The policy responses to limit air pollution are multiple, and include efforts on clean household fuel and energy, clean energy technologies, clean use of technology in industry, urban planning and transport practices that reduce pollution, taxes, and market mechanisms to incentivize green technologies, and reforming waste management practices.[51]

The third is ***expanding coverage of social insurance***. This applies first and foremost to social health insurance, where more rapid progression toward UHC, and inclusion of cost-effective NCD interventions in essential health packages, has the potential to impact NCD prevalence and management in several ways. But is also applies to other forms of social insurance such as sickness, workplace injury, disability, and unemployment insurance. For example, sickness cover can be protective of human capital, reducing further deterioration of health conditions by allowing recovery time, but also protection of fellow workers from infectious conditions. In addition, unemployment benefits may help to mitigate the negative mental health effects that have been shown to accompany job loss and unemployment (McKee-Ryan et al. 2005; Paul et al. 2009). See Annex Table 2A.3 for examples of social insurance and other social protection policies which are relevant to NCDs and HC across the life cycle.

The fourth ***is interventions to improve road safety*** and reduce the enormous toll of mortality and injury from traffic accidents. While not NCDs in the main sense of the HLI, road accidents claim 1.35 million lives per year (over 90 percent of them in developing countries), and up to 50 million people sustain non-fatal injuries, accounting for output losses of 7 to 22 percent of GDP over a 24-year period.[52] Addressing the causes of traffic accidents includes policies on road and roadside design and operation, safety standards for vehicles, behavioral issues such as drunk driving and seat belt and helmet use, and improving post-crash emergency and healthcare services (WHO 2018).

CONCLUSION

NCDs are one of the major health and development challenges of our time. The preconception that NCDs are mainly conditions of rich countries is increasingly untenable, and the HLI is one of a growing set of efforts to increase the urgency of policy response across the world. An operational framework is imperative to address the impact of the rising toll of NCDs on the lives and wellbeing of people in low and middle-income countries. NCDs reduce the possibility of healthy longevity and their negative impact on human capital and productivity is complemented by their effect on wellbeing, itself an intrinsic outcome of development. This chapter has attempted to unbundle the intricate web of relationships between NCDs, human capital, and the end outcomes of healthy longevity, inclusive growth, and wellbeing.

The three main channels through which NCDs may impact end outcomes are the macroeconomic/savings channel, the fiscal channel, and the human capital channel. On the first channel, there has been much debate on the impact of population health on economic growth, and an inherent challenge is how to account for non-health factors such as institutions and geography. But a growing body of empirical work, including from developing countries, supports a negative relationship between NCD prevalence and economic growth, though the causal nature of the relationship remains a subject of debate. NCDs also have clear fiscal impacts on the expenditure and revenue sides, increasing public spending on healthcare and aged care, and reducing revenues from both workers and firms. At the same time, taxes on tobacco, alcohol and sugar-sweetened beverages are crucial instruments for prevention of NCDs, increasing longevity, and promoting future productivity.

51 https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health.

52 https://www.worldbank.org/en/news/feature/2019/05/09/how-can-you-help-save-lives-on-the-road.

In terms of the human capital channel, a life course perspective is vital, and the discussion has attempted to unbundle how NCDs impact HC from conception through to old age, and also across generations. NCDs compromise the entire trajectory of HC, from its formation to deployment to protection and preservation. The immediate and long-term impacts of NCDs and risk behaviors play out in the labor market in multiple ways, compromising individual welfare, and productivity and growth at the societal level. The relationships between NCDs and HC, and between them and end outcomes, are also multi-directional. NCDs and HC have a two-way impact on each other, and NCDs and HC are themselves affected by levels of economic development and wellbeing. While the tangled nature of the relationships makes attribution of causality challenging, the expanding literature from rich and developing countries increasingly suggests a causal link between NCDs, human capital and end outcomes.

Apart from the aggregate impacts of NCDs, the chapter has highlighted the importance of distributional implications. In terms of socio-economic status, most NCDs and risk factors disproportionately affect poorer and more vulnerable people within countries, both in terms of their incidence and in terms of lower financial protection offered by public programs. These disparities appear to be even more pronounced within LICs. There are also important gender inequality considerations, both in terms of the NCDs of women themselves and how they are managed by health systems, and in terms of the disproportionate burden on women of caring for NCD-affected family members.

NCDs also have crucial effects on human wellbeing itself, over and above their impact on human capital, productivity, and growth. That intrinsic benefit is a fundamental motivation for addressing the rising toll of NCDs in developing countries. Research on the relationships between NCDs and wellbeing consistently demonstrates that NCDs compromise quality of life across various wellbeing measures, and that the relationship is also bidirectional: subjective measures of wellbeing matter for health (including appearing to be a protective factor), and NCDs impact subjective measures of wellbeing.

Just as NCDs impact HC and end outcomes across the life course, policy responses to prevent and control them are needed from before birth to the end of life. The chapter has outlined some of the major policy areas, with detailed consideration of specific policy domains in various areas of HLI research. The most direct are the areas of nutrition, public health, and healthcare services, where the economic and social returns to investments are high, and affordable packages of essential NCD interventions are available. While cost-effectiveness is a key consideration for developing countries in prioritizing limited budgets, it is also important to integrate equity and financial protection considerations, as well as feasibility of implementation. Beyond the health sector, there are improvements needed in taxation policies to shift risk behaviors (and raise revenue), and policies and interventions to reduce air pollution, improve road safety, adapt the built environment, and expand coverage of social security systems.

Finally, while some of the channels through which NCDs influence the end outcomes of interest are becoming better understood, there remains a huge outstanding research agenda, especially for developing countries. The knowledge base on NCDs and their socioeconomic and wellbeing impacts in developing countries is growing rapidly, but that evidence also points to the diversity of situations across countries and within them. In particular, making the economic case for why NCDs matter for development will be crucial to persuading policymakers of the urgency of and high returns to enhancing investments in NCD prevention and management.

REFERENCES

1. Abdullah, Asnawi. 2015. "The Double Burden of Undernutrition and Overnutrition in Developing Countries: An Update." *Current Obesity Reports* 4 (3): 337–49. https://doi.org/10.1007/s13679-015-0170-y.
2. Acemoglu, Daron, Francisco Gallego, and James A. Robinson. 2014. "Institutions, Human Capital and Development." National Bureau of Economic Research. February 1, 2014. https://doi.org/10.3386/w19933.
3. Acemoglu, Daron, and Simon Johnson. 2007. "Disease and Development: The Effect of Life Expectancy on Economic Growth." *Journal of Political Economy* 115 (6): 925–85. https://doi.org/10.1086/529000.
4. Acuña, Carlos, Héctor Acuña, and Diego Carrasco. 2019. "Health Shocks and the Added Worker Effect: A Life Cycle Approach." *Journal of Applied Economics* 22 (1): 273–86. https://ideas.repec.org/a/taf/recsxx/v22y2019i1p273-286.html.

5. Adda, Jérôme, James Banks, and Hans-Martin von Gaudecker. 2009. "The Impact of Income Shocks on Health: Evidence from Cohort Data." *Journal of the European Economic Association* 7 (6): 1361–99. https://doi.org/10.1162/jeea.2009.7.6.1361.
6. Aghion, Philippe, and Peter Howitt. 1998. *Endogenous Growth Theory*. Cambridge, MA: The MIT Press.
7. Allen, Luke, Julianne Williams, Nick Townsend, Bente Mikkelsen, Nia Roberts, Charlie Foster, and Kremlin Wickramasinghe. 2017. "Socioeconomic Status and Non-Communicable Disease Behavioural Risk Factors in Low-Income and Lower-Middle-Income Countries: A Systematic Review." *The Lancet Global Health* 5 (3): e277–89. https://doi.org/10.1016/s2214-109x(17)30058-x.
8. Angner, Erik, Jennifer Ghandhi, Kristen Williams Purvis, Daniel Amante, and Jeroan Allison. 2012. "Daily Functioning, Health Status, and Happiness in Older Adults." *Journal of Happiness Studies* 14 (5): 1563–74. https://doi.org/10.1007/s10902-012-9395-6.
9. Arabi, Yaseen M., Hanan H. Balkhy, Frederick G. Hayden, Abderrezak Bouchama, Thomas Luke, J. Kenneth Baillie, Awad Al-Omari, et al. 2017. "Middle East Respiratory Syndrome." *New England Journal of Medicine* 376 (6): 584–94. https://doi.org/10.1056/nejmsr1408795.
10. Armengaud, J. B., C. Yzydorczyk, B. Siddeek, A. C. Peyter, and U. Simeoni. 2021. "Intrauterine Growth Restriction: Clinical Consequences on Health and Disease at Adulthood." *Reproductive Toxicology* 99 (January): 168–76. https://doi.org/10.1016/j.reprotox.2020.10.005.
11. Arokiasamy, Perianayagam, Uttamacharya Uttamacharya, Kshipra Jain, Richard Berko Biritwum, Alfred Edwin Yawson, Fan Wu, Yanfei Guo, et al. 2015. "The Impact of Multimorbidity on Adult Physical and Mental Health in Low- and Middle-Income Countries: What Does the Study on Global Ageing and Adult Health (SAGE) Reveal?" *BMC Medicine* 13 (1). https://doi.org/10.1186/s12916-015-0402-8.
12. Arrow, Kenneth J., Partha Dasgupta, Lawrence H. Goulder, Kevin J. Mumford, and Kirsten Oleson. 2013. "Sustainability and the Measurement of Wealth: Further Reflections." *Environment and Development Economics* 18 (4): 504–16. https://doi.org/10.1017/s1355770x13000193.
13. Ashraf, Quamrul H., Ashley Lester, and David N. Weil. 2008. "When Does Improving Health Raise GDP?" *NBER Macroeconomics Annual* 23 (1): 157–204. https://doi.org/10.1086/593084.
14. Atella, Vincenzo, and Joanna Kopinska. 2014. "Body Weight, Eating Patterns, and Physical Activity: The Role of Education." *Demography* 51 (4): 1225–49. https://doi.org/10.1007/s13524-014-0311-z.
15. Baldanzi, Annarita, Alberto Bucci, and Klaus Prettner. 2017. "Children's Health, Human Capital Accumulation, and R&D-Based Economic Growth." *Hohenheim Discussion Papers in Business, Economics and Social Sciences*. University of Hohenheim, Faculty of Business, Economics and Social Sciences. https://ideas.repec.org/p/zbw/hohdps/012017.html.
16. Banerjee, Abhijit, and Esther Duflo. 2010. Aging and Death under a Dollar a Day. In *Research Findings in the Economicsof Aging.* Edited by David Wise. University of Chicago Press.
17. Bastagli, Francesca, Jessica Hagen-Zanker, and Georgina Sturge. 2016. "Cash Transfers: What Does the Evidence Say? A Rigorous Review of Impacts and the Role of Design and Implementation Features." United Kingdom: Overseas Development Institute (ODI). https://odi.org/en/publications/cash-transfers-what-does-the-evidence-say-a-rigorous-review-of-impacts-and-the-role-of-design-and-implementation-features/.
18. Bastagli, Francesca, Jessica Hagen-Zanker, Luke Harman, Valentina Barca, Georgina Sturge, Tanja Schmidt, and Luca Pellerano. 2016. "Cash Transfers: What Does the Evidence Say? A Rigorous Review of Programme Impact and of the Role of Design and Implementation Features." London: Overseas Development Institute.
19. Basto-Abreu, Ana, Tonatiuh Barrientos-Gutiérrez, Dèsirée Vidaña-Pérez, M. Arantxa Colchero, Mauricio Hernández-F., Mauricio Hernández-Ávila, Zachary J. Ward, Michael W. Long, and Steven L. Gortmaker. 2019. "Cost-Effectiveness of the Sugar-Sweetened Beverage Excise Tax in Mexico." *Health Affairs* 38 (11): 1824–31. https://doi.org/10.1377/hlthaff.2018.05469.
20. Beaglehole, Robert, Ruth Bonita, and Roger S. Magnusson. 2011. "Global Cancer Prevention: An Important Pathway to Global Health and Development." *Public Health* 125 (12): 821–31. https://doi.org/10.1016/j.puhe.2011.09.029.
21. Ben-Porath, Yoram. 1967. "The Production of Human Capital and the Life Cycle of Earnings." *Journal of Political Economy* 75 (4, Part 1): 352–65. https://doi.org/10.1086/259291.
22. Bennett, James E, Gretchen A Stevens, Colin D Mathers, Ruth Bonita, Jürgen Rehm, Margaret E Kruk, Leanne M Riley, et al. 2018. "NCD Countdown 2030: Worldwide Trends in Non-Communicable Disease Mortality and Progress towards Sustainable Development Goal Target 3.4." *The Lancet* 392 (10152): 1072–88. https://doi.org/10.1016/s0140-6736(18)31992-5.
23. Bertuccio, Paola, Gianfranco Alicandro, Matteo Malvezzi, Greta Carioli, Paolo Boffetta, Fabio Levi, Carlo La Vecchia, and Eva Negri. 2020. "Childhood Cancer Mortality Trends in Europe, 1990-2017, with Focus on Geographic Differences." *Cancer Epidemiology* 67 (August): 101768. https://doi.org/10.1016/j.canep.2020.101768.
24. Bhalotra, Sonia, and Samantha B. Rawlings. 2011. "Intergenerational Persistence in Health in Developing Countries: The Penalty of Gender Inequality?" *Journal of Public Economics* 95 (3-4): 286–99. https://doi.org/10.1016/j.jpubeco.2010.10.016.
25. Bhutta, Zulfiqar A, Tahmeed Ahmed, Robert E Black, Simon Cousens, Kathryn Dewey, Elsa Giugliani, Batool A Haider, et al. 2008. "What Works? Interventions for Maternal and Child Undernutrition and Survival." *The Lancet* 371 (9610): 417–40. https://doi.org/10.1016/s0140-6736(07)61693-6.
26. Black, Robert E, Cesar G Victora, Susan P Walker, Zulfiqar A Bhutta, Parul Christian, Mercedes de Onis, Majid Ezzati, et al. 2013. "Ma-

ternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries." *The Lancet* 382 (9890): 427–51.
27. Black, Sandra E., Paul J. Devereux , and Kjell G. Salvanes. 2012. "Losing Heart? The Effect of Job Displacement on Health." *NBER Working Paper W18660*. Cambridge, MA: National Bureau of Economic Research. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2194785.
28. Blackstone, Tanja, and Kristen Rensselaer. 2021. "Does Education Contribute to Happiness? A Cross-Country Study." *Research in Business and Economics Journal* 14. https://www.aabri.com/manuscripts/203179.pdf.
29. Blazer, Dan G., Kristine Yaffe, and Jason Karlawish. 2015. "Cognitive Aging." *JAMA* 313 (21): 2121. https://doi.org/10.1001/jama.2015.4380.
30. Bleakley, Hoyt. 2010. "Health, Human Capital, and Development." *Annual Review of Economics* 2 (1): 283–310. https://doi.org/10.1146/annurev.economics.102308.124436.
31. Bloom, David E., Elizabeth T. Cafiero-Fonseca, Mark E. McGovern, Klaus Prettner, Anderson Stanciole, Jonathan Weiss, Samuel Bakkila, and Larry Rosenberg. 2014. "The Macroeconomic Impact of Non-Communicable Diseases in China and India: Estimates, Projections, and Comparisons." *The Journal of the Economics of Ageing* 4 (December): 100–111. https://doi.org/10.1016/j.jeoa.2014.08.003.
32. Bloom, David E., David Canning, and Bryan Graham. 2003. "Longevity and Life-Cycle Savings." *The Scandinavian Journal of Economics* 105 (3): 319–38. https://www.jstor.org/stable/3440944.
33. Bloom, David E., David Canning, and Jaypee Sevilla. 2004. "The Effect of Health on Economic Growth: A Production Function Approach." *World Development* 32 (1): 1–13. https://doi.org/10.1016/j.worlddev.2003.07.002.
34. Bloom, David E., Michael Kuhn, and Klaus Prettner. 2018. "Health and Economic Growth." *IZA Discussion Paper 11939*. Bonn, Germany: IZA Institute of Labor Economics. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3301688.
35. Bloom, David, Michael Kuhn, and Klaus Prettner. 2015. "The Contribution of Female Health to Economic Development." *NBER Working Paper 21411*. Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w21411/w21411.pdf.
36. BMJ. 2018. "The Health, Poverty, and Financial Consequences of a Cigarette Price Increase among 500 Million Male Smokers in 13 Middle Income Countries: Compartmental Model Study." *BMJ*, April, k1162. https://doi.org/10.1136/bmj.k1162.
37. Boehm, Julia K., and Laura D. Kubzansky. 2012. "The Heart's Content: The Association between Positive Psychological Well-Being and Cardiovascular Health." *Psychological Bulletin* 138 (4): 655–91. https://doi.org/10.1037/a0027448.
38. Bommer, Christian, Esther Heesemann, Vera Sagalova, Jennifer Manne-Goehler, Rifat Atun, Till Bärnighausen, and Sebastian Vollmer. 2017. "The Global Economic Burden of Diabetes in Adults Aged 20-79 Years: A Cost-of-Illness Study." *The Lancet. Diabetes & Endocrinology* 5 (6): 423–30. https://doi.org/10.1016/S2213-8587(17)30097-9.
39. Bonita, Ruth, and Robert Beaglehole. 2014. "Women and NCDs: Overcoming the Neglect." *Global Health Action* 7 (1): 23742. https://doi.org/10.3402/gha.v7.23742.
40. Boucekkine, Raouf, David de la Croix, and Omar Licandro. 2002. "Vintage Human Capital, Demographic Trends, and Endogenous Growth." *Journal of Economic Theory* 104 (2): 340–75. https://ideas.repec.org/a/eee/jetheo/v104y2002i2p340-375.html.
41. Braakmann, Nils. 2011. "The Causal Relationship between Education, Health and Health Related Behaviour: Evidence from a Natural Experiment in England." *Journal of Health Economics* 30 (4): 753–63. https://doi.org/10.1016/j.jhealeco.2011.05.015.
42. Brouwers, Evelien P. M. 2020. "Social Stigma Is an Underestimated Contributing Factor to Unemployment in People with Mental Illness or Mental Health Issues: Position Paper and Future Directions." *BMC Psychology* 8 (1). https://doi.org/10.1186/s40359-020-00399-0.
43. Buckles, Kasey, Andreas Hagemann, Ofer Malamud, Melinda Morrill, and Abigail Wozniak. 2013. "The Effect of College Education on Health." *NBER Working Paper 19222*. Cambridge, MA: National Bureau of Economic Research. https://econpapers.repec.org/paper/nbrnberwo/19222.htm.
44. Bundy, Donald A.P., Nilanthi de Silva, Susan Horton, George C. Patton, Linda Schultz, and Dean T. Jamison. 2017. "Child and Adolescent Health and Development: Realizing Neglected Potential." In *Child and Adolescent Health and Development. 3rd Edition*. Washington, D.C.: World Bank. doi: 10.1596/978-1-4648-0423-6_ch1.
45. Cancelliere, Carol, J David Cassidy, Carlo Ammendolia, and Pierre Côté. 2011. "Are Workplace Health Promotion Programs Effective at Improving Presenteeism in Workers? A Systematic Review and Best Evidence Synthesis of the Literature." *BMC Public Health* 11 (1). https://doi.org/10.1186/1471-2458-11-395.
46. Capatina, Elena, Michael Keane, and Shiko Maruyama. 2020. "Health Shocks and the Evolution of Earnings over the Life-Cycle." *UNSW Economics Working Paper 2018-14a*. Sydney, Australia: School of Economics, The University of New South Wales. https://ideas.repec.org/p/swe/wpaper/2018-14b.html.
47. Carney, Robert M., and Kenneth E. Freedland. 2016. "Depression and Coronary Heart Disease." *Nature Reviews Cardiology* 14 (3): 145–55. https://doi.org/10.1038/nrcardio.2016.181.
48. Cervellati, Matteo, and Uwe Sunde. 2009. "Life Expectancy and Economic Growth: The Role of the Demographic Transition." *IZA Discussion Paper No. 4160*. Bonn, Germany: Institute for the Study of Labor (IZA). https://doi.org/10.2139/ssrn.1405928.
49. Chakraborty, Debapriya, Daphne Wu, and Prabhat Jha. 2024. "Exploring the Labour Market Outcomes of the Risk Factors for Non-communicable Diseases: A Systematic Review." In *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington, D.C.: World Bank.

50. Elliott, Lana M, Sarah L Dalglish and Stephanie M. Topp. 2020. "Health Taxes on Tobacco, Alcohol, Food and Drinks in Low- and Middle-Income Countries: A Scoping Review of Policy Content, Actors, Process and Context." *International Journal of Health Policy and Management* 11: 414 - 428.
51. International Food Policy Research Institute (IFPRI). 2016. Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030. Washington, DC
52. International LabourOrganization (ILO). "Care work and care jobs for the future of decent work." Geneva, Switzerland: International Labour Office.
53. Save the Children. 2008. "Saving the lives of mothers and newborns inAfghanistan: Afghanistan newborn health situation analysis." Kabul: Save the Children.
54. ———. 2015. "The Economic and Demographic Transition, Mortality, and Comparative Development." *American Economic Journal: Macroeconomics* 7 (3): 189–225. https://doi.org/10.1257/mac.20130170.
55. Chaker, Layal, Abby Falla, Sven J. van der Lee, Taulant Muka, David Imo, Loes Jaspers, Veronica Colpani, et al. 2015. "The Global Impact of Non-Communicable Diseases on Macro-Economic Productivity: A Systematic Review." *European Journal of Epidemiology* 30 (5): 357–95. https://doi.org/10.1007/s10654-015-0026-5.
56. Chan, J.W.M., C.K. Ng, Y.H. Chan, T.Y.W. Mok, W.H.O.S. Lee, S.Y.Y. Chu, W.L. Law, M.P. Lee, and P.C.K. Li. 2003. "Short Term Outcome and Risk Factors for Adverse Clinical Outcomes in Adults with Severe Acute Respiratory Syndrome (SARS)." *Thorax* 58 (8): 686–89. https://doi.org/10.1136/thorax.58.8.686.
57. Chang, Anna Marie, Bryn Mumma, Keara L. Sease, Jennifer L. Robey, Frances S. Shofer, and Judd E. Hollander. 2007. "Gender Bias in Cardiovascular Testing Persists after Adjustment for Presenting Characteristics and Cardiac Risk." *Academic Emergency Medicine: Official Journal of the Society for Academic Emergency Medicine* 14 (7): 599–605. https://doi.org/10.1197/j.aem.2007.03.1355.
58. Charlton, Karen E., and Donald Rose. 2001. "Nutrition among Older Adults in Africa: The Situation at the Beginning of the Millenium." *The Journal of Nutrition* 131 (9): 2424S2428S. https://doi.org/10.1093/jn/131.9.2424S.
59. Charmes, Jacques. 2019. "The Unpaid Care Work and the Labour Market. An Analysis of Time Use Data Based on the Latest World Compilation of Time-Use Surveys." Geneva, Switzerland: International Labour Office. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---gender/documents/publication/wcms_732791.pdf.
60. Chatenoud, Liliane, Paola Bertuccio, Cristina Bosetti, Fabio Levi, Eva Negri, and Carlo La Vecchia. 2010. "Childhood Cancer Mortality in America, Asia, and Oceania, 1970 through 2007." *Cancer* 116 (21): 5063–74. https://doi.org/10.1002/cncr.25406.
61. Chida, Yoichi, and Andrew Steptoe. 2008. "Positive Psychological Well-Being and Mortality: A Quantitative Review of Prospective Observational Studies." *Psychosomatic Medicine* 70 (7): 741–56. https://doi.org/10.1097/psy.0b013e31818105ba.
62. Chłoń-Domińczak , Agnieszka, and Dariusz Stańko. 2015. "Are Survivor Pensions Still Needed?" In *OECD Pensions Outlook 2018*. Paris: OECD Publishing. https://www.oecd-ilibrary.org/sites/pens_outlook-2018-10-en/index.html?itemId=/content/component/pens_outlook-2018-10-en.
63. Clark, Andrew E., Sarah Flèche, Richard Layard, Nattavudh Powdthavee, and George Ward. 2017. "The Key Determinants of Happiness and Misery." *CEP Discussion Papers*. UK: Centre for Economic Performance, LSE. https://ideas.repec.org/p/cep/cepdps/dp1485.html.
64. Clark, Damon, and Heather Royer. 2013. "The Effect of Education on Adult Mortality and Health: Evidence from Britain." *American Economic Review* 103 (6): 2087–2120. https://doi.org/10.1257/aer.103.6.2087.
65. Conti, Gabriella, and Christopher Hansman. 2013. "Personality and the Education–Health Gradient: A Note on 'Understanding Differences in Health Behaviors by Education.'" *Journal of Health Economics* 32 (2): 480–85. https://doi.org/10.1016/j.jhealeco.2012.07.005.
66. Conti, Gabriella, and James J. Heckman. 2010. "Understanding the Early Origins of the Education–Health Gradient." *Perspectives on Psychological Science* 5 (5): 585–605. https://doi.org/10.1177/1745691610383502.
67. Conti, Gabriella, James Heckman, and Sergio Urzua. 2010. "The Education-Health Gradient." *American Economic Review* 100 (2): 234–38. https://doi.org/10.1257/aer.100.2.234.
68. Currie, Janet, and Mark Stabile. 2006. "Child Mental Health and Human Capital Accumulation: The Case of ADHD." *Journal of Health Economics* 25 (6): 1094–1118. https://doi.org/10.1016/j.jhealeco.2006.03.001.
69. Cutler, David, and Adriana Lleras-Muney. 2006. "Education and Health: Evaluating Theories and Evidence." *NBER Working Paper 12352*. Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w12352/w12352.pdf.
70. Das, Maitreyi B., Arai Yuko, Terri B. Chapman, and Vibhu Jain. 2022. "Silver Hues: Building Age-Ready Cities." Washington, D.C.: World Bank. http://hdl.handle.net/10986/37259.
71. Davidson, Karina W., Elizabeth Mostofsky, and William Whang. 2010. "Don't Worry, Be Happy: Positive Affect and Reduced 10-Year Incident Coronary Heart Disease: The Canadian Nova Scotia Health Survey." *European Heart Journal* 31 (9): 1065–70. https://doi.org/10.1093/eurheartj/ehp603.
72. Deaton, Angus. 2008. "Income, Health, and Well-Being around the World: Evidence from the Gallup World Poll." *Journal of Economic Perspectives* 22 (2): 53–72. https://doi.org/10.1257/jep.22.2.53.
73. Deaton, Angus S., and Christina H. Paxson. 1998. "Aging and Inequality in Income and Health." *The American Economic Review* 88 (2): 248–53. https://www.jstor.org/stable/116928.

74. Debas, Haile T., Peter Donkor, Atul Gawande, Dean T. Jamison, Margaret E. Kruk, and Charles N. Mock, eds. 2015. *Essential Surgery*. Disease Control Priorities, Third Edition (Volume 1). Washington, D.C.: World Bank.
75. Desbordes, Rodolphe. 2011. "The Non-Linear Effects of Life Expectancy on Economic Growth." *Economics Letters* 112 (1): 116–18. https://doi.org/10.1016/j.econlet.2011.03.027.
76. Devercelli, Amanda E., and Frances Beaton-Day. 2020. "Better Jobs and Brighter Futures: Investing in Childcare to Build Human Capital." Washington, D.C.: World Bank. https://openknowledge.worldbank.org/server/api/core/bitstreams/a5e-7a52e-115c-5dd1-97e6-c1b062c945c9/content.
77. Devries, K. M., J. Y. T. Mak, C. García-Moreno, M. Petzold, J. C. Child, G. Falder, S. Lim, et al. 2013. "The Global Prevalence of Intimate Partner Violence against Women." *Science* 340 (6140): 1527–28. https://doi.org/10.1126/science.1240937.
78. Dinerstein, Michael, Rigissa Megalokonomou, and Constantine Yannelis. 2022. "Human Capital Depreciation and Returns to Experience." *NBER Working Paper 27925*. Vol. 112. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.1257/aer.20201571.
79. Do, Young Kyung, and Mary Ann Bautista. 2015. "Tobacco Use and Household Expenditures on Food, Education, and Healthcare in Low- and Middle-Income Countries: A Multilevel Analysis." *BMC Public Health* 15 (1). https://doi.org/10.1186/s12889-015-2423-9.
80. Donfouet, Hermann P.P., Shukri F. Mohamed, and Eric Malin. 2021. "Socioeconomic Inequality in Tobacco Use in Kenya: A Concentration Analysis." *International Journal of Health Economics and Management*, January. https://doi.org/10.1007/s10754-020-09292-0.
81. Doshi, Kokila. 1994. "Determinants of the Savings Rate: An International Comparison." *Contemporary Economic Policy* 12 (1): 37–45. https://doi.org/10.1111/j.1465-7287.1994.tb00410.x.
82. Dumas, Julie A. 2017. "Strategies for Preventing Cognitive Decline in Healthy Older Adults." *The Canadian Journal of Psychiatry* 62 (11): 754–60. https://doi.org/10.1177/0706743717720691.
83. Ekpu, Victor U., and Abraham K. Brown. 2015. "The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence." *Tobacco Use Insights* 8 (8): TUI.S15628. https://doi.org/10.4137/tui.s15628.
84. Eliason, Marcus, and Donald Storrie. 2009. "Job Loss Is Bad for Your Health – Swedish Evidence on Cause-Specific Hospitalization Following Involuntary Job Loss." *Social Science & Medicine* 68 (8): 1396–1406. https://doi.org/10.1016/j.socscimed.2009.01.021.
85. Essue, Beverley M., Tracey-Lea Laba, Felicia Knaul, Annie Chu, Hoang Van Minh, Thi Kim Phuong Nguyen, and Stephen Jan. 2017. "Economic Burden of Chronic Ill Health and Injuries for Households in Low- and Middle-Income Countries." Edited by Dean T. Jamison, Hellen Gelband, Susan Horton, Prabhat Jha, Ramanan Laxminarayan, Charles N. Mock, and Rachel Nugent. PubMed. Washington (DC): The International Bank for Reconstruction and Development / The World Bank. 2017. https://pubmed.ncbi.nlm.nih.gov/30212160/.
86. Etilé, Fabrice, and Andrew M. Jones. 2011. "Schooling and Smoking among the Baby Boomers – an Evaluation of the Impact of Educational Expansion in France." *Journal of Health Economics* 30 (4): 811–31. https://doi.org/10.1016/j.jhealeco.2011.05.002.
87. Evans, Brooks F., and Robert J. Palacios. 2015. "An Examination of Elderly Co-Residence in the Developing World." *Social Protection & Labor Policy Note No. 17*. Washington, D.C.: World Bank. http://documents.worldbank.org/curated/en/600291467992481736/An-examination-of-elderly-co-residence-in-the-developing-world.
88. Evans, David, Maryam Akmal, and Pamela Jakiela. 2020. "Gender Gaps in Education: The Long View." Washington, D.C.: Center for Global Development. https://www.cgdev.org/publication/gender-gaps-education-long-view.
89. Eze, Paul, Lucky Osaheni Lawani, Ujunwa Justina Agu, and Yubraj Acharya. 2022. "Catastrophic Health Expenditure in Sub-Saharan Africa: Systematic Review and Meta-Analysis." *Bulletin of the World Health Organization* 100 (05): 337–51J. https://doi.org/10.2471/blt.21.287673.
90. Field, John. 2013. "Learning through the Ages? Generational Inequalities and Inter-Generational Dynamics of Lifelong Learning." *British Journal of Educational Studies* 61 (1): 109–19. https://doi.org/10.1080/00071005.2012.756172.
91. Finkelstein, Eric. A., Wan. C.K. Graham, and Rahul Malhotra. 2014. "Lifetime Direct Medical Costs of Childhood Obesity." *PEDIATRICS* 133 (5): 854–62. https://doi.org/10.1542/peds.2014-0063.
92. Folbre, Nancy. 2015. "Valuing Non-Market Work." *Think Piece for 2015 UNDP Human Development Report* . New York, NY: United Nations Development Programme. https://hdr.undp.org/system/files/documents/folbrehdr2015finalpdf.pdf.
93. Galama, Titus J., Adriana Lleras-Muney, and Hans van Kippersluis. 2018. "The Effect of Education on Health and Mortality: A Review of Experimental and Quasi-Experimental Evidence." *NBER Working Paper 24225*. Cambridge, MA: National Bureau of Economic Research. https://ideas.repec.org/p/nbr/nberwo/24225.html.
94. García, Sandra, and Juan E. Saavedra. 2017. "Educational Impacts and Cost-Effectiveness of Conditional Cash Transfer Programs in Developing Countries: A Meta-Analysis." *Review of Educational Research* 87 (5): 921–65. https://doi.org/10.3102/0034654317723008.
95. Garrow, Valerie. 2016. "Presenteeism: A Review of Current Thinking." *Report 507*. Brighton, UK: Institute for Employment Studies. https://www.employment-studies.co.uk/system/files/resources/files/507_0.pdf.
96. Glinskaya, Elena E., and Zhanlian Feng. 2018. *Building an Effi-*

cient and Sustainable Aged Care System : Option for Aged Care in China. Washington, D.C.: World Bank Group.

97. Global Tobacco Economics Consortium. 2018. "The Health, Poverty, and Financial Consequences of a Cigarette Price Increase among 500 Million Male Smokers in 13 Middle Income Countries: Compartmental Model Study." *BMJ*, April, k1162. https://doi.org/10.1136/bmj.k1162.
98. Gore, Fiona M, Paul J N Bloem, George C Patton, Jane Ferguson, Véronique Joseph, Carolyn Coffey, Susan M Sawyer, and Colin D Mathers. 2011. "Global Burden of Disease in Young People Aged 10-24 Years: A Systematic Analysis." *Lancet* 377 (9783): 2093–2102. https://doi.org/10.1016/S0140-6736(11)60512-6.
99. Greenhalgh, Elizabeth M., Michelle M. Scollo, and Merryn Pearce. 2016. "The Relationship between Tobacco Smoking and Financial Stress - Tobacco in Australia." In *Tobacco in Australia: Facts and Issues*, edited by Elizabeth M. Greenhalgh, Michelle M. Scollo, and Margaret H. Winstanley. Melbourne, Australia: Cancer Council Victoria. https://www.tobaccoinaustralia.org.au/chapter-9-disadvantage/9-4-the-relationship-between-tobacco-smoking-and-f.
100. Grossman, Michael. 2006. "Education and Nonmarket Outcomes." In *Handbook of the Economics of Education*, edited by Eric Hanushek and Finis Welch, 1:577–633. Elsevier. https://ideas.repec.org/h/eee/educhp/1-10.html.
101. Gupta, Nidhi, Kashish Goel, Priyali Shah, and Anoop Misra. 2012. "Childhood Obesity in Developing Countries: Epidemiology, Determinants, and Prevention." *Endocrine Reviews* 33 (1): 48–70. https://doi.org/10.1210/er.2010-0028.
102. Haakenstad, Annie, Matthew Coates, Gene Buhkman, Margaret McConnell, and Stéphane Verguet. 2022. "Comparative Health Systems Analysis of Differences in the Catastrophic Health Expenditure Associated with Non-Communicable versus Communicable Diseases among Adults in Six Countries." *Health Policy and Planning*, July. https://doi.org/10.1093/heapol/czac053.
103. Hackett, Ruth A., and Andrew Steptoe. 2017. "Type 2 Diabetes Mellitus and Psychological Stress — a Modifiable Risk Factor." *Nature Reviews Endocrinology* 13 (9): 547–60. https://doi.org/10.1038/nrendo.2017.64.
104. Handa, Sudhanshu, Silvio Daidone, Amber Peterman, Benjamin Davis, Audrey Pereira, Tia Palermo, and Jennifer Yablonski. 2018. "Myth-Busting? Confronting Six Common Perceptions about Unconditional Cash Transfers as a Poverty Reduction Strategy in Africa." *The World Bank Research Observer* 33 (2): 259–98. https://doi.org/10.1093/wbro/lky003.
105. Hansen, Casper Worm. 2013. "Life Expectancy and Human Capital: Evidence from the International Epidemiological Transition." *Journal of Health Economics* 32 (6): 1142–52. https://doi.org/10.1016/j.jhealeco.2013.09.011.
106. Hanson, M. A., and P. D. Gluckman. 2014. "Early Developmental Conditioning of Later Health and Disease: Physiology or Pathophysiology?" *Physiological Reviews* 94 (4): 1027–76. https://doi.org/10.1152/physrev.00029.2013.
107. Heckman, James J, and Ganesh Karapakula. 2019. "Intergenerational and Intragenerational Externalities of the Perry Preschool Project." *NBER Working Paper 25889*. Cambridge, MA: National Bureau of Economic Research. https://www.nber.org/papers/w25889.
108. Heckman, James J., John Eric Humphries, and Greg Veramendi. 2016. "Returns to Education: The Causal Effects of Education on Earnings, Health and Smoking." *IZA Discussion Paper No. 9957*. Bonn, Germany: Institute of Labor Economics (IZA). https://doi.org/10.2139/ssrn.2786041.
109. Heckman, James J., and Thomas E. Macurdy. 1980. "A Life Cycle Model of Female Labour Supply." *The Review of Economic Studies* 47 (1): 47. https://doi.org/10.2307/2297103.
110. Hedayati, S. Susan. 2010. "Association between Major Depressive Episodes in Patients with Chronic Kidney Disease and Initiation of Dialysis, Hospitalization, or Death." *JAMA* 303 (19): 1946. https://doi.org/10.1001/jama.2010.619.
111. Heidari-Beni, Motahar. 2019. "Early Life Nutrition and Non Communicable Disease." *Advances in Experimental Medicine and Biology*, 33–40. https://doi.org/10.1007/978-3-030-10616-4_4.
112. Heide, Iris van der, Rogier M van Rijn, Suzan JW Robroek, Alex Burdorf, and Karin I Proper. 2013. "Is Retirement Good for Your Health? A Systematic Review of Longitudinal Studies." *BMC Public Health* 13 (1). https://doi.org/10.1186/1471-2458-13-1180.
113. Helliwell, John F, Richard Layard, and Jeffrey Sachs. 2017. *World Happiness Report 2017*. New York, NY: Sustainable Development Solutions Network. https://worldhappiness.report/ed/2017/.
114. Helliwell, John F., and Robert D. Putnam. 1999. "Education and Social Capital." *NBER Working Paper No. W7121*. Cambridge, MA: National Bureau of Economic Research.
115. Henkel, Dieter. 2011. "Unemployment and Substance Use: A Review of the Literature (1990-2010)." *Current Drug Abuse Reviewse* 4 (1): 4–27. https://doi.org/10.2174/1874473711104010004.
116. Höfelmann, Doroteia A, David A Gonzalez-Chica, Karen Glazer Peres, Antonio Fernando Boing, and Marco Aurelio Peres. 2017. "Chronic Diseases and Socioeconomic Inequalities in Quality of Life among Brazilian Adults: Findings from a Population-Based Study in Southern Brazil." *European Journal of Public Health* 28 (4): 603–10. https://doi.org/10.1093/eurpub/ckx224.
117. Hokayem, Charles, and James P. Ziliak. 2014. "Health, Human Capital, and Life Cycle Labor Supply." *American Economic Review* 104 (5): 127–31. https://doi.org/10.1257/aer.104.5.127.
118. Horioka, Charles Yuji, and Akiko Terada-Hagiwara. 2012. "The Determinants and Long-Term Projections of Saving Rates in Developing Asia." *Japan and the World Economy* 24 (2): 128–37. https://doi.org/10.1016/j.japwor.2012.01.006.
119. Hosseinpoor, Ahmad Reza, Nicole Bergen, Shanthi Mendis, Sam Harper, Emese Verdes, Anton Kunst, and Somnath Chatterji. 2012. "Socioeconomic Inequality in the Prevalence of

Noncommunicable Diseases in Low- and Middle-Income Countries: Results from the World Health Survey." *BMC Public Health* 12 (1). https://doi.org/10.1186/1471-2458-12-474.

120. Hsieh, Chang-Tai, and Pete Klenow. 2010. "Development Accounting." *American Economic Journal: Macroeconomics* 2 (1): 207–23. https://doi.org/10.1257/mac.2.1.207.
121. Hyclak, Thomas J., Christopher L. Skeels, and Larry W. Taylor. 2016. "The Cardiovascular Revolution and Economic Performance in the OECD Countries." *Journal of Macroeconomics* 50 (C): 114–25. https://ideas.repec.org/a/eee/jmacro/v50y2016icp114-125.html.
122. Izquierdo, Mikel, R. A. Merchant, J. E. Morley, S. D. Anker, I. Aprahamian, H. Arai, M. Aubertin-Leheudre, et al. 2021. "International Exercise Recommendations in Older Adults (ICFSR): Expert Consensus Guidelines." *The Journal of Nutrition, Health & Aging* 25 (7): 824–53. https://doi.org/10.1007/s12603-021-1665-8.
123. Jan, Stephen, Tracey-Lea Laba, Beverley M Essue, Adrian Gheorghe, Janani Muhunthan, Michael Engelgau, Ajay Mahal, et al. 2018. "Action to Address the Household Economic Burden of Non-Communicable Diseases." *The Lancet* 391 (10134): 2047–58. https://doi.org/10.1016/s0140-6736(18)30323-4.
124. Jaspers, Loes, Veronica Colpani, Layal Chaker, Sven J. van der Lee, Taulant Muka, David Imo, Shanthi Mendis, et al. 2014. "The Global Impact of Non-Communicable Diseases on Households and Impoverishment: A Systematic Review." *European Journal of Epidemiology* 30 (3): 163–88. https://doi.org/10.1007/s10654-014-9983-3.
125. Jayachandran, Seema, and Adriana Lleras-Muney. 2009. "Life Expectancy and Human Capital Investments: Evidence from Maternal Mortality Declines*." *Quarterly Journal of Economics* 124 (1): 349–97. https://doi.org/10.1162/qjec.2009.124.1.349.
126. Jha, Prabhat, Mary MacLennan, Frank J. Chaloupka, Ayda Yurekli, Chintanie Ramasundarahettige, Krishna Palipudi, WItold Zatonsky, Samira Asma, and Prakash C. Gupta. 2014. "Global Hazards of Tobacco and the Benefits of Tobacco Cessation and Tobacco Taxes." In *Disease Control Priorities (Volume 3): Cancer*, edited by Prabhat Jha and Rangaswamy Sankaranarayanan. Washington, D.C.: World Bank.
127. Jin, Lei, Lin Tao, and Xiangqian Lao. 2022. "Diverging Trends and Expanding Educational Gaps in Smoking in China." *International Journal of Environmental Research and Public Health* 19 (8): 4917. https://doi.org/10.3390/ijerph19084917.
128. Kachan, Diana, Lora E. Fleming, Sharon Christ, Peter Muennig, Guillermo Prado, Stacey L. Tannenbaum, Xuan Yang, Alberto J. Caban-Martinez, and David J. Lee. 2015. "Health Status of Older US Workers and Nonworkers, National Health Interview Survey, 1997–2011." *Preventing Chronic Disease* 12 (September). https://doi.org/10.5888/pcd12.150040.
129. Kankeu, Hyacinthe Tchewonpi, Priyanka Saksena, Ke Xu, and David B Evans. 2013. "The Financial Burden from Non-Communicable Diseases in Low- and Middle-Income Countries: A Literature Review." *Health Research Policy and Systems* 11 (1). https://doi.org/10.1186/1478-4505-11-31.
130. Karakochuk, Crystal D., Kyly C. Whitfield, Tim J. Green, and Kraemer Klaus, eds. 2018. "The Biology of the First 1,000 Days." Boca Raton, FL: CRC Press.
131. Kaur, Damanpreet, Prasad Rasane, Jyoti Singh, Sawinder Kaur, Vikas Kumar, Dipendra Kumar Mahato, Anirban Dey, Kajal Dhawan, and Sudhir Kumar. 2019. "Nutritional Interventions for Elderly and Considerations for the Development of Geriatric Foods." *Current Aging Science* 12 (1): 15–27. https://doi.org/10.2174/1874609812666190521110548.
132. Kilian, Reinhold, and Thomas Becker. 2007. "Macro-Economic Indicators and Labour Force Participation of People with Schizophrenia." *Journal of Mental Health* 16 (2): 211–22. https://doi.org/10.1080/09638230701279899.
133. Kim, Kyeongkuk, Sang-Hyop Lee, and Timothy J. Halliday. 2018. "Health Shocks, the Added Worker Effect, and Labor Supply in Married Couples: Evidence from South Korea." *Department of Economics Working Paper No. 18-12*. Honolulu: University of Hawaii at Manoa. https://ideas.repec.org/p/hai/wpaper/201812.html.
134. Kinugasa, Tomoko, and Andrew Mason. 2007. "Why Countries Become Wealthy: The Effects of Adult Longevity on Saving." *World Development* 35 (1): 1–23. https://doi.org/10.1016/j.worlddev.2006.09.002.
135. Knapp, Martin, and Gloria Wong. 2020. "Economics and Mental Health: The Current Scenario." *World Psychiatry* 19 (1): 3–14. https://doi.org/10.1002/wps.20692.
136. Knaul, Felicia Marie, Beverley M Essue, Héctor Arreola-Ornelas, David Watkins, and Ana Langer. 2021. "Universal Health Coverage Must Become a Best Buy for Women." *The Lancet* 398 (10318): 2215–17. https://doi.org/10.1016/s0140-6736(21)02755-0.
137. Kraay, Aart. 2018. "Methodology for a World Bank Human Capital Index." *Policy Research Working Paper 8593*. Washington, D.C.: World Bank. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3255311.
138. Kruger, Herculina S., and Naomi S. Levitt. 2017. "Fetal Origins of Obesity, Cardiovascular Disease, and Type 2 Diabetes." In *The Biology of the First 1,000 Days*, edited by Crystal D. Karakochuk, Kyly C. Whitfield, Tim J. Green, and Klaus Kraemer. Boca Raton, FL: CRC Press. https://doi.org/10.1201/9781315152950.
139. Lane, Chris, Amanda Glassman, and Eleni Smitham. 2021. "Using Health Taxes to Support Revenue: An Action Agenda for the IMF and World Bank." *Development Policy Paper 203*. Washington, D.C.: Centre for Global Development (CGD). https://www.cgdev.org/sites/default/files/Lane-Health-Tax-COVID-19.pdf.
140. Lane, Christopher. 2022. "Meeting Health Challenges in Developing Asia with Corrective Taxes on Alcohol, Tobacco, and Unhealthy Foods." Manila, Philippines: Asian Development Bank. https://www.adb.org/sites/default/files/institutional-document/782851/ado2022bp-health-challenges-asia-corrective-taxes.pdf.

141. Langer, Ana, Afaf Meleis, Felicia M Knaul, Rifat Atun, Meltem Aran, Héctor Arreola-Ornelas, Zulfiqar A Bhutta, et al. 2015. "Women and Health: The Key for Sustainable Development." *The Lancet* 386 (9999): 1165–1210. https://doi.org/10.1016/s0140-6736(15)60497-4.
142. Laureys, Lien. 2021. "The Cost of Human Capital Depreciation during Unemployment." *The Economic Journal* 131 (634): 827–50. https://ideas.repec.org/a/oup/econjl/v131y-2021i634p827-850..html.
143. Layard, Richard, Andrew E. Clark, Francesca Cornaglia, Nattavudh Powdthavee, and James Vernoit. 2014. "What Predicts a Successful Life? A Life-Course Model of Well-Being." *The Economic Journal* 124 (580): F720–38. https://doi.org/10.1111/ecoj.12170.
144. Lee, John Tayu, Fozia Hamid, Sanghamitra Pati, Rifat Atun, and Christopher Millett. 2015. "Impact of Noncommunicable Disease Multimorbidity on Healthcare Utilisation and Out-Of-Pocket Expenditures in Middle-Income Countries: Cross Sectional Analysis." Edited by Ignacio Correa-Velez. *PLOS ONE* 10 (7): e0127199. https://doi.org/10.1371/journal.pone.0127199.
145. Lee, Ronald, Andrew Mason, and Timothy Miller. 2000. "Life Cycle Saving and the Demographic Transition: The Case of Taiwan." *Population and Development Review* 26 (Supplemental): 194–219. https://www.jstor.org/stable/3115217.
146. Li, Hongbin, Jie Zhang, and Junsen Zhang. 2007. "Effects of Longevity and Dependency Rates on Saving and Growth: Evidence from a Panel of Cross Countries." *Journal of Development Economics* 84 (1): 138–54. https://doi.org/10.1016/j.jdeveco.2006.10.002.
147. Li, Min, Xiao-Wei Zhang, Wen-Shang Hou, and Zhen-Yu Tang. 2015. "Impact of Depression on Incident Stroke: A Meta-Analysis." *International Journal of Cardiology* 180 (February): 103–10. https://doi.org/10.1016/j.ijcard.2014.11.198.
148. Liakos, Matthew, and Puja B. Parikh. 2018. "Gender Disparities in Presentation, Management, and Outcomes of Acute Myocardial Infarction." *Current Cardiology Reports* 20 (8). https://doi.org/10.1007/s11886-018-1006-7.
149. Lleras-Muney, Adriana. 2022. "Education and Income Gradients in Longevity: The Role of Policy." *NBER Working Paper 29694*. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w29694.
150. Lorentzen, Peter, John McMillan, and Romain Wacziarg. 2008. "Death and Development." *Journal of Economic Growth* 13 (2): 81–124. https://doi.org/10.1007/s10887-008-9029-3.
151. Low, Lee-Fay, Melvyn Yap, and Henry Brodaty. 2011. "A Systematic Review of Different Models of Home and Community Care Services for Older Persons." *BMC Health Services Research* 11 (1). https://doi.org/10.1186/1472-6963-11-93.
152. Lundberg, Shelly. 1985. "The Added Worker Effect." *Journal of Labor Economics* 3 (1): 11–37. https://www.jstor.org/stable/2535048.
153. Ma, Xiao, Alejandro Nakab, and Daniela Vidart. 2022. "Human Capital Investment and Development: The Role of On-The-Job Training." *Working Papers 2021-10*. Department of Economics, University of Connecticut. https://ideas.repec.org/p/uct/uconnp/2021-10.html.
154. Malta, Deborah Carvalho, Regina Tomie Ivata Bernal, Maria de Fatima Marinho de Souza, Celia Landman Szwarcwald, Margareth Guimarães Lima, and Marilisa Berti de Azevedo Barros. 2016. "Social Inequalities in the Prevalence of Self-Reported Chronic Non-Communicable Diseases in Brazil: National Health Survey 2013." *International Journal for Equity in Health* 15 (1). https://doi.org/10.1186/s12939-016-0427-4.
155. Manley, James, Yarlini Balarajan, Shahira Malm, Luke Harman, Jessica Owens, Sheila Murthy, David Stewart, Natalia Elena Winder-Rossi, and Atif Khurshid. 2020. "Cash Transfers and Child Nutritional Outcomes: A Systematic Review and Meta-Analysis." *BMJ Global Health* 5 (12): e003621. https://doi.org/10.1136/bmjgh-2020-003621.
156. Martín-María, Natalia, Marta Miret, Francisco Félix Caballero, Laura Alejandra Rico-Uribe, Andrew Steptoe, Somnath Chatterji, and José Luis Ayuso-Mateos. 2017. "The Impact of Subjective Well-Being on Mortality." *Psychosomatic Medicine* 79 (5): 565–75. https://doi.org/10.1097/psy.0000000000000444.
157. Mattke, Soeren, Aruna Balakrishnan, Giacomo Bergamo, and Sydne J. Newberry. 2007. "A Review of Methods to Measure Health-Related Productivity Loss." *The American Journal of Managed Care* 13 (4): 211–17. https://pubmed.ncbi.nlm.nih.gov/17408341/.
158. McIntyre, Diane, Michael Thiede, Göran Dahlgren, and Margaret Whitehead. 2006. "What Are the Economic Consequences for Households of Illness and of Paying for Health Care in Low- and Middle-Income Country Contexts?" *Social Science & Medicine* 62 (4): 858–65. https://doi.org/10.1016/j.socscimed.2005.07.001.
159. McKee-Ryan, Frances, Zhaoli Song, Connie R Wanberg, and Angelo J Kinicki. 2005. "Psychological and Physical Well-Being during Unemployment: A Meta-Analytic Study." *The Journal of Applied Psychology* 90 (1): 53–76. https://doi.org/10.1037/0021-9010.90.1.53.
160. Meijer, Anna, Henk Jan Conradi, Elisabeth H. Bos, Brett D. Thombs, Joost P. van Melle, and Peter de Jonge. 2011. "Prognostic Association of Depression Following Myocardial Infarction with Mortality and Cardiovascular Events: A Meta-Analysis of 25 Years of Research." *General Hospital Psychiatry* 33 (3): 203–16. https://doi.org/10.1016/j.genhosppsych.2011.02.007.
161. Meng, Liping, Haiquan Xu, Ailing Liu, Joop van Raaij, Wanda Bemelmans, Xiaoqi Hu, Qian Zhang, et al. 2013. "The Costs and Cost-Effectiveness of a School-Based Comprehensive Intervention Study on Childhood Obesity in China." Edited by Maarten Postma. *PLoS ONE* 8 (10): e77971. https://doi.org/10.1371/journal.pone.0077971.
162. Modini, Matthew, Sadhbh Joyce, Arnstein Mykletun, Helen Christensen, Richard A Bryant, Philip B Mitchell, and Samuel B Harvey. 2016. "The Mental Health Benefits of Employment:

Results of a Systematic Meta-Review." *Australasian Psychiatry* 24 (4): 331–36. https://doi.org/10.1177/1039856215618523.

163. Moreira da Silva, Jorge. 2019. "Why You Should Care about Unpaid Care Work." *OECD Development Matters* (blog). March 18, 2019. https://oecd-development-matters.org/2019/03/18/why-you-should-care-about-unpaid-care-work..
164. Mortensen, Laust H, Johan Rehnberg, Espen Dahl, Finn Diderichsen, Jon Ivar Elstad, Pekka Martikainen, David Rehkopf, Lasse Tarkiainen, and Johan Fritzell. 2016. "Shape of the Association between Income and Mortality: A Cohort Study of Denmark, Finland, Norway and Sweden in 1995 and 2003." *BMJ Open* 6 (12): e010974. https://doi.org/10.1136/bmjopen-2015-010974.
165. Mushkin, Selma J. 1962. "Health as an Investment." *Journal of Political Economy* 70 (5): 129–57. https://www.jstor.org/stable/1829109.
166. Naoum, Panagiota, Elpida Pavi, and Kostas Athanasakis. 2021. "Economic Evaluation of Digital Health Interventions in Palliative Care: A Systematic Review of the Literature." *Frontiers in Digital Health* 3 (November). https://doi.org/10.3389/fdgth.2021.730755.
167. Nikoloski, Zlatko, Ada Mohammed Alqunaibet, Rasha Abdulrahman Alfawaz, Sami Saeed Almudarra, Christopher H. Herbst, Sameh El-Saharty, Reem Alsukait, and Abdullah Algwizani. 2021. "Covid-19 and Non-Communicable Diseases: Evidence from a Systematic Literature Review." *BMC Public Health* 21 (1). https://doi.org/10.1186/s12889-021-11116-w.
168. Nikoloski, Zlatko, Luc Christiaensen, and Ruth Hill. 2018. "Household Shocks and Coping Mechanism: Evidence from Sub-Saharan Africa." In *Agriculture in Africa: Telling Myths from Facts. Directions in Development—Agriculture and Rural Development*, edited by Luc Christiaensen and Lionel Demery. Washington, D.C.: World Bank. https://doi.org/10.1596/978-1-4648-1134-0.
169. Noordt, Maaike van der, Helma IJzelenberg, Mariël Droomers, and Karin I Proper. 2014. "Health Effects of Employment: A Systematic Review of Prospective Studies." *Occupational and Environmental Medicine* 71 (10): 730–36. https://doi.org/10.1136/oemed-2013-101891.
170. Norström, Fredrik, Pekka Virtanen, Anne Hammarström, Per E Gustafsson, and Urban Janlert. 2014. "How Does Unemployment Affect Self-Assessed Health? A Systematic Review Focusing on Subgroup Effects." *BMC Public Health* 14 (1). https://doi.org/10.1186/1471-2458-14-1310.
171. Nussbaum, Martha C. 2013. *Creating Capabilities*. *Harvard University Press*. Cambridge, MA: Harvard University Press. https://www.hup.harvard.edu/books/9780674072350.
172. Nyaradi, Anett, Jianghong Li, Siobhan Hickling, Jonathan Foster, and Wendy H. Oddy. 2013. "The Role of Nutrition in Children's Neurocognitive Development, from Pregnancy through Childhood." *Frontiers in Human Neuroscience* 7. https://doi.org/10.3389/fnhum.2013.00097.
173. Nyirenda, Moffat J., and Peter Byass. 2019. "Pregnancy, Programming, and Predisposition." *The Lancet Global Health* 7 (4): e404–5. https://doi.org/10.1016/S2214-109X(19)30051-8.
174. O'Keefe, Phillip B., Puja V. Dutta, and Harry Moroz. 2022. "Diverse Paths: The Dynamic Evolution of Social Protection in Asia and the Pacific." Washington, D.C.: World Bank.
175. Oldereid, Nan B., Ulla-Britt Wennerholm, Anja Pinborg, Anne Loft, Hannele Laivuori, Max Petzold, Liv Bente Romundstad, Viveca Söderström-Anttila, and Christina Bergh. 2018. "The Effect of Paternal Factors on Perinatal and Paediatric Outcomes: A Systematic Review and Meta-Analysis." *Human Reproduction Update* 24 (3): 320–89. https://doi.org/10.1093/humupd/dmy005.
176. Onarheim, Kristine Husøy, Johanne Helene Iversen, and David E. Bloom. 2016. "Economic Benefits of Investing in Women's Health: A Systematic Review." Edited by Jodi Pawluski. *PLOS ONE* 11 (3): e0150120. https://doi.org/10.1371/journal.pone.0150120.
177. Oreopoulos, Philip, and Kjell G Salvanes. 2011. "Priceless: The Nonpecuniary Benefits of Schooling." *Journal of Economic Perspectives* 25 (1): 159–84. https://doi.org/10.1257/jep.25.1.159.
178. Organisation for Economic Cooperation and Development (OECD). 2017. "Preventing Ageing Unequally." Paris: OECD Publishing. https://www.oecd.org/social/preventing-ageing-unequally-9789264279087-en.htm.
179. ———. 2019. "OECD Future of Education 2030: Making Physical Education Dynamic and Inclusive for 2030 - International Curriculum Analysis." Paris: OECD Publishing. https://www.oecd.org/education/2030-project/contact/OECD_FUTURE_OF_EDUCATION_2030_MAKING_PHYSICAL_DYNAMIC_AND_INCLUSIVE_FOR_2030.pdf.
180. ———. 2020. *Who Cares? Attracting and Retaining Elderly Care Workers*. *OECD Health Policy Studies*. Paris: OECD Publishing. https://doi.org/10.1787/92c0ef68-en.
181. Patel, Vikram, and Somnath Chatterji. 2015. "Integrating Mental Health in Care for Noncommunicable Diseases: An Imperative for Person-Centered Care." *Health Affairs* 34 (9): 1498–1505. https://doi.org/10.1377/hlthaff.2015.0791.
182. Patterson, Christopher C., Suvi Karuranga, Paraskevi Salpea, Pouya Saeedi, Gisela Dahlquist, Gyula Soltesz, and Graham D. Ogle. 2019. "IDF Diabetes Atlas: Worldwide Estimates of Incidence, Prevalence and Mortality of Type 1 Diabetes in Children and Adolescents: Results from the International Diabetes Federation Diabetes Atlas, 9th Edition." *Diabetes Research and Clinical Practice* 157 (September): 107842. https://doi.org/10.1016/j.diabres.2019.107842.
183. Paul, Karsten I., and Klaus Moser. 2009. "Unemployment Impairs Mental Health: Meta-Analyses." *Journal of Vocational Behavior* 74 (3): 264–82. https://doi.org/10.1016/j.jvb.2009.01.001.
184. Petrosino, Anthony, Claire Morgan, Trevor Fronius, Emily E. Tanner-Smith, and Robert F. Boruch. 2014. "What Works in Developing Nations to Get Children into School or Keep Them There?" *Research on Social Work Practice* 25 (1): 44–60. https://doi.org/10.1177/1049731514524837.
185. Pizzi, Michael A., and Kerryellen Vroman. 2013. "Childhood Obesity: Effects on Children's Participation, Mental Health, and Psy-

chosocial Development." *Occupational Therapy in Health Care* 27 (2): 99–112. https://doi.org/10.3109/07380577.2013.784839.

186. Png, May Ee, Joanne Yoong, Thao Phuong Phan, and Hwee Lin Wee. 2016. "Current and Future Economic Burden of Diabetes among Working-Age Adults in Asia: Conservative Estimates for Singapore from 2010-2050." *BMC Public Health* 16 (1). https://doi.org/10.1186/s12889-016-2827-1.
187. Pol, Marjon van der. 2010. "Health, Education and Time Preference." *Health Economics* 20 (8): 917–29. https://doi.org/10.1002/hec.1655.
188. Popkin, Barry M, Camila Corvalan, and Laurence M Grummer-Strawn. 2020. "Dynamics of the Double Burden of Malnutrition and the Changing Nutrition Reality." *The Lancet* 395 (10217): 65–74. https://doi.org/10.1016/s0140-6736(19)32497-3.
189. Powdthavee, Nattavudh, Warn N. Lekfuangfu, and Mark Wooden. 2015. "What's the Good of Education on Our Overall Quality of Life? A Simultaneous Equation Model of Education and Life Satisfaction for Australia." *Journal of Behavioral and Experimental Economics* 54 (February): 10–21. https://doi.org/10.1016/j.socec.2014.11.002.
190. Pozzan, Emanuela, and Umberto Cattaneo. 2020. "Women Health Workers: Working Relentlessly in Hospitals and at Home." *ILO Newsroom*, April 7, 2020. https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_741060/lang--en/index.htm.
191. Proimos, Jenny, and Jonathan D. Klein. 2012. "Noncommunicable Diseases in Children and Adolescents." *Pediatrics* 130 (3): 379–81. https://doi.org/10.1542/peds.2012-1475.
192. Propper, Carol, John Rigg, and Simon Burgess. 2007. "Child Health: Evidence on the Roles of Family Income and Maternal Mental Health from a UK Birth Cohort." *Health Economics* 16 (11): 1245–69. https://doi.org/10.1002/hec.1221.
193. Reis, Mauricio C. 2007. "Added Worker Effect: Evidence from Health Shocks in the Brazilian Informal Labor Market." Brasil: IPEA. https://www.econ.puc-rio.br/uploads/adm/trabalhos/files/seminario/2007/Mauricio.pdf.
194. Roberts, Helen C., Stephen E. R. Lim, Natalie J. Cox, and Kinda Ibrahim. 2019. "The Challenge of Managing Undernutrition in Older People with Frailty." *Nutrients* 11 (4): 808. https://doi.org/10.3390/nu11040808.
195. Rohwedder, Susann, and Robert J Willis. 2010. "Mental Retirement." *Journal of Economic Perspectives* 24 (1): 119–38. https://doi.org/10.1257/jep.24.1.119.
196. Romer, Paul M. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98 (5). https://www.jstor.org/stable/2937632.
197. Saavedra, Jaine C., Mario Cristian Aedo Inostroza, Omar S. Arias Diaz, Adelle Pushparatnam, Marcela Gutierrez Bernal, and F. Halsey Rogers. 2022. "Realizing the Future of Learning : From Learning Poverty to Learning for Everyone, Everywhere."Washington, D.C.: World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/250981606928190510/pdf.
198. Salmuth, Victoria von, Eilise Brennan, Marko Kerac, Marie McGrath, Severine Frison, and Natasha Lelijveld. 2021. "Maternal-Focused Interventions to Improve Infant Growth and Nutritional Status in Low-Middle Income Countries: A Systematic Review of Reviews." Edited by Mary Hamer Hodges. *PLOS ONE* 16 (8): e0256188. https://doi.org/10.1371/journal.pone.0256188.
199. Satin, Jillian R., Wolfgang Linden, and Melanie J. Phillips. 2009. "Depression as a Predictor of Disease Progression and Mortality in Cancer Patients." *Cancer* 115 (22): 5349–61. https://doi.org/10.1002/cncr.24561.
200. Savelyev, Peter A. 2014. "Psychological Skills, Education, and Longevity of High-Ability Individuals." *Department of Economics Working Papers 14-00007*. Vanderbilt University. https://ideas.repec.org/p/van/wpaper/vuecon-14-00007.html.
201. Schuring, Merel, Johan Mackenbach, Toon Voorham, and Alex Burdorf. 2010. "The Effect of Re-Employment on Perceived Health." *Journal of Epidemiology & Community Health* 65 (7): 639–44. https://doi.org/10.1136/jech.2009.103838.
202. Sen, Amartya. 1997. "Editorial: Human Capital and Human Capability." *World Development* 25 (12): 1959–61. https://www.staff.ncl.ac.uk/david.harvey/AEF806/Sen1997.pdf.
203. Seuring, Till, Pieter Serneels, and Marc Suhrcke. 2019. "The Impact of Diabetes on Labour Market Outcomes in Mexico: A Panel Data and Biomarker Analysis." *Social Science & Medicine* 233 (July): 252–61. https://doi.org/10.1016/j.socscimed.2019.05.051.
204. Sewdas, Ranu, Astrid de Wind, Sari Stenholm, Pieter Coenen, Ilse Louwerse, Cécile Boot, and Allard van der Beek. 2020. "Association between Retirement and Mortality: Working Longer, Living Longer? A Systematic Review and Meta-Analysis." *Journal of Epidemiology and Community Health* 74 (5): 473–80. https://doi.org/10.1136/jech-2019-213023.
205. Shekar, Meera, Jakub Kakietek, Julia Dayton Eberwein, and Dylan Walters. 2017. "An Investment Framework for Nutrition: Reaching the Global Targets for Stunting, Anemia, Breastfeeding, and Wasting." *Directions in Development*. Washington, D.C.: World Bank. https://doi.org/10.1596/978-1-4648-1010-7.
206. Shrimpton, Roger, and Claudia Rokx. 2012. "The Double Burden of Malnutrition: A Review of Global Evidence." *Health, Nutrition, and Population (HNP) Discussion Paper*. Washington, D.C.: World Bank. http://hdl.handle.net/10986/27417.
207. Si, Chengyu, Denis Nadolnyak, and Valentina Hartarska. 2021. "The Gender Wage Gap in Developing Countries." *Applied Economics and Finance* 8 (1): 1–12. https://ideas.repec.org/a/rfa/aefjnl/v8y2021i1p1-12.html.
208. Smith, James P. 1999. "Healthy Bodies and Thick Wallets: The Dual Relation between Health and Economic Status." *Journal of Economic Perspectives* 13 (2): 145–66. https://doi.org/10.1257/jep.13.2.145.
209. Smith, James P. 2004. "Unraveling the SES: Health Connection."

Population and Development Review 30: 108–32. https://www.jstor.org/stable/3401465.

210. Snilstveit, Birte, Jennifer Stevenson, Radhika Menon, Daniel R Phillips, Emma Gallagher, Maisie Geleen, Hannah Jobse, Tanja Schmidt, and Emmanuel Jimenez. 2016. "The Impact of Education Programmes on Learning and School Participation in Low- and Middle-Income Countries." *Systematic Review Summary 7*. International Initiative for Impact Evaluation (3ie). https://doi.org/10.23846/srs007.
211. Sommer, Isolde, Ursula Griebler, Peter Mahlknecht, Kylie Thaler, Kathryn Bouskill, Gerald Gartlehner, and Shanti Mendis. 2015. "Socioeconomic Inequalities in Non-Communicable Diseases and Their Risk Factors: An Overview of Systematic Reviews." *BMC Public Health* 15 (1). https://doi.org/10.1186/s12889-015-2227-y.
212. Stacey, Nicholas, Ijeoma Edoka, Karen Hofman, Elizabeth C. Swart, Barry Popkin, and Shu Wen Ng. 2021. "Changes in Beverage Purchases Following the Announcement and Implementation of South Africa's Health Promotion Levy: An Observational Study." *The Lancet Planetary Health* 5 (4): e200–208. https://doi.org/10.1016/S2542-5196(20)30304-1.
213. Stephen, Ruth, Mariagnese Barbera, Ruth Peters, Nicole Ee, Lidan Zheng, Jenni Lehtisalo, Jenni Kulmala, et al. 2021. "Development of the First WHO Guidelines for Risk Reduction of Cognitive Decline and Dementia: Lessons Learned and Future Directions." *Frontiers in Neurology* 12 (October). https://doi.org/10.3389/fneur.2021.763573.
214. Steptoe, Andrew, ed. 2006. *Depression and Physical Illness*. Cambridge University Press.
215. ———. 2019. "Happiness and Health." *Annual Review of Public Health* 40 (1): 339–59. https://doi.org/10.1146/annurev-publhealth-040218-044150.
216. Steptoe, Andrew, Angus Deaton, and Arthur A Stone. 2015. "Subjective Wellbeing, Health, and Ageing." *The Lancet* 385 (9968): 640–48. https://doi.org/10.1016/s0140-6736(13)61489-0.
217. Steptoe, Andrew, and Jane Wardle. 2012. "Enjoying Life and Living Longer." *Archives of Internal Medicine* 172 (3): 273. https://doi.org/10.1001/archinternmed.2011.1028.
218. Stuck, Andreas E, Albert L Siu, G. Darryl Wieland, Laurence Z Rubenstein, and John L. Adams. 1993. "Comprehensive Geriatric Assessment: A Meta-Analysis of Controlled Trials." *The Lancet* 342 (8878): 1032–36. https://doi.org/10.1016/0140-6736(93)92884-v.
219. Sudharsanan, Nikkil, Yuan Zhang, Collin F. Payne, William Dow, and Eileen Crimmins. 2020. "Education and Adult Mortality in Middle-Income Countries: Surprising Gradients in Six Nationally-Representative Longitudinal Surveys." *SSM - Population Health* 12 (December): 100649. https://doi.org/10.1016/j.ssmph.2020.100649.
220. Suhrcke, Marc, Rachel A. Nugent, David Stuckler, and Lorenzo Rocco. 2006. "Chronic Disease: An Economic Perspective." London: Oxford Health Alliance. https://www.uv.es/~atortosa/chronicdis-ecoperspective.
221. Suhrcke, Marc, and Dieter Urban. 2010. "Are Cardiovascular Diseases Bad for Economic Growth?" *Health Economics* 19 (12): 1478–96. https://doi.org/10.1002/hec.1565.
222. Sum, Grace, Chris Salisbury, Gerald Choon-Huat Koh, Rifat Atun, Brian Oldenburg, Barbara McPake, Sukumar Vellakkal, and John Tayu Lee. 2019. "Implications of Multimorbidity Patterns on Health Care Utilisation and Quality of Life in Middle-Income Countries: Cross-Sectional Analysis." *Journal of Global Health* 9 (2). https://doi.org/10.7189/jogh.09.020413.
223. Summan, Amit, Nicholas Stacey, Johanna Birckmayer, Evan Blecher, Frank J Chaloupka, and Ramanan Laxminarayan. 2020. "The Potential Global Gains in Health and Revenue from Increased Taxation of Tobacco, Alcohol and Sugar-Sweetened Beverages: A Modelling Analysis." *BMJ Global Health* 5 (3): e002143. https://doi.org/10.1136/bmjgh-2019-002143.
224. Surkan, Pamela J, Caitlin E Kennedy, Kristen M Hurley, and Maureen M Black. 2011. "Maternal Depression and Early Childhood Growth in Developing Countries: Systematic Review and Meta-Analysis." *Bulletin of the World Health Organization* 89 (8): 608–15E. https://doi.org/10.2471/blt.11.088187.
225. Sweeny, Kim, Bruce Rasmussen, and Peter Sheehan. 2015. "The Impact of Health on Worker Attendance and Productivity in Twelve Countries." *Project Report. Victoria Institute of Strategic Economic Studies (VISES)*. Melbourne, Australia: Victoria University. https://vuir.vu.edu.au/32605/.
226. Terada-Hagiwara, Akiko, Shiela Camingue-Romance, and Joseph Zveglich Jr. 2018. "Gender Pay Gap: A Macro Perspective." *ADB Economics Working Paper Series No. 538*. Manilla, Philippines: Asian Development Bank. http://dx.doi.org/10.22617/WPS189255-2.
227. The Task Force on Fiscal Policy for Health. 2019. "Health Taxes to Save Lives: Employing Effective Excise Taxes on Tobacco, Alcohol, and Sugary Beverages." New York, NY: Bloomberg Philanthropies. https://www.issup.net/files/2019-04/Health-Taxes-to-Save-Lives-Report.pdf.
228. Tilvis, Reijo S., Venla Laitala, Pirkko Routasalo, Timo E. Strandberg, and Kaisu H. Pitkala. 2012. "Positive Life Orientation Predicts Good Survival Prognosis in Old Age." *Archives of Gerontology and Geriatrics* 55 (1): 133–37. https://doi.org/10.1016/j.archger.2011.06.030.
229. Verguet, Stéphane, Cindy L Gauvreau, Sujata Mishra, Mary MacLennan, Shane M Murphy, Elizabeth D Brouwer, Rachel A Nugent, Kun Zhao, Prabhat Jha, and Dean T Jamison. 2015. "The Consequences of Tobacco Tax on Household Health and Finances in Rich and Poor Smokers in China: An Extended Cost-Effectiveness Analysis." *The Lancet Global Health* 3 (4): e206–16. https://doi.org/10.1016/s2214-109x(15)70095-1.
230. Verguet, Stéphane, Paulina Limasalle, Averi Chakrabarti, Arif Husain, Carmen Burbano, Lesley Drake, and Donald A. P. Bundy. 2020. "The Broader Economic Value of School Feeding Pro-

grams in Low- and Middle-Income Countries: Estimating the Multi-Sectoral Returns to Public Health, Human Capital, Social Protection, and the Local Economy." *Frontiers in Public Health* 8: 587046. https://doi.org/10.3389/fpubh.2020.587046.

231. Victora, Cesar G, Linda Adair, Caroline Fall, Pedro C Hallal, Reynaldo Martorell, Linda Richter, and Harshpal Singh Sachdev. 2008. "Maternal and Child Undernutrition: Consequences for Adult Health and Human Capital." *The Lancet* 371 (9609): 340–57. https://doi.org/10.1016/s0140-6736(07)61692-4.
232. Vila, Luis E. 2000. "The Non-Monetary Benefits of Education." *European Journal of Education* 35 (1): 21–32. https://doi.org/10.1111/1467-3435.00003.
233. Wagstaff, Adam, Gabriela Flores, Justine Hsu, Marc-François Smitz, Kateryna Chepynoga, Leander R. Buisman, Kim van Wilgenburg, and Patrick Eozenou. 2018. "Progress on Catastrophic Health Spending in 133 Countries: A Retrospective Observational Study." *The Lancet Global Health* 6 (2): e169–79. https://doi.org/10.1016/S2214-109X(17)30429-1.
234. Wagstaff, Adam, and Sven Neelsen. 2020. "A Comprehensive Assessment of Universal Health Coverage in 111 Countries: A Retrospective Observational Study." *The Lancet Global Health* 8 (1): e39–49. https://doi.org/10.1016/S2214-109X(19)30463-2.
235. Watkins, David A., Dean T. Jamison, Anne Mills, Rifat Atun, Kristen Danforth, Amanda Glassman, Susan Horton, et al. 2017. "Universal Health Coverage and Essential Packages of Care." Edited by Dean T. Jamison, Hellen Gelband, Susan Horton, Prabhat Jha, Ramanan Laxminarayan, Charles N. Mock, and Rachel Nugent. 3rd ed. Washington, D.C.: World Bank. https://www.ncbi.nlm.nih.gov/books/NBK525285/.
236. Watkins, David, Sali Ahmed, and Sarah Pickersgill. 2024. "Priority Setting for NCD Control and Health System Investments." In *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington, D.C.: World Bank.
237. Webb, Roger, Kathryn Abel, Andrew Pickles, and Louis Appleby. 2005. "Mortality in Offspring of Parents with Psychotic Disorders: A Critical Review and Meta-Analysis." *American Journal of Psychiatry* 162 (6): 1045–56. https://doi.org/10.1176/appi.ajp.162.6.1045.
238. Williams, Julianne, Luke Allen, Kremlin Wickramasinghe, Bente Mikkelsen, Nia Roberts, and Nick Townsend. 2018. "A Systematic Review of Associations between Non-Communicable Diseases and Socioeconomic Status within Low- and Lower-Middle-Income Countries." *Journal of Global Health* 8 (2): 020409. https://doi.org/10.7189/jogh.08.020409.
239. Windle, Gill, Dyfrig Hughes, Pat Linck, Ian Russell, and Bob Woods. 2010. "Is Exercise Effective in Promoting Mental Well-Being in Older Age? A Systematic Review." *Aging & Mental Health* 14 (6): 652–69. https://doi.org/10.1080/13607861003713232.
240. Wodrich, David L., and Melissa M. Cunningham. 2007. "School-Based Tertiary and Targeted Interventions for Students with Chronic Medical Conditions: Examples from Type 1 Diabetes Mellitus and Epilepsy." *Psychology in the Schools* 45 (1): 52–62. https://doi.org/10.1002/pits.20278.
241. World Bank. 2015. Global Monitoring Report 2015/2016. Washington, D.C.: World Bank. https://doi.org/10.1596/978-1-4648-0669-8.
242. ———. 2018. "The State of Social Safety Nets 2018." Washington, D.C.: World Bank. http://hdl.handle.net/10986/29115.
243. ———. 2021. "The Changing Wealth of Nations 2021: Managing Assets for the Future." Washington, D.C.: World Bank. http://hdl.handle.net/10986/36400.
244. World Health Organization (WHO). 2012. "Programme on Mental Health: WHOQOL User Manual, 2012 Revision." Geneva, Switzerland: World Health Organization. https://www.who.int/publications/i/item/WHO-HIS-HSI-Rev.2012-3.
245. ———. 2016. "Report of the Commission on Ending Childhood Obesity." Geneva: Switzerland: World Health Organization. https://iris.who.int/bitstream/handle/10665/204176/9789241510066_eng.pdf?sequence=1.
246. ———. 2017. "Tackling NCDs: 'Best Buys' and Other Recommended Interventions for the Prevention and Control of Noncommunicable Diseases." Geneva, Switzerland: World Health Organization. https://www.who.int/publications/i/item/WHO-NMH-NVI-17.9.
247. ———. 2018. "Global Status Report on Road Safety 2018." Geneva, Switzerland: World Health Organization. https://www.who.int/publications/i/item/9789241565684.
248. ———. 2019. "'GHE: Life Expectancy and Healthy Life Expectancy.'" Global Health Observatory. World Health Organization. 2019. https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-life-expectancy-and-healthy-life-expectancy.
249. ———. 2020. "Palliative Care." *Fact Sheet*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/palliative-care.
250. ———. 2021. "Obesity and Overweight." *Fact Sheet*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.
251. ———. 2022. "World Health Statistics 2022." World Health Organization. May 20, 2022. https://www.who.int/news/item/20-05-2022-world-health-statistics-2022.
252. Wu, Chenkai, Michelle C Odden, Gwenith G Fisher, and Robert S Stawski. 2016. "Association of Retirement Age with Mortality: A Population-Based Longitudinal Study among Older Adults in the USA." *Journal of Epidemiology and Community Health* 70 (9): 917–23. https://doi.org/10.1136/jech-2015-207097.
253. Yiengprugsawan, Vasoontara S., and John Piggott. 2022. *Shaping Long-Term Care in Emerging Asia*. Taylor & Francis.
254. Yiengprugsawan, Vasoontara Sbirakos, Riana Rahmawati, Robert G. Cumming, and John Piggott. 2022. "Factors Relating to Depressive Symptoms of Caregivers for Older Care Recipients in Indonesia." *Aging & Mental Health* 26 (12): 2454–61. https://doi.org/10.1080/13607863.2021.1980858.

255. You, Emily C., David Dunt, Colleen Doyle, and Arthur Hsueh. 2012. "Effects of Case Management in Community Aged Care on Client and Carer Outcomes: A Systematic Review of Randomized Trials and Comparative Observational Studies." *BMC Health Services Research* 12 (1). https://doi.org/10.1186/1472-6963-12-395.

256. Yusuf, Salim, Sumathy Rangarajan, Koon Teo, Shofiqul Islam, Wei Li, Lisheng Liu, Jian Bo, et al. 2014. "Cardiovascular Risk and Events in 17 Low-, Middle-, and High-Income Countries." *New England Journal of Medicine* 371 (9): 818–27. https://doi.org/10.1056/nejmoa1311890.

ANNEX 2.1

TABLE 2A.1 Mapping the human capital trajectory and its interactions with ncds across the life cycle

Life stage	Human Capital (HC) Trajectory stage/elements	NCD Incidence and factors	Impacts of NCD on HC (and feedback)
Gestation/birth	HC "at entry"	• IUGR as risk factor for NCD in adulthood, incl. CVD, renal, lung, and diabetes. Maternal, placental or fetal origins (10-15% of pregnancies) • Health/nutrition at birth incl. birthweight, and at-birth disability. Mainly inter-generational drivers, derivative of maternal health/nutrition, risk factors/behaviour, and genetics	• IUGR impacts both child vulnerability to CDs and adult NCDs, with negative HC acquisition and deployment implications • Low birthweight increases risks of later life NCDs, incl. diabetes, obesity, hypertension, CVD and neurological disorders. And children or low BW mothers more likely to have low BW children • Compromised foundation for HC development
Early years 0-14	HC intensive formation and building stage • Early cognitive base, learning and foundational skills built • Childhood health and formation of health behaviours • Childhood nutritional status as key HC life course determinant	• Childhood NCD onset and NCD-related mortality. incl. asthma, obesity, congenital heart, mental/behavioural health • Derivative impacts of parental NCDs on children/adolescents • Some risk factors and behaviours for later NCDs start. Pollution, sugar and salt intake, diet	Short to medium run impacts: • Short-circuit of future HC through childhood deaths • Decreased education attendance and attainment • Returns to HK compromised by lower attainment • Decreased educational attendance and attainment from parental NCD impacts on children Long-run impacts: • Nutritional deficits, esp. in early years, increase adult NCD risks • Horizon effect of lower societal life expectancy from NCDs on investments in education
School to working age transition and early career – 15-34	HC trajectory diversifies, as HC accumulation continues, HC deployment stage starts, and potential HC depreciation stage starts for some Tracks of accumulation: • Intensive formative stage + for those continuing education • Learning-by-doing HC accumulation stage in work starts Track of deployment: • Returns to stock+flow of HC initiated Track of depreciation: • For some, disability or serious or recurrent NCD may prevent LM entry altogether or compromise participation, resulting in active depreciation and failure to accumulate further HC on the job	• Intensive period of mental health conditions onset • Initiation of some NCD risk behaviours, e.g., smoking and alcohol • Childhood NCD continuation and exacerbation (e.g., obesity) • Earlier onset of adulthood NCDs, [with social gradient]	• Lower likelihood to progress in education due to lagged and current NCD impacts • Failure to enter labor force or withdrawal from LF due to NCD mortality, disability or morbidity: multiple HC impact of no HC stock deployment, depreciation of HC stock (which had investment costs to build) and failure to accumulate further HC on-job. • Compromised HC deployment/returns due to lower productivity within jobs from absenteeism and presenteeism • HK depreciation due to work gaps/weak LM attachment • Reduced accumulation of OTJ HC and reduced incentives to deepen human capital • Lower HC of parents/mothers starts to impact children • Correlation between education and own health outcomes, but casual link disputed and may vary according to health variable and other factors

Life stage	Human Capital (HC) Trajectory stage/elements	NCD Incidence and factors	Impacts of NCD on HC (and feedback)
Mid-career to end of "standardized" working life – 35-65/69	Three track HC trajectory continues, but relative balance between tracks may shift over this life stage: • HC accumulation through learning by doing continues, with maintenance or increase of crystallized skills and tapering of fluid abilities. • HC accumulation divergence in low and high quality jobs • Continued deployment of HC/returns, with RoR to human capital diverging over time for high/low skilled • Employer biases against older workers compromise returns to HC from around 55 • Normal depreciation of skills element of HC may be more compromised with time • Protection of human capital stock challenge increases	• Increased onset of NCDs, some originating in childhood • Increase in co-morbidities • NCDs of older parents increase and rising ADL/IADL impacts	• Withdrawal from LF due to NCD mortality, disability or morbidity: multiple HC impact of no HC stock deployment, depreciation of HC stock, and failure to accumulate further HC on-job • Where acute, spillover effects on partners/families as carers and secondary LM impacts, and income effects and SES association with lower HK accumulation for children • Compromised HC deployment/returns due to lower productivity within jobs from absenteeism and presenteeism • HK depreciation due to work gaps/weak LM attachment • Reduced accumulation of OTJ HC and reduced incentives to deepen human capital • Parental NCDs require LF withdrawal or reduction (or transition to informal sector) for adult children, esp. women, with low/no RoR in HK deployment
Later life: 65/70 till death	• LM participation divergence between formal and informal workers • Decelerated and then terminated accumulation of HC • Returns to HK decline and cease • Protection of stock of HK more crucial on health and cognitive domains	• Co-morbidities increase sharply, and disabling ADL/IADL with time • Enhanced risk factor of social isolation and links to other risk factors and worse NCD status • Specific NCDs of age onset (dementia/cognitive deterioration/ higher depression rates?)	• Impacts on HC of adult children, esp. women, more pronounced, both in LM/economic terms and in terms of higher NCD likelihood for carer also • Impacts of grandparental HC decline on their care contribution and spillover to grandchild HC formation and increased demand for parental child care

TABLE 2A.2 Selected policies for human capital and ncds across the life course

Life stage	Policy and action areas	Cross life course policies
Gestation and early years 0-14	*Gestation and early years* • Generalized nutritional interventions for adolescent girls and women of child-bearing age pre-pregnancy • Nutritional interventions for pregnant and lactating women (PLW), including supplementation and SBCC for parental roles WRT nutrition • Ante-natal care, including growth monitoring of fetus • Early years nutritional interventions for children 0-5, with priority focus on first 1,000 days, including zinc and Vitamin A supplementation • (Un)conditional cash transfers linked to PLW and early years cohort and participation in nutrition interventions, including SBCC and parenting • Parental leave policies • Early intervention for childhood NCD prevention and management including obesity and asthma • Pre-primary education interventions, including community-based approaches • Free or subsidized childcare to facilitate parental LFP *School years:* • Tuition free basic education • Incentive policies to minimize school drop-out, including cash transfers, allowances for transport/uniforms, fee-free education etc. • School feeding programs • Remedial programs to address lagging learning • Health education mainstreaming in school curricula and physical activity programs • Labor regulation to prohibit harmful child labor and accompanying enforcement mechanism	• Taxation policies to reduce NCD risks at individual and societal levels, including public bads such as pollution, tobacco, alcohol and sugars • Accessible and affordable health care/UHC with enhanced NCD emphasis in basic package, including mental health (aligned with WHO best buys and DCP3) • Governments engaging with private sector to control NCD risk factors, promote healthy lifestyles, and manage impacts, using sticks and carrots (e.g., pharma, food, sports and fitness, insurance, banking, advertising, entertainment, transport, and infrastructure). Consider Public–private partnerships with appropriate statutory and regulatory frameworks + managing conflicts of interest • Fiscal systems built on regular demographic projections and stress testing

Life stage	Policy and action areas	Cross life course policies
Youth, education-to-work transition and early career, 15-35	• Free or subsidized post-secondary education, with targeted financial incentives for low-income and vulnerable groups • Adult/life-long learning programs to promote regular skills upgrading/refreshing • Tax/financial incentives to employers to invest in workforce training • Incorporation of experiential learning in National Qualifications Frameworks • Social security programs for sickness, disability and work injury (non-contributory for informal sector) and financial subsidies to promote pension scheme participation by workers • Unemployment allowances and/or generalized social assistance and ALMP to promote workforce re-entry and skills building	• Deepening research on key aspects of healthy longevity, NCDs, human capital and their interactions and economic, distributional and gender impacts, and evaluation of public interventions to assess cost-effectiveness • Promotion of universal design through planning and approval processes to promote accessibility to the built environment, transport and other services for those with functional impairment
Mid-career to end of "normal" working age, 36-69	• Adult/life-long learning programs to promote regular skills upgrading/refreshing across working life, adapted/targeted to meet particular needs and learning strengths of late-career workers • Tax/financial incentives to employers to invest in workforce training • Revised labor regulations to facilitate flexible work arrangements • Financial incentives to firms to retain or hire older workers • Public information/awareness campaigns to address older worker discrimination/biases • Financial incentives to adapt workplaces to minimize work injury and maximize participation and productivity of people with health conditions and disabilities • Social security programs for sickness, disability and work injury (non-contributory for informal sector) and financial subsidies to promote pension scheme participation by workers • Unemployment allowances and/or generalized social assistance and ALMP to promote workforce re-entry and skills building • Reform of pension systems to incentivize longer working lives in formal sector and align male and female retirement ages • Option of carer allowances for care of older parents	
Young elderly stage, 70-79	• Adequate pensions/social pensions for elderly with wide coverage, and consider "soft" conditioning of pensions to periodic health checks • Learning and skill development interventions for those past working age, adapted for specific learning strengths/deficits of older people • Promotion of volunteer initiatives for older people to enhance community engagement and non-market contributions • Publicly subsidized aged care system with emphasis on home- and community-based care, and targeted support to most vulnerable populations (and consideration of financing model). Built on case management and age-integrated care centres • Option of carer allowances for care of older parents and enhanced care support for care-related NCDs • Community-based initiatives to address social isolation and promote social participation • Cross-sectoral mechanisms to promote coordination of care across healthcare and aged/social care systems, built around case management. • Dementia risk reduction and treatment programs • Further research and implementation of multi-mode interventions to delay or reverse cognitive decline in healthy older people • Incorporation of gerontology modules in GP, nurse and social work training • Public information/awareness campaigns to address ageism	
Older elderly stage, 80-death	• As for 65-75 • Home and community-based interventions to address social isolation • Widespread and affordable availability of palliative care	

TABLE 2A.3 Human capital promoting policies during working life for accumulation, deployment and protection of HC

Dimension of human capital	Policy/intervention
Further HC accumulation	• Build second chance education pathways, both towards formal qualifications and directly to the labor market, including subsidies for poor/vulnerable participants • Targeted and timebound wage subsidy program to provide work experience and improve employability for youth, women and people with disabilities • Provide tax/financial incentives for employers to enhance in- and on-job training • Consider training levy to promote formal sector firm-level training • Ensure modularity of TVET, university and other formal adult learning offerings to allow workers to upgrade skills while employed • Enhance emphasis on digital skills development for older workers, and use of technology in LLL offerings and remote access • Incorporate adult/lifelong learning into National Qualifications Frameworks • Ensure stipends or other support to ensure low-income people can access adult learning opportunities • Promote accessible public-available information on career options, skills requirements, compensation and other features • Expand skill, entrepreneurship, and financial literacy programs for informal sector workers/groups, including through partnerships with non-governmental providers and community-based approaches • Encourage inter-generational work teams to maximize diverse skill exchange • Sustain funding for agricultural extension services and increase use of technology in their provision to promote reach
HC deployment/utilization	• Implement Recognition of Prior Learning (RPL) system to recognize and increase returns to skills and competencies acquired through non-formal channels • Expand state subsidies for parental leave and childcare to increase LFPR, especially for women • Promote personal tax regimes that incentivize, or at minimum do not disincentivize, labor force participation by couples • Expand state support to aged care to reduce mid-late career labor force withdrawal by those providing care • Pension system reforms to incentivize longer working lives and remove mandates or financial incentives to retire prematurely • Review taxation systems to ensure that tax force to retire is minimized • Phase out wage setting practices which reward age/tenure over worker productivity • Facilitate access to credit for firms and particularly for informal sector workers/enterprises through diverse channels, including banks, MFIs, group credit schemes, etc. • Ensure non-discrimination in hiring, through labor and/or general anti-discrimination laws and their enforcement • Consider employer incentives/subsidies for retention of older workers • Adaptation of workplaces to ensure sustained productive work
HC depreciation	• Strengthen employment services/ALMPs to reduce human capital depreciation during unemployment and accelerate LM re-entry • Provide unemployment insurance/assistance for laid-off workers • Provide financial incentives for workplace adaptations to allow for longer working lives with lower physical stress on workers • Provide incentives in pension systems for longer working lives to realized health benefits of longer working lives • Promote and incentivize volunteerism for benefit of volunteers and recipients of services
HC protection	• Enforcement of legislation outlawing harmful child labor • Expand social security coverage of HI, sickness/disability, and pension social insurance, with full/partial subsidization of premiums for informal sector workers • Strengthen workplace occupational health and safety compliance and provide incentives for workplace health promotion/wellness programs • Labor regulations on unfair dismissal and workplace discrimination, with grievance redress mechanisms • General social assistance in event of need/poverty

Economic Cost of Avoidable Mortality

Chapter 3
The Economic Value of Avoidable Mortality

Chapter 4
The Economic Value Associated with Avoidable Mortality: A Systematic Assessment by Cause of Death across World Regions

Chapter 5
Rates of Progress in Mortality Decline, 2000–2019



3

The Economic Value of Avoidable Mortality

Angela Y. Chang[a,b,c], Gretchen A. Stevens[d], Diego S. Cardoso[e], Bochen Cao[f], Dean T. Jamison[g]

[a] Danish Institute for Advanced Study, University of Southern Denmark
[b] Department of Clinical Research, University of Southern Denmark
[c] The Interdisciplinary Centre on Population Dynamics (CPop), University of Southern Denmark
[d] Independent Researcher
[e] Department of Agricultural Economics, Purdue University
[f] Department of Data Analytics, World Health Organization
[g] Department of Epidemiology and Biostatistics and Institute for Global Health Sciences, University of California, San Francisco

INTRODUCTION

Disease burden is commonly measured using a variety of health statistics, including deaths by cause, injury and disease prevalence and incidence, and disability-adjusted life years. While these metrics are meaningful, it is also evident that preventing injuries and diseases has practical economic and social consequences beyond health which have economic value. As part of the World Bank's Healthy Longevity Initiative, this chapter aims to estimate the economic value of avoidable mortality by world regions, sex, and age, between 2000 and 2019, with projection to 2050.

This work lies at the conjunction of three important strands of literature – estimation of the global burden of disease (GBD); estimation of the proportion of that burden that is amenable to intervention or can otherwise be avoided; and estimation of the economic value associated with reducing this burden (OECD 2019; Rutstein 1976; Nolte & McKee 2004). Key to defining the GBD was correcting for the overestimation of deaths by individual causes that resulted from individual disease communities providing estimates for their own disease. In the 1980s, researchers at the World Health Organization (WHO) initiated systematic correction by imposing demographically defined death totals as an envelope within which disease-specific estimates must lie (Hakulinen et al. 1986). This work was extended to include a more detailed list of causes of death and estimates of nonfatal health burden and initially published in the World Bank's 1993 World Development Report, Investing in Health, Appendix B (World Bank 1993; Murray et al. 1994). Earlier than the work on burden of disease, economists had initiated efforts to place value on small changes in mortality probabilities and, quite separately, on estimating the value of mortality reductions relative to increases in GDP in providing a comprehensive estimate of growth in national eco-nomic welfare. Schelling provided early approaches to valuing changes in mortality rates; recent, comprehensive pictures of a now substantially empirical literature are now available (Schelling 1968; Hammitt and Herrera-Araujo 2019; Viscusi 1993; Viscusi and Aldy 2003; Robinson et al. 2019; Hammitt 2020). Usher introduced methods for assessing the contribution of mortality change to growth in economic welfare and provided estimates for selected countries (Usher 1973; Bloom et al. 2004). The Lancet Commission on Investing in Health provided updated estimates of the contribution of mortality reduction to economic welfare change in low- and middle-income countries (Jamison 2013; Chang et al. 2017).

The purpose of this chapter is to bring together these two literatures with the economists' valuation of mortality change and the demographers and epidemiologists' definition of an overall envelope of mortality within which the sum of deaths from individual diseases must lie. The result is an estimate of the economic value of avoidable mortality that points to the monetized benefits from future improvements in health. With our framework, one could answer (albeit tentatively) questions such as: *"For a typical female, age 45, from Colombia: What percentage of their income would they be willing to forgo to live the next year under the lowest possible mortality risk?"*. By systematically applying our framework to a variety of populations, we then characterize the economic value to various groups and regions.

CONCEPTUAL FRAMEWORK

Two fundamental concepts underlie our effort: the definition of avoidable mortality and the economic valuation of mortality risks. This section outlines the conceptual framework adopted in our methodology.

Avoidable mortality

Avoidable mortality comprises deaths that may be prevented through public health or prevention interventions that reduce incidence (preventable mortality) and those that can be avoided through curative health care interventions that reduce case-fatality (treatable or amenable mortality) (OECD 2019; Nolte and McKee 2004; Rutstein 1976). Avoidable mortality is typically estimated as the number of deaths assigned to set of specific causes of death, when they occur below a threshold age (OECD 2019; Rutstein 1998; Nolte and McKee 2004). These deaths are categorized as either preventable or treatable. This list-based approach has several drawbacks for our purposes: first, it requires comparable, detailed,

and accurate cause-of-death data, which are not currently available for most countries (WHO 2020). Second, deaths cannot be categorized as exclusively preventable or amenable as some deaths may fit in both categories: a death from road traffic injury could, in many cases, have been prevented (e.g., by traffic calming measures) or avoided by better care (e.g., in the emergency room). We have addressed these issues by implementing a simplified method which is suitable for countries with varying availability and quality in cause-of-death information. Our method estimates avoidable mortality without disaggregation into preventable and treatable mortality. Specifically, we estimate avoidable mortality as the difference between current (estimated or projected) mortality levels and unavoidable, or frontier mortality levels, which are the lowest mortality levels that can be obtained for each age given past and current technologies and knowledge.

Frontier mortality levels are estimated for each time *t* as the lowest projected or observed mortality rates at each age in either sex at time *t*. We apply a single age-sex-year-specific frontier to all countries and both sexes. In other words, all countries are compared to the single best-practice frontier, and both females and males are compared to the same frontier. This is built on our belief that all countries, with the right level of financial investment, political will, policies, and technological advancements, have the opportunity to reach the frontier, even though it may be more challenging (and take longer) for some countries than others.

We compared both male and female mortality to the lowest sex-specific mortality rate, which in all cases is a female mortality rate. Most of the sex differences in life expectancy has been shown to be due to non-biological factors, namely gender differences in health behavior and risks, such as smoking, alcohol use, and injuries (Luy 2016). In high-income settings, from which our frontier mortality rates are drawn, excess male mortality is caused by injuries and non-communicable diseases (WHO 2020). Excess injury deaths in males are likely a result of socio-cultural factors rather than innate biological susceptibility. A higher proportion of male non-communicable disease deaths can be attributed to modifiable risk factors, again pointing to the importance of socio-cultural differences causing higher male mortality (GBD 2019). Specialized studies of populations where the gender differences in health exposures are minimized have found that the female longevity advantage is around 1-2 years, far smaller than the 5-year gap between male and female frontier life expectancy in 2019 (Luy 2016).

Economic value of mortality reduction

Reductions in mortality risks lead to improved wellbeing and higher living standards in societies. As such, these reductions are perceived as a benefit to the populations that experience them. But consistent mortality reductions are often the result of costly public interventions. Therefore, governments seeking to make more objective decisions frequently perform quantitative comparisons of the benefits and costs of various interventions before establishing their priorities. While estimating the cost of potential interventions is a relatively straightforward accounting exercise, quantifying the benefits of mortality reductions requires a conceptual framework of economic value.

Leading scholars have developed and applied estimates of the value per statistical life (VSL) to quantify the benefits of mortality reductions (Viscusi 1992; Sunstein 2002; Revesz 2008; Sunstein 2014; Viscusi 2018; Robinson et al. 2019; Chang et al. 2018; Khadka and Verguet 2021). The VSL measures the willingness to pay (or to accept compensation) for a small reduction (increase) in mortality risk. The following example illustrates the concept. Suppose we know that a group of workers is willing to pay $1,000 on average to reduce their individual annual fatality risk by 1/10,000. Then, if exactly 10,000 of those workers reduce their fatality risk by this amount, they statistically avoid one death among them. Therefore, they collectively spend $10 million to save one statistical life – or, equivalently they imply a VSL of $10 million. The VSL as a unit is, empirically, on the order of 10,000 times the value actually measured.

The VSL approach is widely adopted by governments and regulatory agencies in countries that require an economic analysis of potential public sector investments and regulations, including the United States, Norway, United Kingdom, and Canada (Viscusi and Aldy 2003). Before the theoretical and empirical advances that led to the consolidation of the VSL framework, the value of saving lives was usually equated to savings in medical costs and forgone wages. However, this alternative approach based on economic losses had substantial limitations for its use in benefit-cost analyses. For instance, because of the list-based quantification, the calculated value is highly sensitive to omissions and often leads to

substantial underestimation. Moreover, measures of cost savings are inherently disconnected from the idea of economic benefits, which are conceptually linked to willingness to pay in the economic theory. As the studies by Viscusi have indicated, policies that incorporate the VSL are much more protective of lives and health than policies that adopt the economic losses approach (Viscusi 2018).

The VSL can be estimated based on two types of data: observed behavior (the revealed preference approach) or surveys about subjects' willingness to pay (the stated preference approach). The empirical VSL literature generally favors estimates based on observed behavior because of the significant challenges in eliciting truthful and consistent answers about willingness to pay from hypothetical scenario.[1] However, inference from observed behavior also poses relevant limitations, such as biases from individuals' misperception of risks or selection into specific behaviors.[2] Estimates following the revealed preference approach frequently infer the VSL based on market data. For instance, these studies can statistically estimate the VSL based on the labor markets, using the differences between wages in occupations with different fatality risks, or safety equipment markets (such as helmets and airbags), using the differences in the demand for various devices with different degrees of risk protection. These inherent uncertainties in empirical estimation imply that findings based on the literature should be viewed more as importantly suggestive than conveying quantitative decision.

The VSL approach is increasingly applied in the global health literature (Robinson et al. 2019; Chang et al. 2018). These applications typically calculate the economic value of reducing mortality by multiplying the VSL by the number of expected lives saved (Jamison et al. 2013 Khadka and Verguet, 2021). However, this approach is appropriate only when mortality risk changes are not appreciably larger than values empirically measured. As indicated above, the VSL is defined and estimated based on small risk changes. When applied to large risk changes, the VSL multiplication approach can lead to substantial overestimation and even to values that exceeds one's income – a direct contradiction with the concept of the income-mortality trade-off that underlies the VSL.

The VSL multiplication (or fixed VSL) approach can overestimate economic values because it is a linear approximation which holds constant the economic value of risk change. Such approximation results in negligible errors when risk changes are small and of the same order used for the empirical estimation of the VSL. However, as the mortality risk increases, each subsequent risk reduction plausibly has a smaller value – a principle commonly referred to as the decreasing marginal value. Intuitively, this principle also holds because as individuals trade off more and more of their resources for reduced mortality, they need to forgo other uses of their income in increasing order of value. The linear extrapolation in the fixed VSL approach fails to account for the changing nature of this substitution rate. Therefore, in cases where mortality risk changes can be large, such as the case of eliminating avoidable mortality, it is necessary to adjust the value of risk reductions to stay consistent with the underlying VSL framework (Hammitt and Herrera-Araujo 2019; Cardoso and Dahis 2024; Bressler 2022).

In this chapter, we apply the more plausible approach that regards estimates of the value of mortality change as reasonable approximation for modest changes around the baseline mortality levels. Then, we approximate the value of larger changes based on assumed functions that respect income and resource constraints, thus never exceeding one's means in their valuation of mortality reduction.

METHODS

Estimating avoidable mortality

We define avoidable mortality as the difference between current (estimated or projected) mortality levels and unavoidable, or frontier mortality levels, which are the lowest mortality levels that can be obtained for each age given current technologies and knowledge.

Frontier mortality rates are selected from countries with high-quality death registration data to avoid selecting incorrectly estimated mortality rates. Specifically, we selected the frontier mortality rates

1 For further details, see discussions in Hammitt, James and Graham (1999); and Andersson and Treich (2011).

2 For an extensive discussion of these limitations, see Viscusi and Aldy (2003)

from lifetables included in the Human Mortality Database (HMD), which are derived from populations where death registration and census data are virtually complete (Barbieri et al. 2015; Wilmoth et al. 2021; Human Mortality Database 2023). We took two steps to reduce the effect of stochastic variability on frontier mortality: (1) we selected the lowest mortality rates for each age range and year from 5x5 mortality tables (5 years of age by 5 calendar years), and we excluded countries with a population of 1 million or less in 2019.

Formally, we define

$$ {}_{n}a_{x,\,i,s,t} = {}_{n}m_{x,i,s,t} - {}_{n}f_{x,t} \qquad [1] $$

where ${}_{n}a_{x,\,i,s,t}$ is avoidable mortality rate in deaths/1000 population in the age range [*x,x+n*) in country *i,* sex *s,* and year *t*, ${}_{n}m_{x,i,s,t}$ is the observed/projected mortality rate in deaths/1000 population in the age range [*x,x+n*) in country *i,* sex *s,* and year *t* from the World Population Prospects (WPP) 2022, and ${}_{n}f_{x,t}$ is the lowest reliably observed mortality rate of any population-sex unit, obtained from populations included in the HMD of age range [*x,x+n*) in year *t* or projected as described below (Human mortality database, 2023; UNDESA, 2022).

We compared both male and female mortality to the lowest sex-specific mortality rate, which in nearly all cases is a female mortality rate. In high-income settings, from which our frontier mortality rates are drawn, excess male mortality is caused by injuries and by non-communicable diseases (2). Excess injury deaths in males are likely a result of socio-cultural factors rather than innate biological susceptibility. A higher proportion of male non-communicable disease deaths can be attributed to modifiable risk factors (3), again pointing to the importance of socio-cultural differences causing higher male mortality. We carry out a sensitivity analysis where we construct separate frontiers for males and females, however, this sensitivity analysis is expected to underestimate avoidable mortality in males.

The HMD includes historical data as soon as they are available, up to the 2022 calendar year, but does not include projections. Frontier (or highest observed) life expectancy has been shown to increase linearly at around 2.5 years per decade (Oeppen and Vaupel 2002; Vaupel et al. 2021). We projected log age-specific frontier mortality rates linearly for the years 2022-2050 on the basis of observed mortality rates from all complete 5-year periods in the HMD from the 1980-1984 to 2015-2019. This is a commonly used approach for projecting mortality that results in a projected rate of increase of frontier life expectancy of 1.8 years/decade, lower than predicted by Vaupel and colleagues but consistent with historical increases in our derived frontier life expectancy (webappendix Figure 1) (Oeppen and Vaupel 2002). Frontier mortality rates for each age were then interpolated to obtain annual estimates for the years 2000-2021. An implication of this approach is that frontier mortality rates continue to decline in 2020 and beyond, despite the COVID-19 pandemic. This is consistent with continued declines in mortality in some of the lowest-mortality countries in 2020. In 2020, Japanese women's life expectancy increased 0.3 years to 87.7, and South Korean women's life expectancy also increased 0.2 years to 86.5 years in 2020 (Human Mortality Database, 2023). These increases were similar to the historical annual increase in frontier life expectancy, and they occurred in the populations that set the frontier for some age groups prior to 2020.

Avoidable deaths are computed as the product of age-country-sex-year avoidable mortality rates (${}_{n}a_{x,\,i,s,t}$) and age-country-sex-year population totals from WPP2022.

To provide context and asses the feasibility of achieving the frontier mortality rates, we calculated the historical average annual rate of change for all country-year-sex-age combinations between 2000 and 2019 and identified the top 10th percentile performers. We consider these observed changes to be fast but plausible, and created a scenario (named "rapid progress") in which countries experience such rates from the present to 2050. We compare this scenario to the frontier for 2050 to assess the feasibility of achieving the frontier mortality rates by 2050.

Estimating the economic value of avoidable mortality

The economic value of avoidable mortality in a given year is measured as the percentage of annual income an individual is willing to forgo to live that year at the frontier survival probabilities. We assign economic values to changes in the mortality risk using VSL estimates from the literature (Robinson et al. 2019).

We follow the literature in assuming that individuals are willing to forgo part of their available resources—usually consumption, wealth, or income—for a lower mortality risk (Schelling 1968; Viscusi 1993). Specifically, we assume that the value of income is modeled with a logarithmic function – the simplest

nonlinear member of the family of functions typically used to relate utility to income. Function $F_a(\boldsymbol{S}, y)$ represents the discounted expected value of remaining lifetime income for an individual at age a, where $\boldsymbol{S} = \{S_0, S_1, S_2, \dots\}$ represents the vector of current annual survival probabilities at ages $a = \{0,1,2,3, \dots\}$ and y is annual income. For simplicity, we model one country-representative individual for each age group. Moreover, annual income is constant over time and equal to the gross national income per capita (denoted by $\bar{y}$). Then, we can write $F_a(\boldsymbol{S}, y) = f(\bar{y})L_a(\boldsymbol{S})$, where $f(\bar{y}) = ln(\bar{y}) + k$ is the value attributed to living one year with income level $\bar{y}$ and k is a normalization constant, $L_a(\boldsymbol{S}) \equiv \sum_{t=0}^{\infty}(1+\rho)^{-t}S_{a,t}$ is analogous to a discounted remaining life expectancy, ρ is the annual discount rate, and $S_{a,t}$ is the probability of surviving from age a until age $a+t$.

Let $\tilde{S}_a$ represent the frontier one-year survival probability at age *a*. Then, the economic value of avoidable mortality is implicitly defined by $F_a(\boldsymbol{S}, \bar{y}) = \tilde{S}_a f(\bar{y} - v_a\bar{y}) + \tilde{S}_a(1+\rho)^{-1}F_{a+1}(\boldsymbol{S}, \bar{y})$. This equality says that an individual at age is indifferent between continuing under the status quo and a hypothetical scenario where she forgoes a proportion v_a of this year's income in exchange for higher survival probability (no avoidable mortality) that year.

Using the equality above, we can obtain the expression to calculate $v_a(S_a, \tilde{S}_a, \boldsymbol{S})$: the proportion of income that corresponds to the value of avoidable mortality. However, this procedure solves for a family of functions. To pin down an exact solution, we use empirical estimates of the VSL. This is possible because the VSL contains information about the value of income relative to small mortality risk changes (see webappendix A1 for details). Solving for v_a allows us to derive an expression for the value of eliminating avoidable mortality, which is given by

$$v_a(S_a, \tilde{S}_a, \boldsymbol{S}) = 1 - exp\left(-\hat{\lambda}\frac{\tilde{S}_a - S_a}{\tilde{S}_a}\frac{L_a(\boldsymbol{S})}{S_a}\right) \quad [2]$$

where $\hat{\lambda}$ is a country-specific parameter grounded on empirical estimates of the VSL and background risk. Parameter $\hat{\lambda}$ is defined as $\hat{\lambda} = \hat{V}S_{\hat{a}}^2/\bar{y}L_{\hat{a}}(\boldsymbol{S})$, where $\hat{a}$ denotes reference age for the typical worker $\hat{a}$ and $\hat{V}$ is the estimated VSL.[3] This parameter is analogous to the Value per Statistical Life-Year (VSLY) for the typical worker adjusted for background risk.

Equation (2) characterizes the key elements of our framework to calculate the economic valuation of large mortality risk changes. We can check that when a country is at the frontier, there is no mortality change ($\tilde{S}_a = S_a$), so the value is zero. As the distance between the frontier mortality ($\tilde{S}_a$) and a country's mortality (S_a) increases, the value also increases. At first, S_a increases faster, with a rate governed primarily by the VSL-based parameter $\hat{\lambda}$. As the distance between $\tilde{S}_a$ and S_a becomes larger, v_a goes towards 1 (full income) but never exceeds it (see webappendix A1 for a detailed discussion of this equation).

We closely followed the recommendations made by the Harvard Benefit Cost Analysis Reference Case for conducting benefit cost analysis in global health in choosing the base VSL, setting the level of income elasticity, placing a floor constraint on VSLr — the ratio between VSL and annual income per capita—, and conducting the recommended sensitivity analysis scenarios (Viscusi and Aldy 2003). As a starting point, we set the VSLr at 160 (the ratio comes from a United States VSL of $9.4 million and GNI per capita of $57,900), and income elasticity of 0.8 when extrapolating across countries with higher GNI per capita than the United States, and 1.2 for countries with lower GNI per capita. We apply a lower bound constraint for the VSLr at 20. We choose to estimate income using GNI per capita expressed in 2017 international dollars and adjusted for purchasing power parity (PPP), as recommended by the reference case. Data on GNI per capita (PPP constant 2017 International $) between 2000-2021 came from the World Bank (World Bank 2021); income levels for 2050 are projected using OECD's projected country-specific growth rates between 2021 and 2050 for listed countries (OECD and G20 countries), and the world average growth rate during the same time period for all remaining countries. The initial VSLr for all ages are set as equal. The annual discount rate is 3 percent. The economic value of avoidable mortality is presented as percentage of annual income for both sexes, and females and males separately. Following the common approach in the literature, we used the same VSL for both sexes due to two reasons: lack of good data on sex-specific VSL, and that females likely have lower VSL due to lower labor income. For example, Aldy & Smyth estimated about 13 percent lower VSL for American females than males, reflecting a combination of females' higher life expectancy (increase in VSL) but lower labor market compensation

3 Using a reference value of 40 years based on VSL estimates for the United States, the VSLY = VSL / 40.

(decrease in VSL) than males (Aldy and Smyth 2014).

We present the estimated avoidable mortality and its associated economic value by the World Bank's geographic regions, with China and India presented separately. We focus on the years 2000, 2019, and 2050, which represent the beginning of the era of major international investment in global health, current conditions just prior to the COVID-19 pandemic, and future projections. We also discuss estimates for 2021, which is the latest observed year available from WPP2022 and reflects the unique mortality profile during the COVID-19 pandemic.

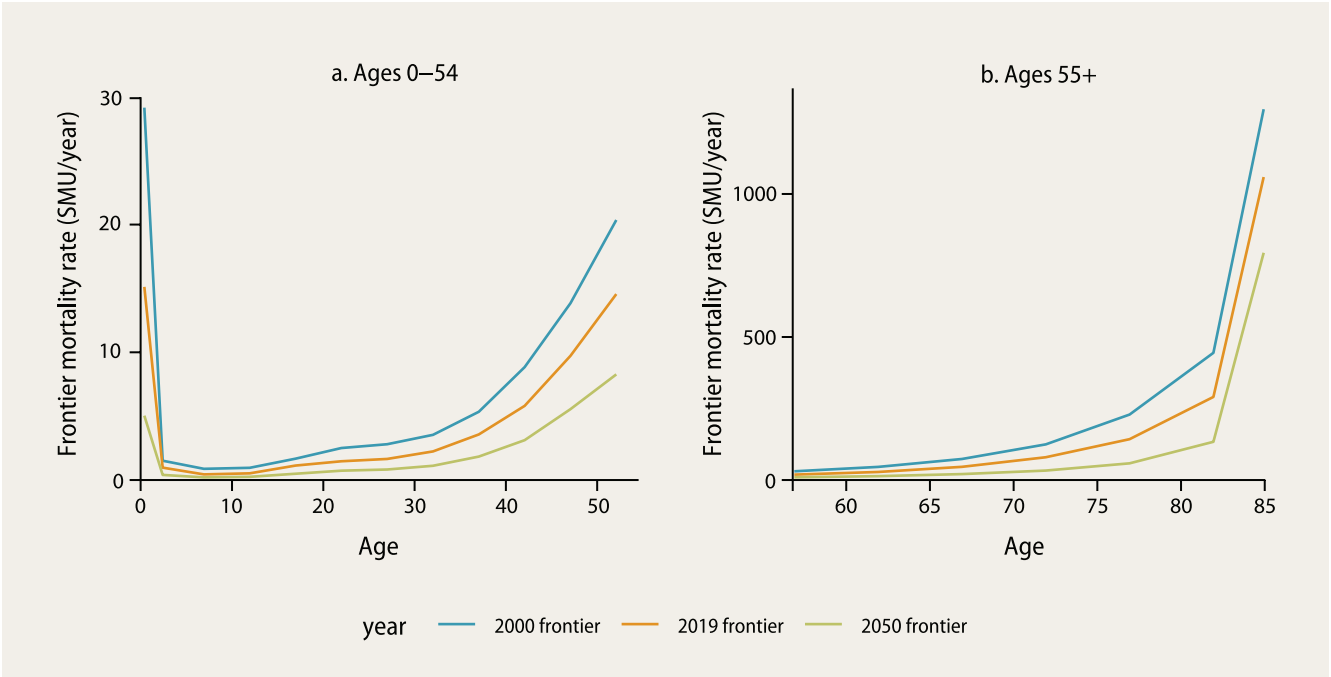
Sensitivity analyses

Six sets of sensitivity analyses were conducted. In estimating avoidable mortality, we first replaced the mortality frontier with sex-specific frontiers. In other words, we applied the lowest frontier mortality levels for each sex separately to estimate avoidable mortality by sex. Second, we compared mortality under the rapid progress scenario to business-as-usual WPP2022 projections and the 2050 frontier. In estimating the value of mortality reduction, in addition to the three sets of standard sensitivity analyses proposed by the Harvard Benefit Cost Analysis Reference Case (on income elasticities, discount rates, baseline VSL-to-income ratio), we further test different value-of-income functions (linear, reciprocal).

RESULTS

During the four five-year periods between 2000-2019 and considering 19 age groups (76 age-period categories), Japanese women had the lowest observed mortality rate for 22 age-period categories; the next most frequently appearing population was Hong Kong SAR, China women (15 age-period categories; webappendix Table A1). Other populations that set the frontier for at least two age-period categories were women from Denmark, Finland, Italy, Slovenia, South Korea, Spain, Sweden, and Switzerland. Combining these age-specific mortality rates, frontier life expectancy was estimated to increase from 84.8 in 2000 to 88.5 in 2019, and was projected to reach 94.2 in 2050 (webappendix Figure A7), an increase of 1.8 years per decade. Frontier mortality rates for years 2000, 2019, and 2050 are depicted in Figure 3.1, and the gap between the frontier life expectancy at birth and observed or projected life expectancy is listed in Table 3.1.

FIGURE 3.1 Frontier mortality rates from 2000, 2019, and 2050



Note: The scale of the y-axes for the two graphs are different. SMU = standardized mortality unit, deaths per 10^{-4} per year

TABLE 3.1 Gap between observed and frontier life expectancy at birth in years, 2000, 2019 and 2050, globally and by region

	World	China	Euroasia & Mediterranean	High-income	India	Latin America & Caribbean	Sub-Saharan Africa
Males							
2000	20.7	15.0	21.9	10.1	23.0	17.1	35.4
2019	18.3	13.2	19.7	9.7	18.9	16.9	29.5
2050	19.4	11.9	20.0	10.5	18.0	16.2	29.8
Females							
2000	15.9	10.5	15.7	3.8	21.1	10.5	32.4
2019	13.1	7.5	13.4	4.3	16.0	10.5	25.8
2050	14.4	8.1	14.0	6.2	14.1	10.9	24.9

Note: estimated life expectancies at birth were compared to frontier life expectancies at birth, which were 84.8 in 2000, 88.5 in 2019, and 94.2 in 2050.

Avoidable mortality as percentage of total mortality was approximately 69 percent in 2019, equivalent to 40 million deaths. Nearly half of avoidable deaths occurred in Euroasia & Mediterranean (10.7 million) and Sub-Saharan Africa (8.9 million). The percentage of deaths that were avoidable was lowest and highest in High-income countries (42 percent) and sub-Saharan Africa (91 percent), respectively (Figure 3.2, Table 3.2). More than 70 percent of mortality in every age group under age 80 was avoidable.

For the oldest age group – adults aged 80 years and older – avoidable mortality as a percentage of total mortality ranged from 26 percent of deaths in High-income to 64 percent in sub-Saharan Africa. Avoidable mortality in the oldest ages account for an increasing proportion of overall avoidable mortality, with avoidable mortality in ages 80 and over contributing 17 percent of avoidable mortality globally in 2019 and anticipated to contribute 34 percent of avoidable mortality in 2050.

FIGURE 3.2 Avoidable mortality as percentage of total mortality, year 2019

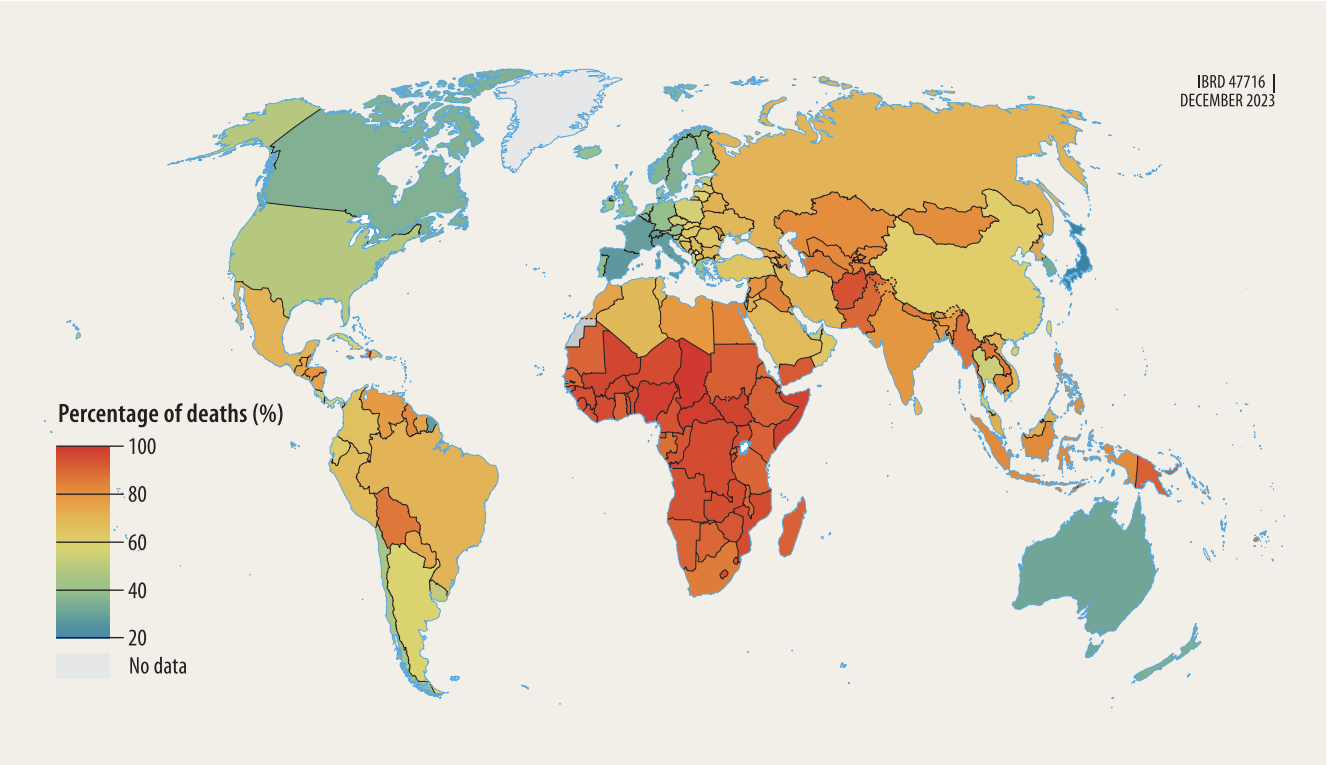


TABLE 3.2 **Total mortality and percentage of mortality that is avoidable in 2019, globally and by region, for all ages and by age**

	World		China		Euroasia & Mediterranean		High-income		India		Latin America & Caribbean		Sub-Saharan Africa	
	total deaths (millions)	% avoidable	total deaths (millions)	% avoidable	total deaths (millions)	% avoidable	total deaths (millions)	% avoidable	total deaths (millions)	% avoidable	total deaths (millions)	% avoidable	total deaths (millions)	% avoidable
All ages	58.1	69	10	62	14.2	75	10.6	42	9.3	78	4.1	69	9.7	91
Infants	4.0	95	0.1	77	1.0	94	0.1	64	0.7	95	0.1	90	2.0	97
1-9 years	2.1	96	0.05	79	0.3	93	0.02	54	0.2	94	0.04	87	1.4	99
10-19 years	1.1	91	0.06	79	0.2	88	0.03	64	0.2	88	0.06	85	0.6	97
20-39 years	4.0	88	0.3	72	0.9	86	0.2	71	0.7	87	0.3	86	1.5	95
40-59 years	9.2	77	1.4	64	2.5	79	1.0	61	2.0	83	0.7	76	1.5	89
60-79 years	21.4	75	4.5	71	5.8	80	3.7	58	3.8	81	1.6	74	2.0	86
80 and over	16.3	43	3.7	48	3.5	55	5.6	26	1.7	50	1.2	51	0.7	64

Across regions, mortality rates have converged in absolute terms over time, but the percentage of mortality that is avoidable has changed little. Avoidable mortality rates were estimated and projected to decline, with a few exceptions (webappendix Figure A9). Regional trends in the percentage of deaths that are avoidable in each age group are a mixture of stable or, especially after 2010, increasing, indicating that relative gains in frontier mortality rates have been and are projected to outpace gains in mortality in many countries (Figure A10). Despite increases in the percentage of deaths avoidable at each age, the percentage of all deaths that were avoidable changed little globally and in each region because average ages are increasing everywhere, and the percentage of deaths that are avoidable declines with age (Figure 3.3). Avoidable mortality as percentage of total mortality was approximately 72 percent in 2000, 69 percent in 2019, and projected to be 70 percent in 2050 (Figure 3.3). Across all regions, the lowest proportions of avoidable mortality were found in the high-income region, with 42, 42, and 45 percent in years 2000, 2019, and 2050, respectively. The highest proportions were found in sub-Saharan Africa (92, 91, and 92 percent in years 2000, 2019, 2050), India (82, 78, 75 percent), and Euroasia & Mediterranean (77, 75, 76 percent).

FIGURE 3.3 Avoidable mortality globally and by region, year, and age group

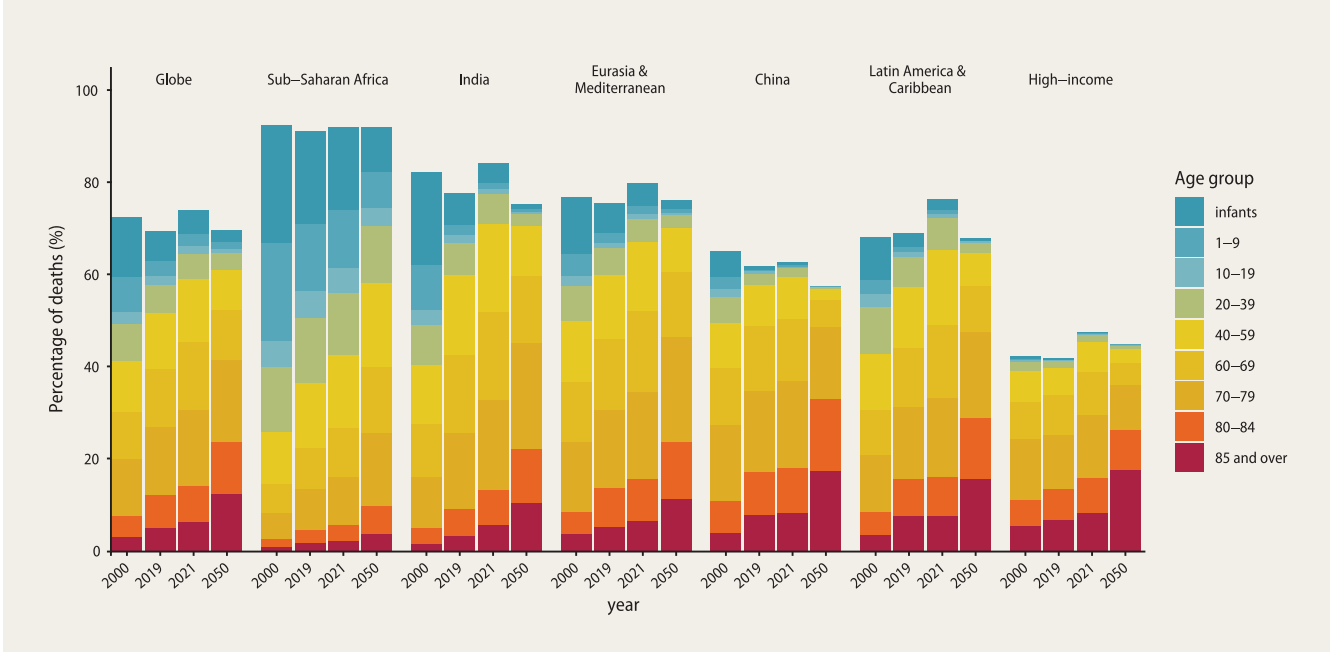
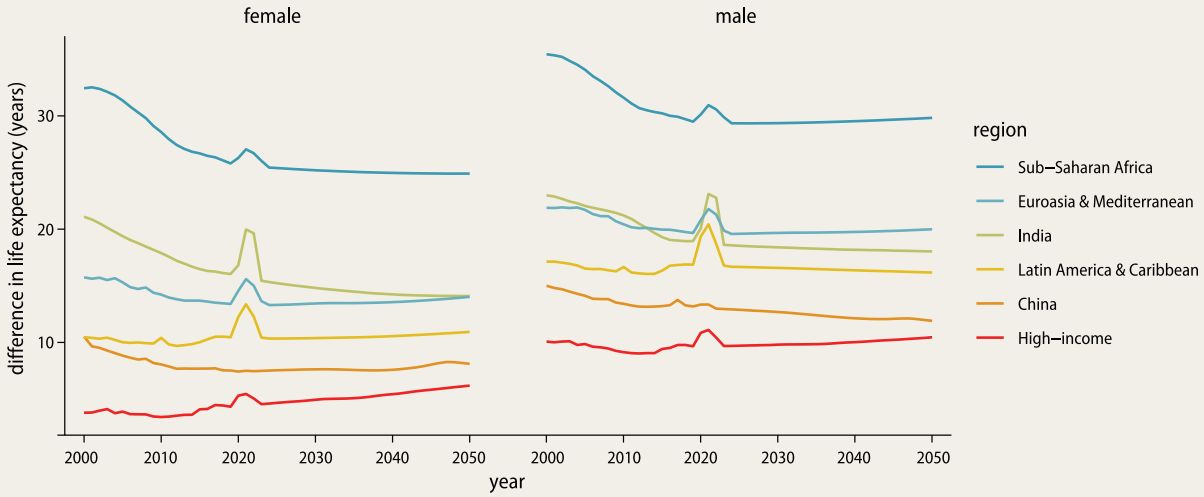


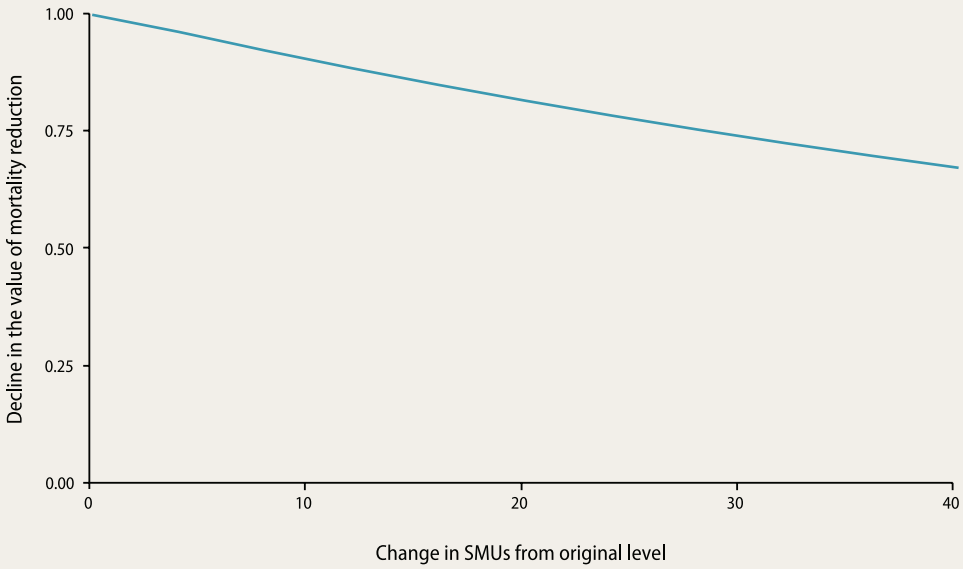
Figure 3.4 depicts the gap between regional life expectancy and frontier life expectancy. From 2000-2010, this gap was decreasing for most regions. However, the gaps between frontier and projected life expectancy are expected to change little after 2025 due to the projected deceleration of reductions in avoidable mortality at all ages. In some populations, including women in high-income countries, this gap is projected to grow as women in some countries fall behind the frontier. Because males have higher mortality rates, avoidable mortality in males is larger than in females, both in percentage of deaths and number of deaths, in all regions and years (webappendix Figures A9 and A10).

FIGURE 3.4 Gap in life expectancy at birth between observed/projected life expectancy and frontier life expectancy



Based on the estimated levels of avoidable mortality presented above, we calculated the economic value of avoidable mortality as percentage of annual income by region, year, and sex. First, we illustrate the relationship between the size of mortality risk change and the decline in marginal economic value assigned in Figure 3.5, using the example of age group 0-1 in the United States in 2019. As the decay curve shows, our model assigns lower marginal economic value (VSMU) with increasing size of mortality risk reduction.

FIGURE 3.5 Ratio of average VSMU to initial VSMU, for United States age group 0-1

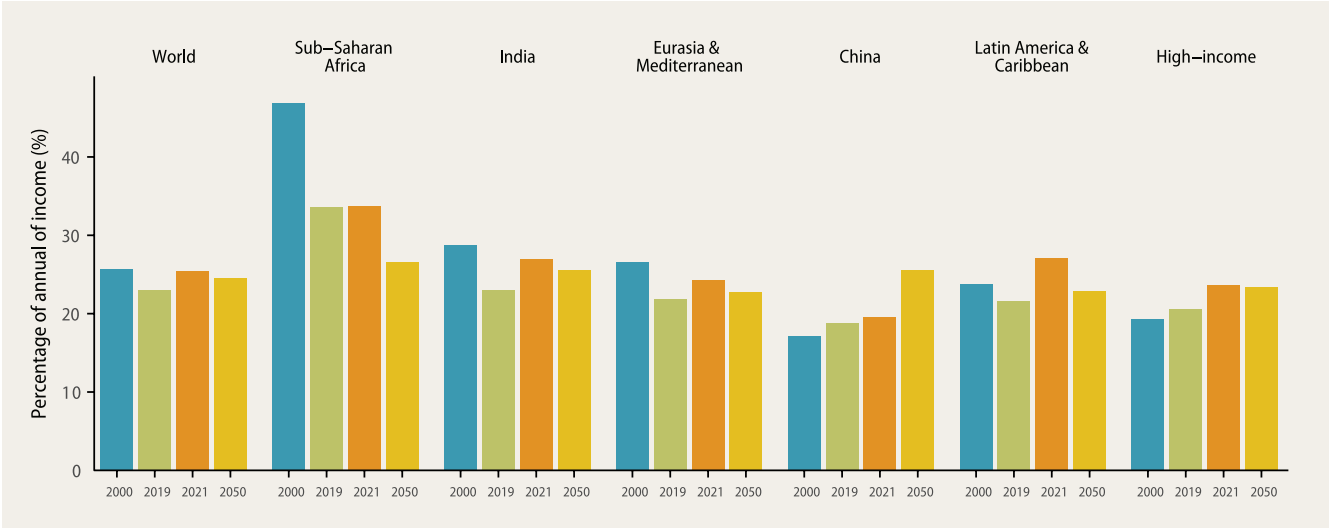


Note: An SMU (standardized mortality unit) is a mortality rate of 10^{-4} per year. The y-axis represents the ratio of the value of SMU (VSMU) associated with small increment from initial mortality level to applied VSMU for active change in mortality level. In this example, we show the decline in the average VSMU with the change in SMUs for age group 0-1 in the United States.

TABLE 3.3 Value of avoidable mortality in 2019 globally and by region and age group

	World	China	Euroasia & Mediterranean	High-income	India	Latin America & Caribbean	Sub-Saharan Africa
Economic value (2017 international billion dollars, PPP)	29320	4249	5080	12344	2077	1878	1380
Economic value as percentage of annual income	23%	19%	22%	21%	23%	22%	34%
Distribution by each age group (%)							
Infants	6	3	7	2	7	6	10
1-9 years	10	2	7	1	8	4	27
10-19 years	6	3	5	1	6	5	12
20-39 years	18	11	18	11	20	22	25
40-59 years	26	28	29	26	30	29	16
60-79 years	28	43	28	44	26	28	9
80 and over	6	10	5	15	4	6	1

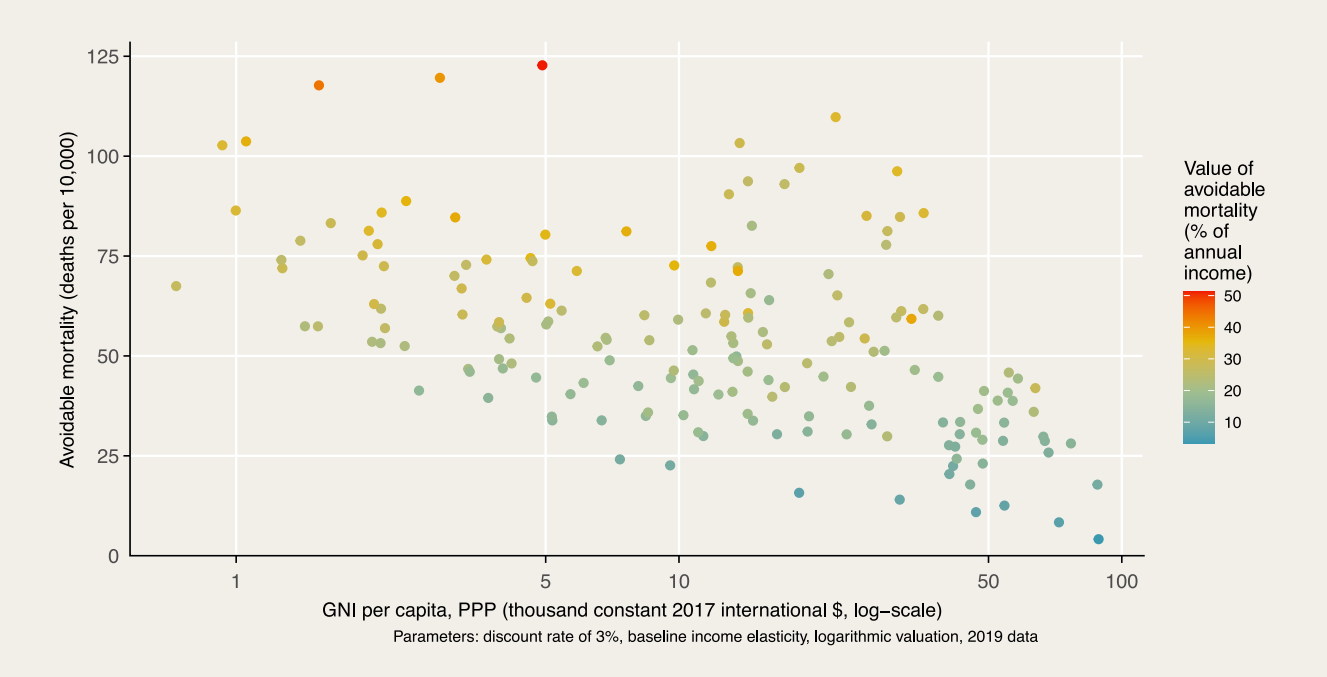
FIGURE 3.6 Value of avoidable mortality as percentage of annual income for years 2000, 2019, 2021, and 2050 (projected)



Globally in 2019, the economic value of avoidable mortality (mean value, weighted by population) is estimated at about 29.4 trillion international dollars (2017, PPP-adjusted), representing approximately 23 percent of annual global income (Table 3.3, Figure 3.6). We estimated the highest percentages in sub-Saharan Africa (34 percent annual income), followed by India (23 percent), Euroasia & Mediterranean (22 percent), Latin America & Caribbean (22 percent), High-income (21 percent), and China (19 percent). The relationships between the levels of avoidable mortality, income, and the value of avoidable mortality are shown in Figure 3.7. Higher avoidable mortality rate reflects the combined effect of older population age structure (because older ages tend to have higher mortality) and relatively higher rates of avoidable mortality across all ages. As shown in the figure, at the same income level, countries with higher avoidable mortality rate have higher value of avoidable mortality as percentage of annual income.

Different time trends are observed across regions (Figure 3.6). In sub-Saharan Africa, Euroasia & Mediterranean, and India, we estimate the value (as percentage of annual income) to decrease over time. In sub-Saharan Africa, for example, the value was 46 percent in 2000, decreased to 34 percent in 2019, and projected to decline further to 27 percent by 2050—nearly halved in 50 years. In Euroasia & Mediterranean and India, large declines were seen

FIGURE 3.7 Relationship between avoidable mortality rate, GNI per capita, and value of avoidable mortality



Parameters: discount rate of 3%, baseline income elasticity, logarithmic valuation, 2019 data

between 2000 and 2019, but the value is projected to increase slightly by 2050. In comparison, the values for the other regions increased over time. The largest increases are seen in China: from 17 percent in 2000, 19 percent in 2019, to 26 percent in 2050, reflecting the large projected increases in income and the proportion of older population. While China had the lowest values in 2000 and 2019, it is expected to surpass many other regions in 2050. In contrast, Euroasia & Mediterranean is expected to have the lowest value (at 23 percent) in 2050.

Global and regional values of avoidable mortality are unevenly distributed among different age groups in all years. The two left-most columns in Figure 3.8 show that infants (age 0) and ages 60 and above account for a proportion of the total value that is larger than their population weights. Globally in 2019, ages 60 and above account for about 34 percent of the total value despite representing 13 percent of the population. Similarly, age 0 contributes to 6 percent of the value while being less than 2 percent of global population. The disproportionate contribution to value from these age groups reflects both their high avoidable mortality rates, especially for infants, and large absolute reductions in elderly mortality rates if avoidable mortality is eliminated (see Figure 3.3). On the other hand, children, adolescents, and younger adults (ages 10 to 39) comprise almost half of the global population (47 percent) but only account for 24 percent of the total value of avoidable mortality.

Regional differences in population age structure led to substantially different age group contributions to the total value of avoidable mortality, as evidenced in Figure 3.8. In sub-Saharan Africa, approximately 37 percent of the value comes from ages 0–9, which accounts for 30 percent of the population. Moreover, ages 60 and above represent about 10 percent of the value and only 5 percent of the population. The distribution of contributions is markedly different in regions with older populations. For instance, in High-Income countries, ages 60 and above account for 60 percent of the total value and represent 24 percent of the population. Furthermore, with low infant mortality rates, age group 0–9 accounts for only 3 percent of the value while being 11 percent of the population.

Looking at the differences by sex, Figure 3.9 shows that the global value of avoidable mortality in 2019 is estimated at 19 and 27 percent of annual income for females and males, respectively. Hence, the value of avoidable mortality is approximately 40 percent higher for males, reflecting the higher avoidable mortality rates of males relative to females

FIGURE 3.8 **Age-group contributions to the total value of avoidable mortality and population composition by age in year 2019**

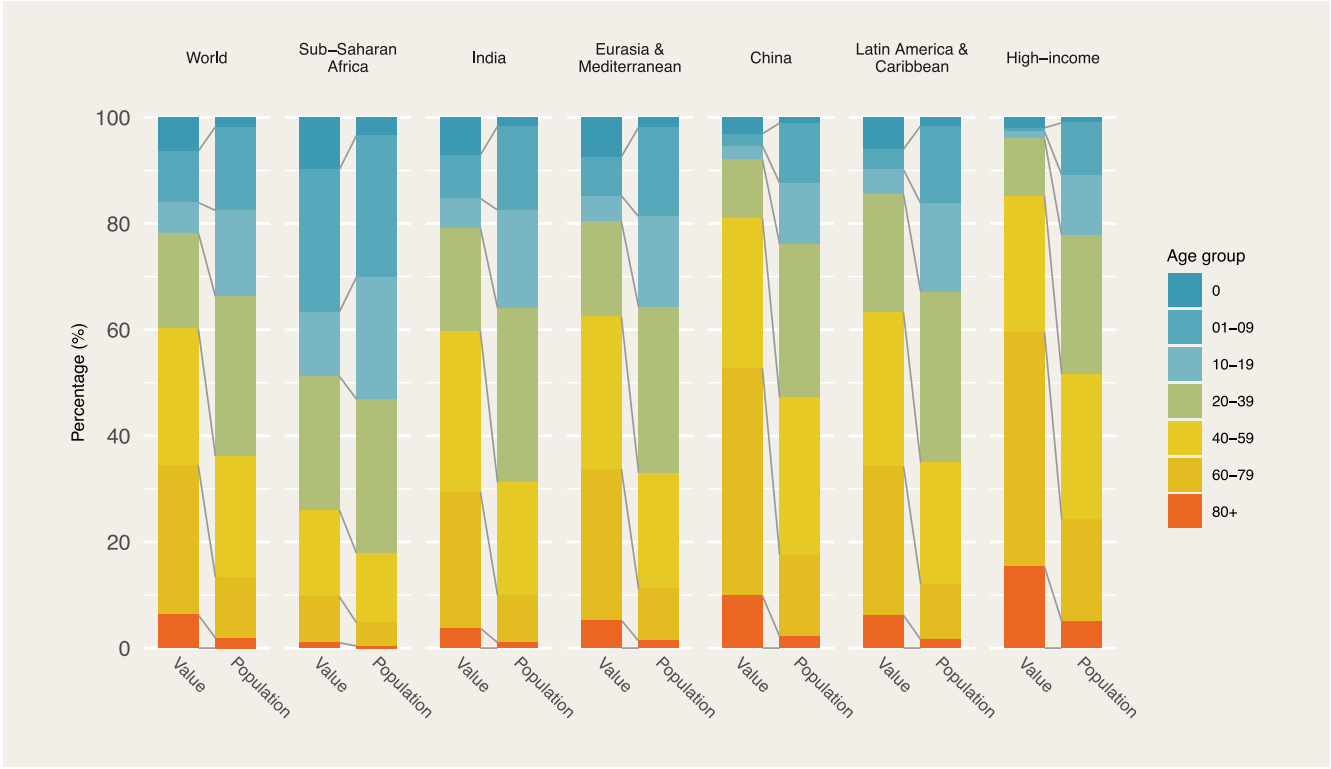
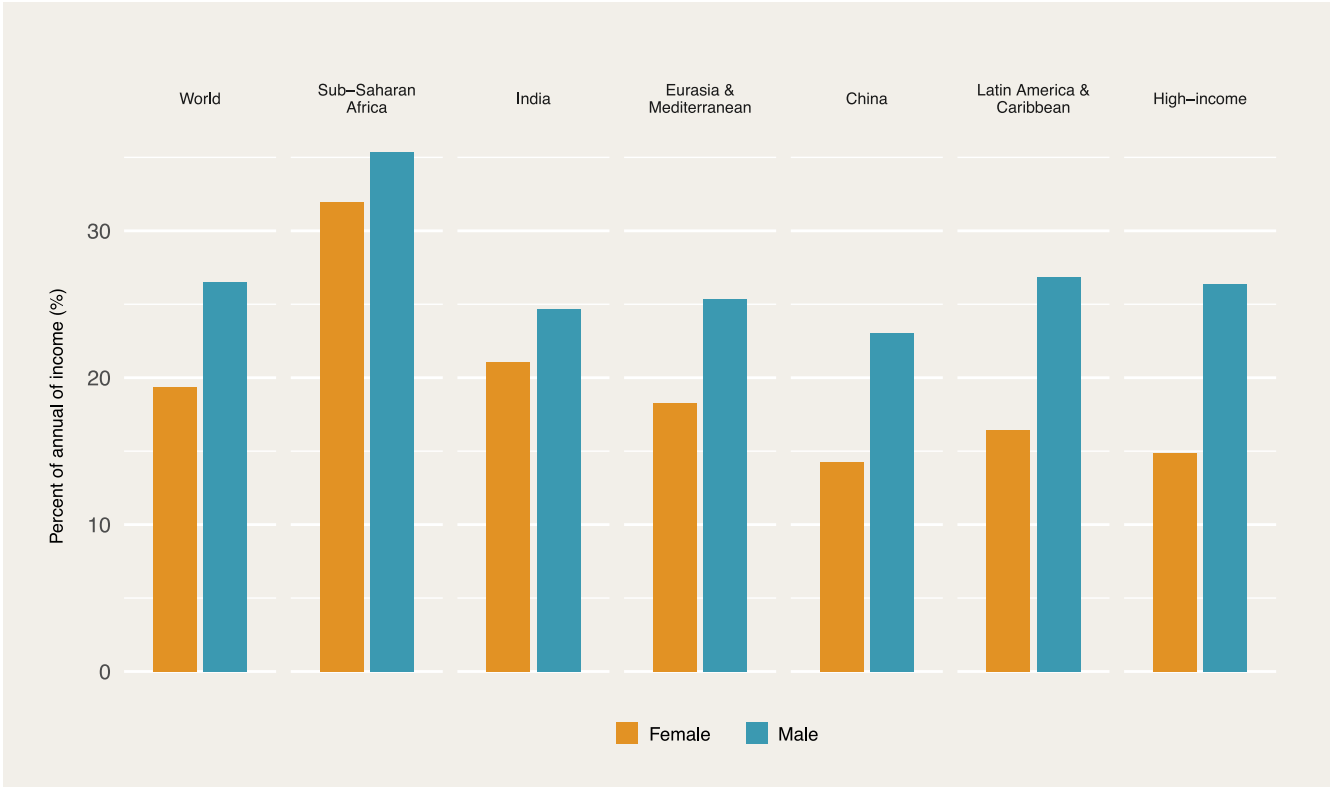


FIGURE 3.9 **Value of avoidable mortality for females and males as percentage of annual income in year 2019**



(see Figure 3.4). Among females, we estimated the lowest values in China (14 percent), High-income (15 percent), and Latin America & Caribbean (16 percent), and the highest values in sub-Saharan Africa (32 percent), India (21 percent), and Euroasia & Mediterranean (18 percent). Among males, the lowest values were found in China (23 percent), India (25 percent), and Euroasia & Mediterranean (25 percent), and the highest values in sub-Saharan Africa (35 percent), Latin America & Caribbean (27 percent), and High-income (26 percent). The largest relative differences between the sexes were found in High-income (male's value is 77 percent higher), Latin America & Caribbean (64 percent), China (61 percent), and the smallest differences in sub-Saharan Africa (11 percent), India (17 percent), and Eurasia & Mediterranean (39 percent).

We observe some changes in the estimated results for 2021 during the COVID-19 pandemic. Globally, avoidable mortality as percentage of total mortality increased from 69 percent in 2019 to 74 percent in 2021, and the gap between frontier and estimated life expectancy at birth increased from 15.7 to 17.9 years. Across regions, the largest increases in the share of avoidable mortality were in Latin America & Caribbean (from 69 to 76 percent), India (78 to 84 percent), and High-income (42 to 47 percent), and lowest in sub-Saharan Africa (91 to 92 percent) and China (62 to 62 percent). The economic value of avoidable mortality increased globally from 23 to 25 percent, with the largest increases in Latin America & Caribbean (22 to 27 percent), India (23 to 27 percent), and High-income (21 to 24 percent), and very little change in sub-Saharan Africa (34 to 34 percent) and China (19 to 20 percent) (Figure 3.6).

Sensitivity analyses

Here, we highlight three key results from our sensitivity analyses; for additional results and details, see webappendix A2. First, replacing the mortality frontier with sex-specific frontier reduced the estimated avoidable mortality among males (webappendix Figure A1). Globally, this reduced the percentage mortality considered avoidable in 2019 from approximately 69 percent to 59 percent. As previously discussed, this likely underestimates male avoidable mortality because causes of excess male mortality in frontier countries are associated with socio-cultural factors rather than biological differences (e.g., road traffic injuries rather than prostate cancer; see methods). This sensitivity analysis reclassified the largest proportion of deaths in high-income countries and the lowest proportion in sub-Saharan Africa, where around 90 percent of deaths are avoidable regardless of the method used to set the frontier. Nevertheless, regional patterns were similar in the sensitivity analysis vs. the baseline analysis.

Second, to determine the extent to which the frontier mortality levels are achievable, we considered a rapid progress scenario in which countries experience fast and plausible (historically observed) rates of mortality change. Between 2000 and 2019, countries with the fastest 10th percentile decline in age-specific mortality rate experienced reductions between 3.4 percent (ages 85+) and 12.2 percent (ages 5-9) annually (webappendix Table A.2). Between 2019 and 2050, under this scenario, we would expect to see 57 percent lower overall mortality compared to the baseline 2050 mortality rates projected by WPP2022 (webappendix Table A.3). In comparison, if all countries had the same mortality rates as the 2050 frontier, we would expect 70 percent lower mortality level. Under the 10th percentile scenario, females from 30 high-income countries are projected to have mortality rates lower than the 2050 frontier in 80 percent of the age groups.

Third, as expected, applying a fixed VSL (linear extrapolation) yields much larger values of avoidable mortality compared to using our parameters methods that adjust for the effect of large changes in risk. For instance, the global value of avoidable mortality in 2019 using a fixed VSL is 35 percent of annual income (versus 23 percent with a logarithmic function). The overestimation with fixed VSL is more pronounced in regions with higher mortality rates, such as sub-Saharan Africa, where this method yields a value of 58 percent (versus 34 percent with a logarithmic function). These differences are particularly striking within high-mortality age groups and countries, where values estimated with a fixed VSL can far exceed annual income–and sometimes reach up to 1600 percent of income. In comparison, applying a negative reciprocal function—another widely-used non-linear adjustment— only slightly reduces the values; for example, the global value for 2019 is 20 percent of income (versus 23 percent with a logarithmic function).

DISCUSSION

We estimated the economic value of avoidable mortality from 2000-2019 and projected to 2050 by region, age, and sex. In other words, we estimated the perceived economic benefits, measured as percentage of annual income, if countries were to live at the lowest possible (frontier) mortality levels. Using the frontier approach, we first identified countries with the lowest all-cause mortality by age and estimated avoidable mortality for all countries. Then, using the VSL approach with non-linear adjustment, we estimated the proportion of annual income one is willing to forgo to live at the mortality frontier. We highlight five key messages from our findings.

First, a high percentage of mortality is avoidable: Our comparisons of frontier mortality to estimated mortality show that, globally, 69 percent of deaths would have been postponed in 2019 if all countries experienced frontier mortality rates, with the lowest and highest percentages in the High-income region (42 percent) and sub-Saharan Africa (91 percent), respectively. While the absolute level of mortality is projected to decline globally over time, the proportion of avoidable mortality has changed little. Although past illness, injuries, and risk exposures mean that a rapid shift to frontier mortality rates would not be possible, this analysis demonstrates that there are large opportunities for health improvements worldwide, even in higher income countries and among older adults.

Second, it is plausible to significantly reduce the level of avoidable mortality by 2050: Although many countries do not reach frontier mortality levels by 2050 under a fast but plausible mortality decline scenario, the gap between the projected and frontier mortality would narrow significantly. If countries experienced the historical 10th percentile declines in mortality, by 2050, they will have reduced avoidable mortality by 81 percent. We also highlight that historical fast declines were frequently observed in some age groups in non-high-income countries, suggesting that these rates are achievable regardless of income level.

Third, the economic value of avoidable mortality is large: globally in 2019, the economic value of avoidable mortality represented approximately 23 percent of global annual income, with the lowest and highest percentages in China (19 percent) and sub-Saharan Africa (34 percent), respectively. The economic value is approximately 4 percent higher for males than females, reflecting the higher avoidable mortality rates of males. Hence, these results indicate that, on average, regional populations would be willing to give up about one-fifth to one-third of their current income in exchange for a year living at the lowest possible mortality rate, even when considering resource constraints. Two main factors drive these results. First, due to the large differences in mortality rates between the frontier countries and the rest, approximately 70 percent of all mortality was deemed avoidable, and this number does not change much across time. Second, in line with the literature, we placed high monetary value on reducing mortality risk (the VSL-to-income ratio at 160). The combination of these two factors resulted in high values of avoidable mortality.

The levels and changes in economic value reflect multiple factors beyond the levels and changes in mortality. First, it reflects national income and how it is projected. For example, Poland and Tajikistan show approximately the same proportion of avoidable mortality (81.3 and 82.6 percent, respectively) and annual survival probabilities for males at ages 50–54. Nevertheless, Poland's per capita income is 8.5 times larger than Tajikistan's ($31,800 versus $3,700 in 2017 USD PPP). As a result, the value of avoidable mortality for this segment of their populations is 47.6 percent of annual income for Poland but only 34.8 percent for Tajikistan. Hence, Tajikistan's value is lower both in absolute dollars and relative to national income levels. Second, the estimates are weighed by the age distribution of the population. For illustration, we compare Japan and Morocco, where the economic values of avoidable mortality are estimated at 14.5 and 16.7 percent of annual income in 2019, respectively. Morocco has lower population-weighted economic value of avoidable mortality than Japan despite having much higher level of avoidable mortality across all ages, and especially in older ages, than Japan, where avoidable mortality is close to the frontier for all except among older males. On the other hand, even though Japan's older age groups are assigned lower values (as percentage of income) than Morocco because of its relatively lower mortality, Japan has a much higher proportion of older adults, whose values are higher than younger people. Thus, countries with larger proportions of older populations (like Japan) have higher economic values of avoidable mortality than younger countries (like Morocco) even though the former has lower levels of avoidable mortality across all ages. Third, baseline

mortality rates should also be considered. Reducing avoidable mortality by 50 percent in a low-mortality country yields a lower value than the same proportional change in a high-mortality country.

Fourth, avoidable mortality and its economic values vary substantially across age groups: as shown in Figure 3.8, some age groups (ages 0 and 60 and above) contribute disproportionately higher value than others (relative to their population share), as a result of the higher rates of avoidable mortality in those age groups. Previous literature on estimating amenable or preventable mortality that use list-based approaches exclude deaths among age 70 or 75 and above (OECD 2019;Barber et al. 2017). In comparison, our approach estimates avoidable deaths in all age groups. For example, using a list-based approach, OECD found that more than a quarter of deaths in OECD countries—mainly high-income countries with high-quality cause-of-death information—were avoidable in 2019 (OECD 2021). In our analysis, we found that 42 percent of deaths in high-income countries were avoidable in 2019, with more than half of avoidable deaths occurring in ages 75 and over. Thus, our analysis demonstrates that exclusion of avoidable deaths in older adults results in a substantial undercount of overall avoidable mortality.

Fifth, it is necessary to adjust the VSL for large risk change. Existing global health literature seldom considers the issues associated with using linear approximation when extrapolating values with larger mortality changes. For example, we find that linear extrapolation yields a value that is on average 54 percent higher than estimates using a logarithmic value of income function. For certain age groups in countries with high avoidable mortality rates, linear extrapolation results in values that are nearly ten times larger than our estimates. The logarithmic approach also ensures that valuation of mortality reduction does not exceed resource constraints, and we believe future research should consider adopting this method.

Contributions to the literature

We aim to make three important contributions to the literature: (1) creating an envelope for global economic value of mortality reduction; (2) implementing a simplified method to estimate avoidable mortality; and (3) incorporating risk-size adjustments that are necessary to the economic valuation framework in this context.

First, similar to the GBD's approach in creating an "envelope" to ensure the sum of cause-specific d eaths d o n ot e xceed a ll-cause d eaths, o ur estimates on the economic value of avoidable mortality could be used as an envelope for the value of mortality reduction from specific causes, interventions or programs.

Second, avoidable mortality is typically estimated as the number of deaths assigned to set of specific causes of death, when they occur below a threshold age (OECD 2019; Rutstein 1998; Nolet and McKee 2004). This list-based approach requires comparable, detailed, and accurate cause-of-death data, which are not currently available for most countries (WHO 2020). We propose a simplified method by computing avoidable mortality as the difference between current observed or estimated mortality and an unavoidable, or frontier, mortality (Mathers et al. 2015). This has several advantages, including application to countries with limited cause-of-death information, allowing for a time-varying frontier based on improvements in knowledge and technology, and inclusion of avoidable mortality in older adults, and avoiding artificial categorization into preventable and treatable deaths.

Third, the global health economics literature using the VSL approach has traditionally relied on existing valuation studies to value mortality risk reduction in various settings. This process, referred to as "benefit transfer" or "value transfer", typically involve extrapolating the VSL from the United States or western Europe to another setting based on differences in the income levels and the assumed level of income elasticity (Robinson et al. 2019; Robinson et al. 2019). This step implicitly assumes that income is the only difference between the settings, such that income adjustment to the VSL is sufficient. However, several other key differences may exist between the original research from which the VSL estimate was derived and the new setting. They may include population age distribution, size of the change in mortality risk, baseline mortality, and whether the risk change is one-time or permanent. There is a lack of empirical evidence on the relationship between these factors and the VSL (with the exception of population age), which may have led to the omission of quantitative adjustments or discussions around them in the global health benefit cost literature. In this chapter, we rely on the theoretical literature and introduce a novel and relatively easy approach to incorporate these factors into the VSL estimate (Hammitt 2020; Cardoso and Dahis 2024). This is

especially important in global health research, which often focuses on a wide range of baseline and size of risk reduction across time and region.

Limitations

This study has several limitations. First, mortality and population projections from WPP2022 are uncertain. For many countries, WPP2022 estimates mortality rates by country, age and sex from incomplete death registration data and population-based census or survey data, such as reports of child or sibling survival, as available. The same limitation holds for country-level income data. We therefore focus on the results at the regional level in the main paper to mitigate the effect of outlying country estimates. Second, the medium- and long-term impact of COVID-19 on levels and trends in mortality is uncertain. As populations gain immunity (from past infection and vaccination) and treatments continue to improve, we expect that mortality rates will resume their declines in all populations and our projections for 2050 may be considered informative. Third, we only focused on mortality and not morbidity, suggesting that the results likely underestimate the actual economic value of preventing and treating diseases and injuries. Fourth, our projected results for 2050 are sensitive to some key assumptions, one of which is the projected GNI per capita in 2050. While we relied on the projected growth rates of a reliable source (OECD), the results are highly sensitive to how income levels in 2050 are projected. Fifth, the VSL approach to assigning monetary values to risk reduction is not without its limitations (Viscusi and Aldy 2003). While we have introduced important adjustments when extrapolating the VSL from the United States to other countries, having empirical studies from countries with different income and risk levels is preferred. Finally, our results estimate one's willingness to forgo income for a one-year change in survival. An alternative perspective and approach would be to estimate the exchange between lifetime income and lifetime changes in survival, which could also be insightful for policymaking.

Comparison to previous literature

Previous work on estimating the economic burden of disease has taken different approaches. One approach is using a list-based approach, for example work by Alkire and colleagues provide estimates of amenable mortality, i.e., mortality that can be reduced by the health care system, for 130 low- and middle-income countries between 2015-30 (Alkire et al. 2018). The second approach looked at what specific packages of interventions could be expected to do if more fully implemented than they now are. These assessments have been undertaken in the context of estimating the impact of universal health coverage on mortality (and on health care costs). Two analytic programs, from the WHO and the third edition of the Disease Control Priorities (DCP) Project, respectively, have generated estimates, and both point to a substantial volume of amenable mortality (and are thus consistent with the main conclusion of this study) (Stenberg et al. 2019; Stenberg et al. 2017; Jamison and Alwan 2018; Watkins et al. 2020). In terms of valuing these mortality reductions, Alkire et al. estimate the value of amenable mortality at $6.0 trillion in 2015 (international dollars) for all low- and middle-income countries, and approximately 5 to 20 percent of GDP in different regions Our methodological differences – the three most important being how and which mortality is valued, inclusion or exclusion of ages over 75, and the use of linear versus logarithmic value-to-income functions – make it difficult to compare the estimates directly. Furthermore, putting our numbers into context, while not directly comparable, in 2019 national health expenditure (as percentage of GDP) in all countries were much less than our estimate, suggesting that people may be willing to invest much more in health promotion and health care or other means in exchange for better survival probabilities (World Bank 2022). Studies on primary health care in low- and middle-income countries reported that an additional 3.3 percent of GDP on top of current levels of health expenditure could lead to large gains in health (Stenberg et al. 2019). Another study estimated an additional 4.6 percent of GDP is required to achieve the Sustainable Development Goal 3 by 2030 (Stenberg et al. 2017). The DCP studies concluded costs would be somewhat higher. These numbers are much lower than our estimates of value.

CONCLUSION

As governments worldwide engage in policy dialogues on how and how much to invest in improving population health, our work provides supportive evidence on the high economic value placed on improving health. Furthermore, the disproportionally higher distribution of the economic value of avoidable mortality among older adults also lends support to policies related to healthy aging and interventions targeting non-communicable diseases.

DEDICATION

We dedicate this study to Professor James W. Vaupel (1945-2022) who inspired us and many others with his intellect, vision, and passion for great research.

REFERENCES

1. Aldy JE, Smyth SJ. Heterogeneity in the Value of Life. National Bureau of Economic Research, 2014.
2. Alkire BC, Peters AW, Shrime MG, Meara JG. The Economic Consequences of Mortality Amenable To High-Quality Health Care In Low- And Middle-Income Countries. Health Aff (Millwood) 2018; 37: 988–96.
3. Barber RM, Fullman N, Sorensen RJ, et al. Healthcare Access and Quality Index based on mortality from causes amenable to personal health care in 195 countries and territories, 1990–2015: a novel analysis from the Global Burden of Disease Study 2015. The lancet 2017; 390: 231–66.
4. Barbieri M, Wilmoth JR, Shkolnikov VM, et al. Data resource profile: the human mortality database (HMD). Int J Epidemiol 2015; 44: 1549–56.
5. Bloom DE, Canning D, Jamison DT. Health, wealth, and welfare. Finance Dev 2004; 41.
6. Bressler RD, Heal G. Valuing Excess Deaths Caused by Climate Change. National Bureau of Economic Research, 2022.
7. Cardoso DS, Dahis R. Calculating the economic value of non-marginal mortality risk reductions. Economics Letters. 2024 Mar 21:111673.
8. Chang AY, Horton S, Jamison DT. Benefit-cost analysis in disease control priorities. 2018.
9. Chang AY, Robinson LA, Hammitt JK, Resch SC. Economics in "Global Health 2035": a sensitivity analysis of the value of a life year estimates. J Glob Health 2017; 7.
10. GBD 2019 Risk Factors Collaborators. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet 2020; 396: 1223–49.
11. Hakulinen T, Hansluwka H, Lopez AD, Nakada T. Global and Regional Mortality Patterns by Cause of Death in 1980. Int J Epidemiol 1986; 15: 226–33.
12. Hammitt JK, Herrera-Araujo D. Using non-marginal risk reductions to elicit VSL: 28.
13. _____. Valuing mortality risk in the time of COVID-19. J Risk Uncertain 2020; 61: 129–54.
14. Human Mortality Database. Max Planck Institute for Demographic Research (Germany), University of California, Berkeley (USA), and French Institute for Demographic Studies (France). www.mortality.org (accessed March 23, 2023).
15. Institute for Health Metrics and Evaluation (IHME). GBD Results Tool | GHDx. http://ghdx.healthdata.org/gbd-results-tool (accessed May 20, 2021).
16. Jamison DT, Alwan A, Mock CN, et al. Universal health coverage and intersectoral action for health: key messages from Disease Control Priorities. The Lancet 2018; 391: 1108–20.
17. Jamison DT, Summers LH, Alleyne G, et al. Global health 2035: a world converging within a generation. The lancet 2013; 382: 1898–955.
18. Khadka A, Verguet S. The economic value of changing mortality risk in low- and middle-income countries: a systematic breakdown by cause of death. BMC Med 2021; 19: 156.
19. Luy M. The impact of biological factors on sex differences in life expectancy: insights gained from a natural experiment. 2016.
20. Mathers CD, Stevens GA, Boerma T, White RA, Tobias MI. Causes of international increases in older age life expectancy. The Lancet 2015; 385: 540–8.
21. Murray CJ, Lopez AD, Jamison DT. The global burden of disease in 1990: summary results, sensitivity analysis and future directions. Bull World Health Organ 1994; 72: 495.
22. Nolte E, McKee M. Measuring the health of nations: analysis of mortality amenable to health care. J Epidemiol Community Health 2004; 58: 326–326.
23. Oeppen J, Vaupel JW. Broken limits to life expectancy. American Association for the Advancement of Science, 2002.
24. Organization for Economic Co-operation and Development (OECD). Avoidable mortality: OECD/Eurostat lists of preventable and treatable causes of death. 2019; published online Nov. https://www.oecd.org/health/health-systems/Avoidable-mortality-2019-Joint-OECD-Eurostat-List-preventable-treatable-causes-of-death.pdf (accessed July 29, 2021).
25. _____. Health at a Glance 2021. 2021. https://www.oecd-ilibrary.org/content/publication/ae3016b9-en.
26. Revesz RL, Livermore MA. Retaking rationality: How cost-benefit analysis can better protect the environment and our health. Oxford University Press, 2008.
27. Robinson LA, Hammitt JK, Cecchini M, et al. Reference Case Guidelines for Benefit-Cost Analysis in Global Health and Development. 2019; : 126.
28. Robinson LA, Hammitt JK, Jamison DT, Walker DG. Conducting Benefit-Cost Analysis in Low- and Middle-Income Countries:

Introduction to the Special Issue. J Benefit-Cost Anal 2019; 10: 1–14.
29. Robinson LA, Hammitt JK, O'Keeffe L. Valuing Mortality Risk Reductions in Global Benefit-Cost Analysis. J Benefit-Cost Anal 2019; 10: 15–50.
30. Rutstein DD, Berenberg W, Chalmers TC, Child CG, Fishman AP, Perrin EB. Measuring the quality of medical care. A clinical method. N Engl J Med 1976; 294: 582–8.
31. Schelling TC. The life you save may be your own. Probl Public Expend 1968: 127–62.
32. Stenberg K, Hanssen O, Bertram M, et al. Guide posts for investment in primary health care and projected resource needs in 67 low-income and middle-income countries: a modelling study. Lancet Glob Health 2019; 7: e1500–10.
33. Stenberg K, Hanssen O, Edejer TT-T, et al. Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries. Lancet Glob Health 2017; 5: e875–87.
34. Sunstein CR. Risk and reason: Safety, law, and the environment. Cambridge university press, 2002.
35. _____. Valuing life. In: Valuing Life. University of Chicago Press, 2014.
36. United Nations Department of Economic and Social Affairs (UNDESA), Population Division. World population prospects 2022. https://population.un.org/wpp/Download/Standard/CSV/ (accessed Oct 4, 2023).
37. Usher D. An imputation to the measure of economic growth for changes in life expectancy. In: The measurement of economic and social performance. NBER, 1973: 193–232.
38. Vaupel JW, Villavicencio F, Bergeron-Boucher M-P. Demographic perspectives on the rise of longevity. Proc Natl Acad Sci 2021; 118: e2019536118.
39. Viscusi WK, Aldy JE. The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World. J Risk Uncertain 2003; 27: 5–76.
40. Viscusi WK. Fatal tradeoffs: Public and private responsibilities for risk. Oxford University Press, 1992.
41. _____. The Value of Risks to Life and Health. J Econ Lit 1993; 31: 1912–46.
42. _____. Pricing lives. In: Pricing Lives. Princeton University Press, 2018.
43. Watkins DA, Qi J, Kawakatsu Y, Pickersgill SJ, Horton SE, Jamison DT. Resource requirements for essential universal health coverage: a modelling study based on findings from Disease Control Priorities. Lancet Glob Health 2020; 8: e829–39.
44. Wilmoth JR, Andreev K, Jdanov D, Glei DA, Riffe T. Methods protocol for the Human Mortality Database. 2021 https://www.mortality.org/File/GetDocument/Public/Docs/MethodsProtocolV6.pdf (accessed Oct 4, 2023).
45. World Bank. World Development Report 1993: Investing in Health. Washington, D.C.: The World Bank, 1993 https://openknowledge.worldbank.org/handle/10986/5976.
46. World Bank. World Development Indicators: GNI per capita, PPP (current international $) 2021. https://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD (accessed Feb 24, 2021).
47. World Bank. World Development Indicators: Current health expenditure (% of GDP). https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS (accessed July 7, 2022).
48. World Health Organization (WHO). Global Health Estimates. 2020. https://www.who.int/data/global-health-estimates (accessed July 29, 2021).
49. _____. WHO methods and data sources for country-level causes of death 2000-2019. Geneva, Switzerland, 2020.

4

The Economic Value Associated with Avoidable Mortality

A systematic assessment by cause of death across world regions

Stéphane Verguet [a], Sarah Bolongaita [a], Angela Y. Chang [b,c], Diego S. Cardoso [d], Gretchen A. Stevens [e]

[a] Department of Global Health and Population, Harvard T.H. Chan School of Public Health
[b] Danish Institute for Advanced Study, University of Southern Denmark
[c] Interdisciplinary Centre on Population Dynamics (CPop), University of Southern Denmark
[d] Department of Agricultural Economics, Purdue University
[e] Independent Researcher

© Harvard University

INTRODUCTION

Before the onset of the COVID-19 pandemic in 2020, life expectancy at birth had been steadily increasing globally (UN 2019); and the advancements to older ages and frontiers of longevity were still regularly progressing (Vaupel et al. 2021). In many countries around the world, populations are rapidly ageing, immediately following the combination of major declines in fertility and important progresses in longevity (Christensen et al. 2009). Such rapid ageing transitions are often accompanied with the development of disability and dependence, including increasing prevalence of diseases of old age. This imposes new and substantial challenges to health systems, necessitating the design of novel technologies, the implementation of innovative health services delivery platforms, and the strengthening of financial architectures (Partridge et al. 2018; Spasova et al. 2018; Tynkkynnen et al. 2022). Facing limited resources and an increasing burden of non-communicable diseases (NCDs), health systems must make difficult trade-offs when allocating resources toward improving the healthy longevity of their populations.

Researchers and policymakers utilize a variety of analytical methods for generating evidence to inform decision-making on which health policies and interventions should be prioritized, funded (or not), and implemented. Commonly used approaches include various types of multi-criteria decision analyses (MCDA) (Baltussen et al. 2018; Verguet et al. 2021) and economic evaluations, traditionally drawn from cost-effectiveness analysis (CEA) methods, of the health policies and interventions under consideration (Drummond et al. 2015; Neumann et al. 2016). Such CEA studies often use a constructed metric, like the quality-adjusted life year (QALY) or the disability-adjusted life year (DALY) (Weinstein et al. 2009; Murray & Acharia 1997), which encompass both mortality and morbidity outcomes of the disease(s) addressed by the interventions under consideration. However, using non-monetary valuations in health intervention assessments limits their broader utility, preventing comparisons with assessments of interventions outside of the health sector (for example, education and social protection) (Robinson et al. 2019).

Yet, an attractive alternative analytical method that can address this intersectoral comparison issue is benefit-cost analysis (BCA; Robinson et al. 2019; Robinson, Hammitt & O'Keeffe 2019), where both the numerator (i.e., the health benefits procured by a given intervention) and the denominator (i.e., the costs incurred by a given intervention) of the benefit-cost ratio are expressed in monetary terms (say in USD gained or spent). As an example, the Copenhagen Consensus Center[1] has long used BCA approaches to consistently compare the returns on investment of a variety of policies globally across multiple key human capital and development sectors (e.g., health, education, agriculture), including health interventions in low- and middle-income countries (LMICs) (Jamison et al. 2013; Jha et al. 2013). Likewise, in their seminal work (Jamison et al. 2013) in which they used the value of a statistical life (VSL) to estimate the monetary gains from reducing under-five mortality rates in LMICs, Jamison and colleagues demonstrated the utility of monetized health outcomes. Most recently, Khadka & Verguet (2021) adapted such VSL methods to assign an economic value to life years and develop further value of a statistical life years, and applied methodologies to assess the economic value of changing mortality risks associated with NCDs. In doing so, they pointed to the vast welfare losses associated with elevated NCD mortality rates, especially cardiovascular diseases (CVDs) and cancers.

In this chapter, we build on this previous VSL scholarship. We compute the economic impact of disease, by first quantifying the avoidable mortality by cause of death (with a focus on major NCD and injury causes) and second applying novel economic valuation methods. Specifically, we compute a monetary value for hypothetical reductions (over 2000-2050) in cause-specific mortality: first, we benchmark these reductions against a mortality frontier (lowest mortality rates achievable) by cause; and second, we assign a willingness to pay value to these reductions in cause-specific mortality. In sum, we estimate the percent of income an individual would be willing to forgo to live one year under the lowest possible mortality rate for a given cause of death. Our assessment is pursued for six large analytical regions (e.g., China, Eurasia & the Mediterranean, High-income, India, Latin America & the Caribbean, and sub-Saharan Africa) and major disease

1 www.copenhagenconsensus.com

areas (e.g., cancers, CVD), with findings presented for the years 2000, 2019, and 2050. Our objective is to provide a systematic monetary assessment of the economic value associated with mortality by cause of death (with a focus on major NCDs and injuries) globally and regionally, and to derive a metric directly comparable to annual incomes (e.g., gross national income (GNI)), so as to enable both health sector and multisectoral priority setting.

METHODS

General approach

We proceeded in three steps. First, we projected age-cause-sex-specific mortality rates into the future (2020-2050) for each country included in the analysis (webappendix Table A1). We estimated age-cause-specific mortality frontiers ($\mathcal{F}_{a,K,s}$; a = age, K = disease cause, s = sex*)[2] for the period 2000-2019, with the mortality frontiers being the lowest (10th percentile) observed mortality rates for a given cause and age group, globally. We then projected these frontiers over 2020-2050. They can be thought of as "aspirational" mortality rates (for both females and males) for countries that experience mortality rates greater than the frontier.

Second, we compared country- and cause-specific mortality rates with frontier mortality rates to yield mortality differentials (i.e., "avoidable mortality", the gap between a country's mortality rate and the frontier mortality rate). We then aggregated these differentials across six analytical regions (inspired by the classification proposed by *The Lancet* Commission on Investing in Health (Watkins et al. 2018)): China; Eurasia & the Mediterranean; India; High-income; Latin America & the Caribbean; and sub-Saharan Africa (webappendix Table A1).

Third, we assigned a monetary value to the avoidable mortality. This gave an estimated percent of annual income an individual would be willing to forgo to live one year under the lowest possible mortality rate for a given cause of death; and a metric directly comparable to national incomes (e.g., GNI). These three steps are further detailed below.

Data sources

Estimates on age-cause-sex-specific death counts for all countries for 2000-2019 were sourced from the World Health Organization's (WHO) Global Health Estimates (GHE) (WHO 2020a). We adapted WHO's comprehensive list of causes to a smaller list of mutually exclusive, collectively exhaustive set of causes primarily focused on NCDs and injuries (Table 4.1; webappendix Table A2 gives a mapping between GHE causes of death and the causes of death used in the analysis). These causes of death were selected as they were leading causes of mortality and morbidity according to burden of disease assessments (WHO 2020a; IHME 2022). For cancers, we focused on tobacco-related (e.g., lung, mouth, esophagus) and infection-related (e.g., cervix, liver, stomach) cancers; breast cancer was selected as it was the leading cancer among females (WHO 2020a; IHME 2022).

Age refers to five-year age groups (except for the first two and final age groups): 0-1, 1-4, 5-9, 10-14, 15-19, …, 75-79, 80-84, and 85+ years. Age- and sex-specific population and all-cause mortality estimates and projections for all countries for the period 2000-2050 were sourced from the United Nations (UN) 2022 World Population Prospects (WPP) (UN 2022).

Estimating the mortality frontiers

The mortality frontiers (hereafter referred to as the "frontiers") were defined as the 10th percentile of the age-cause-specific mortality rates of eligible countries in a given year (Mathers et al. 2015; Chang et al. 2024). Countries were included in the frontier analysis (webappendix Table A1) if they had populations of at least 5 million in 2019; had available income (GNI per capita, current international dollars) data for 2019; had high-quality vital registration data (as defined in WHO 2020b); and were included in GHE estimates for the year 2019. The frontiers were age- and cause-specific for all causes of death except for breast cancer and cervix uteri cancer, for which age-sex-cause-specific frontiers were computed given the sex-specific epidemiology of these two conditions.[3] The frontier was defined as the 10th percentile

2 The frontier was only sex-specific for the following two sex-specific causes: breast cancer and cervix uteri cancer. For all other causes, the frontier was selected from among sex-specific mortality rates of both sexes.

3 Male-specific cancers, such as testicular or prostate cancers were not included as they are less common and affect older ages, so their overall burden is much lower.

of eligible country mortality rates, as opposed to the minimum, to ensure stability and the absence of stochastic variation in the resulting computed frontiers (see details in webappendix Figure A1).

For the period 2000-2019, frontiers were calculated directly using GHE estimates. To ensure that the frontiers of lower-level causes appropriately summed to the frontiers of higher ("parent") level causes (Table 4.1), we utilized a nested, level-wise approach. We first extracted the frontier (i.e., the lowest 10th percentile of eligible country mortality rates) for all-cause mortality, that is the highest level (level 0) cause. The frontiers for the next level of causes (level 1: communicable, maternal, perinatal and nu-

TABLE 4.1 Causes of death

Level	Cause of death
1	Communicable, maternal, perinatal and nutritional conditions
2	Infectious and parasitic diseases
2	Maternal and neonatal conditions
2	Nutritional deficiencies
1	Noncommunicable diseases
2	Cardiovascular diseases
3	Ischaemic heart disease
3	Stroke
3	Other cardiovascular diseases
2	Diabetes mellitus
2	Digestive diseases
3	Cirrhosis of the liver
3	Other digestive diseases
2	Malignant neoplasms
3	Breast cancer
3	Cervix uteri cancer
3	Liver cancer
3	Mouth and oropharynx cancers
3	Oesophagus cancer
3	Stomach cancer
3	Trachea, bronchus, lung cancers
3	Other malignant neoplasms
2	Respiratory diseases
3	Chronic obstructive pulmonary disease
3	Other respiratory diseases
2	Other noncommunicable diseases
1	Injuries
2	Intentional injuries
2	Unintentional injuries
3	Road injury
3	Other unintentional injuries

Note: The causes of death utilized in this analysis were adapted from the WHO's Global Health Estimates (WHO 2020a). Level 1 and 2 causes of death are mutually exclusive and collectively exhaustive; within level 2 causes of death, level 3 causes are mutually exclusive and collectively exhaustive.
Webappendix Table A2 gives a mapping between GHE causes of death and the causes of death used in the analysis.

tritional conditions; NCDs; and injuries) were then extracted. These level 1 frontiers were then summed to calculate the parent level (level 0: all-cause) frontier. The resulting calculated level 0 all-cause frontier was then compared with the extracted level 0 all-cause frontier to determine a scaling factor. This scaling factor was then applied to the component level 1 frontiers. This process was continued for level 2 causes (e.g., CVD, malignant neoplasms) and level 3 causes (e.g., stroke, stomach cancer).

For the period 2020-2050, the frontiers were calculated based on the trends underlying the 2010-2019 frontiers (immediately described above). Log-linear models were used to project the frontier mortality rates using the following equation:

$$ln(M_{a,K,Y}) \sim C_{a,K} + \beta_{A,K} * Y \quad , \quad [1]$$

where $M_{a,K,Y}$ is the mortality rate for age group a in year Y (2000, 2019, and 2050), and cause of death K. $C_{a,K}$ is a constant term, and Y is the year. $\beta_{A,K}$ is the estimated annual rate of change (decline) of the mortality rate associated with each cause and broad age group A (0-4, 5-14, 15-29, 30-44, 45-59, 60-69, 70-84, and 85+ year-olds). The projections (based on $\beta_{A,K}$ and [1]) were conducted separately by cause K and broad age group A to ensure similar mortality trends across neighboring five-year age groups, consistent with previous projection analyses (Mathers & Loncar 2006).

When the 2010-2019 frontier mortality rates contained a zero-value (i.e., an observation of 0 deaths per 100,000 population) or when the average number of deaths (averaged over the 2010-2019 frontiers) for a given age-cause group was less than 100, then the average mortality rate (for the period 2010-2019) was used for the 2020-2050 projection for all five-year age groups within the corresponding broad age group category (yielding a constant frontier over 2020-2050). Additionally, if the regression ([1]) gave a positive trendline ($\beta_{A,K} > 0$, which would indicate increasing frontier rates over time), then the average mortality rate (across years) was also used for all five-year age groups within the corresponding broad age group category (webappendix Table A3).

Consistency with all-cause frontiers

To ensure consistency with all-cause mortality frontiers (i.e. the all-cause mortality frontiers of avoidable mortality developed under Chang et al. 2024), our all-cause frontier mortality rates (immediately described above) were scaled to these all-cause frontiers. We divided our age- and year-specific all-cause frontiers by the corresponding external age- and year-specific all-cause frontier mortality rates to produce a set of age-year-specific scaling factors between our all-cause frontiers and the Chang and colleagues' frontiers. The resulting scalars were then applied to our cause-specific frontiers (i.e., cause levels 1, 2, and 3) to ensure consistency with the avoidable mortality frontiers put forward by Chang et al. (2024).

Estimating mortality projections for the six regions

First, we projected country- and cause-specific mortality rates for the period 2020-2050 using the same methods as for the frontier mortality rate projections described immediately above. Second, we aggregated these country-specific mortality rate projections within each region studied: China; Eurasia & the Mediterranean; India; High-income; Latin America & the Caribbean; and sub-Saharan Africa. For that purpose, population weights (within each age group) based on country- and age-specific populations using 2022 WPP (UN 2022) were used to eventually yield region-age-sex-cause-specific mortality rate projections.

Economic value associated with cause-specific avoidable mortality

We denote $m(x)$ the mortality rate among the age group $[x; x+u)$, where u is the size of the age group ($u = 5$, except for 0-1, 1-4, and 85+ age groups). The probability of dying at age a, $q(a)$, is expressed as $q(a) = 1 - e^{-\int_0^a m(x)dx}$; using a discrete formulation, $q(a) \sim 1 - e^{-u\sum_{x=0}^{a} m(x)}$.

We compare a country's age group's probability of dying ("C" for country) to a reference probability of dying ("$\mathcal{F}$" for frontier), that is $q_C(a)$ to $q_{\mathcal{F}}(a)$. The difference in those probabilities can be obtained by the following "avoidable mortality": $\delta_{C,\mathcal{F}}(a) = q_C(a) - q_{\mathcal{F}}(a)$.[4] Now take the population of country C with an age distribution $\alpha_C(a)$ ($\alpha_C(a) = P_C(a)/\sum_{a=0}^{\omega} P_C(a)$, where $P_C(a)$ is the size of the age group $[a; a+u)$ and ω is the oldest age group). In addition, denote v the monetary value assigned to the change in the probability of dying ($\delta_{C,\mathcal{F},1}$ over one year) at a given age a. Then, for a given year, the aggre-

4 In what follows, we examine differentials over one-year periods, denoted $\delta_{C,\mathcal{F},1}$, where u is then set to 1 year.

gate monetary value associated with avoidable mortality (comparing "*C*" and "$\mathcal{F}$") will be given by:

$$V_{C,\mathcal{F}} \sim \sum_{a=0}^{\omega} \alpha_C(a) v(\delta_{C,\mathcal{F},1}(a)) \quad . \quad [2]$$

We then assign a value to $v(\delta_{C,\mathcal{F},1}(a))$ that depends on the extent of the differential in mortality risk $\delta_{C,\mathcal{F},1}$ and on the VSL in country *C* (VSL_C). We apply the methods developed by Chang et al. 2024, where v increases with $\delta_{C,\mathcal{F},1}$ and its marginal rate of increase decreases with $\delta_{C,\mathcal{F},1}$ (consistent with Cardoso & Dahis (2020) and Hammitt (2020)). The value of VSL_C can be related to the VSL in the United States (VSL_{US}) using an income elasticity ε: $VSL_C = VSL_{US} * (Y_C/Y_{US})^{\varepsilon}$, where Y_C and Y_{US} are the GNI per capita of *C* and the United States, respectively.

To derive VSL_C, we set $\varepsilon = 0.8$ for countries with GNI per capita greater than the United States and $\varepsilon = 1.2$ for countries with lower GNI per capita (Viscusi & Materman 2017; Robinson, Hammitt, & O'Keefe 2019)[5]; we also set a floor constraint for the ratio between VSL and GNI per capita of 20. GNI per capita was expressed in current international dollars (Purchasing Power Parity (PPP); World Bank 2022) for the period 2000-2021; and were projected to 2050 using OECD's projected country-specific growth rates over 2021-2050 for listed countries, and the world average growth rate during the same time period for all other countries. We set VSL_{US} = 160 x US GNI per capita (Robinson, Hammitt, & O'Keeffe 2019); and a discount rate of 3 percent per year.

Therefore, per year and country, we computed the following proportions per cause *K* and age group *a*: $p_{C,K}(a) = \delta_{C,\mathcal{F},K,1}(a)/\sum_K \delta_{C,\mathcal{F},K,1}(a)$. We then derived the following value (per year): $V_{C,\mathcal{F},K} \sim \sum_{a=0}^{\omega} \alpha_C(a) v(\delta_{C,\mathcal{F},1}(a)) p_{C,K}(a)$, aggregated per region *R*:

$$V_{R,K,\mathcal{F}} \sim \sum_{C \in R} w_C V_{C,K,\mathcal{F}} = \sum_{C \in R} \sum_{a=0}^{\omega} w_C \alpha_C(a) v(\delta_{C,\mathcal{F},1}(a)) p_{C,K}(a). \quad [3]$$

From [3], we obtained an economic value directly comparable to annual incomes, which captures the percent of income an individual would be willing to forgo to live one year under the lowest possible mortality rate for a given cause of death (in the region *R*).

Sensitivity analyses

First, we estimated the mortality frontiers in using the lowest cause-specific mortality rates, in place of the 10th percentile of the mortality rates. Second, when quantifying the economic values associated with avoidable mortality, the resulting estimates are sensitive to the VSL values assigned. Though this will not necessarily affect the relative distribution of the cause-specific allocations and associated economic values and we report economic values in terms of multiples of annual income, we applied three sets of standard sensitivity analyses related to VSL estimates (Robinson et al. 2019), in varying (i) income elasticities, to either 1.0 or 1.5; (ii) discount rates, to either 1 or 5 percent per year; and using (iii) an alternative baseline VSL-to-income ratio of 100 relative to the average income among OECD countries (in place of the VSL-to-income ratio for the United States).

All computations and simulations were conducted using R software (version 2022.02.3). All codes are available on GitHub.

RESULTS

We first report on the estimation of the mortality frontiers per cause of death and display the mortality trajectories and avoidable mortality with respect to the frontiers for the six regions. Second, we exhibit the economic values associated with avoidable mortality for each cause of death and region.

Mortality frontiers and region-specific mortality trajectories

The estimated mortality frontiers (for 2000-2050) are displayed for ages 20 years and older (the principal age groups over which NCDs manifest) for the following broad causes of death: all causes; communicable, maternal, perinatal and nutritional conditions; CVD; malignant neoplasms (cancers); and injuries (Figure 4.1).[6] As expected, the mortality frontiers are higher (corresponding to higher

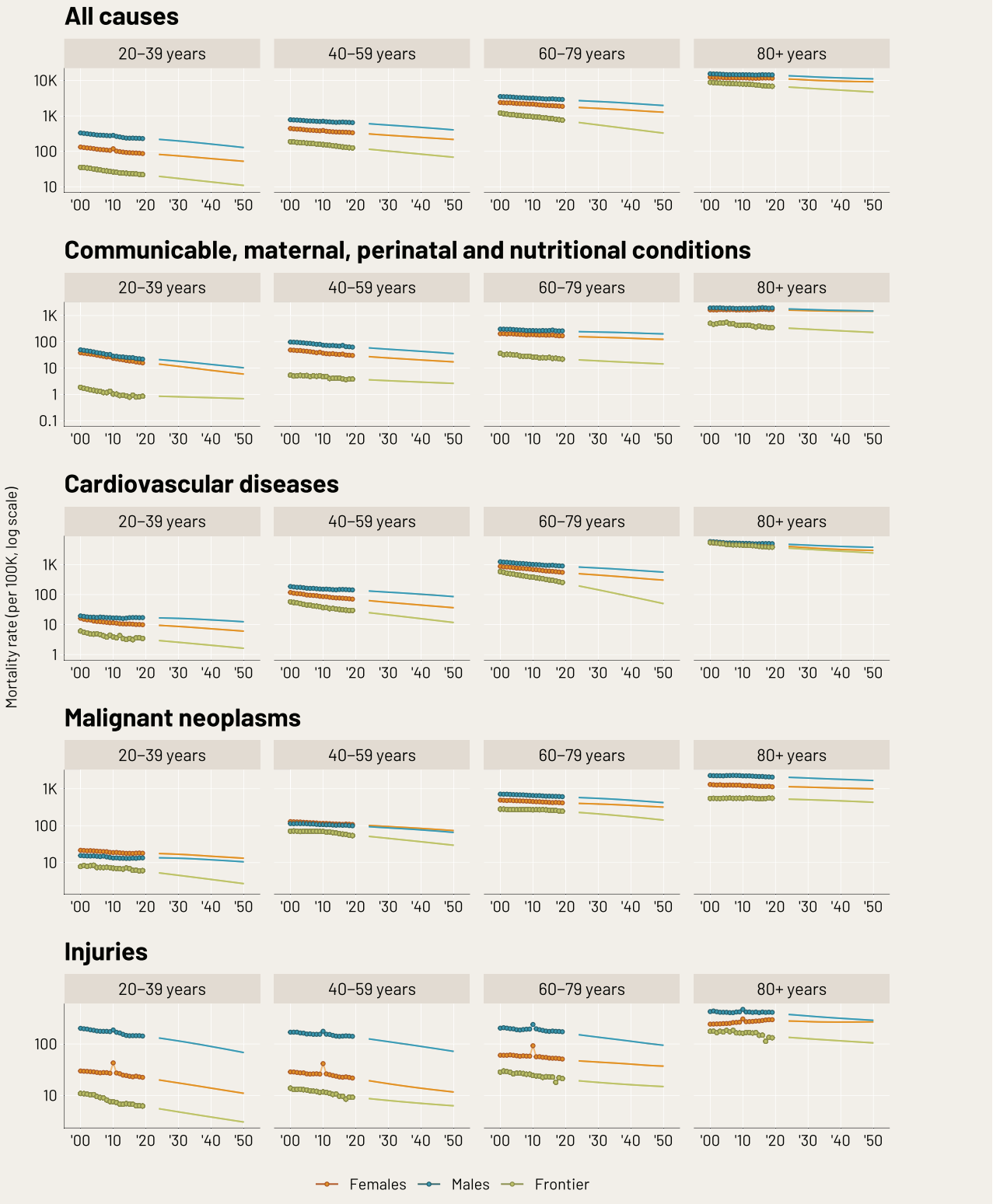
5 Alternative values of income elasticity of 1.0 and 1.5 are tested in sensitivity analyses.

6 Note that some of the slight fluctuations observed for the frontiers are due to the scaling with the all-cause frontiers estimated by Chang et al. (2024). Likewise, for the mortality trajectories, the fluctuations observed are due to the method used for calculating regional estimates (i.e., aggregation of population-weighted country-specific estimates) as well as the scaling with the all-cause frontiers.

mortality rates) for older age groups. All estimated frontiers for all causes of death are available in the webappendix (Figure B1).

Mortality trajectories for the six regions were estimated by sex for all age groups and causes of death (over 2000-2050). As an illustration, we show the trajectories for the Latin America & Caribbean region for females and males, ages 20 years and older (Figure 4.1). Likewise, as expected, the trajectories show higher mortality rates for the older age groups for all causes. In general (to a few rare exceptions), the mortality trajectories are also higher for males than for females. All mortality trajectories for regions and causes of death are collected in the webappendix (Figures B2-B8).

FIGURE 4.1 **Mortality frontiers (females and males) for the period 2000-2050;** *and mortality trajectories for Latin America and the Caribbean over the period 2000-2050; by sex, age group (20-39 years, 40-59 years, 60-79 years, 80+ years), and cause of death: all causes; communicable, maternal, perinatal and nutritional conditions; cardiovascular diseases; malignant neoplasms; and injuries.*



Note: Points correspond to WHO's Global Health Estimates (WHO 2020) for the period 2000-2019; the lines are projections. The impact of COVID-19 is not accounted for in these projections and therefore years 2020-2023 are not displayed.

Economic value of avoidable mortality

For the six regions and calendar years 2000, 2019, and 2050, we display the economic valuations (summed across all age groups) tied to specific causes of death (Figure 4.2 displays level 2 causes; the fractions displayed are percentages of annual income per cause, region, and year; Table 4.2). Alternative disaggregations (level 1 and level 3 causes) are shown in webappendix Figures B9 and B10, along with relative distributions of these economic valuations by cause (webappendix Figures B11, B12, and B13).

We observe important variations in the cause valuations across regions, as well as some slight differences when comparing females and males within the same region. CVD contributes to a very substantial economic value; for example, in 2019: around 6.8 percent of annual income in Eurasia & the Mediterranean, 7.0 percent in China, 5.2 percent in India, 3.9 percent in Latin America & the Caribbean, 3.7 percent in High-income, and 2.5 percent in sub-Saharan Africa (Table 4.2).

Furthermore, cancers (i.e., malignant neoplasms) also largely participate to the economic value of avoidable mortality, especially so in High-income (5.2 percent for females, 7.2 percent for males, of annual income in 2019) and China (3.8 percent and 6.8 percent) (webappendix Table B1). Yet, these economic values would be quite smaller in Eurasia & the Mediterranean (2.5 percent and 3.1 percent), India (1.6 percent and 1.3 percent), Latin America & the Caribbean (2.9 percent and 2.5 percent), and sub-Saharan Africa (2.2 percent and 1.1 percent).

As for injuries, they seem to be more geographically located. Indeed, injuries display substantial values for males in Latin America & the Caribbean (around 8.8 percent of annual income in 2019; compared with 1.6 percent for females) and are concentrated within intentional injuries (around 5.1 percent of male annual income in 2019); as well as for males in sub-Saharan Africa (around 7.4 percent of annual income in 2019, 3.2 percent for females) with a concentration within unintentional injuries (around 5.1 percent of male annual income in 2019) (webappendix Table B1). On the contrary, for the other four regions, the economic values for injuries were lower: between 4.1 and 4.8 percent of annual income for males, between 1.3 and 2.6 percent of annual income for females (in the year 2019).

TABLE 4.2 Economic value of avoidable mortality as a percentage of annual income by region and cause of death, for the years 2000, 2019, and 2030

Cause of death	2000	2019	2050
China			
Communicable, maternal, perinatal and nutritional conditions	2.5%	0.9%	0.2%
Infectious and parasitic diseases	1.8%	0.7%	0.1%
Maternal and neonatal conditions	0.6%	0.3%	0.1%
Nutritional deficiencies	0.0%	0.0%	0.1%
Noncommunicable diseases	10.5%	14.9%	23.6%
Cardiovascular diseases	3.7%	7.0%	12.4%
Ischaemic heart disease	0.6%	2.5%	6.2%
Stroke	2.7%	3.9%	4.4%
Other cardiovascular diseases	0.4%	0.4%	1.7%
Diabetes mellitus	0.1%	0.3%	0.6%
Digestive diseases	0.5%	0.4%	0.1%
Cirrhosis of the liver	0.4%	0.3%	0.1%
Other digestive diseases	0.1%	0.1%	0.0%
Malignant neoplasms	3.5%	5.3%	8.2%
Breast cancer	0.0%	0.1%	0.3%
Cervix uteri cancer	0.1%	0.2%	0.3%
Liver cancer	0.8%	0.5%	0.8%
Mouth and oropharynx cancers	0.1%	0.1%	0.1%
Oesophagus cancer	0.5%	0.6%	0.4%
Stomach cancer	0.8%	1.0%	0.5%
Trachea, bronchus, lung cancers	0.9%	1.9%	3.6%
Other malignant neoplasms	0.6%	1.0%	2.2%
Respiratory diseases	1.9%	1.4%	0.8%
Chronic obstructive pulmonary disease	1.8%	1.4%	0.9%
Other respiratory diseases	0.0%	0.0%	0.0%
Other noncommunicable diseases	0.7%	0.6%	1.4%

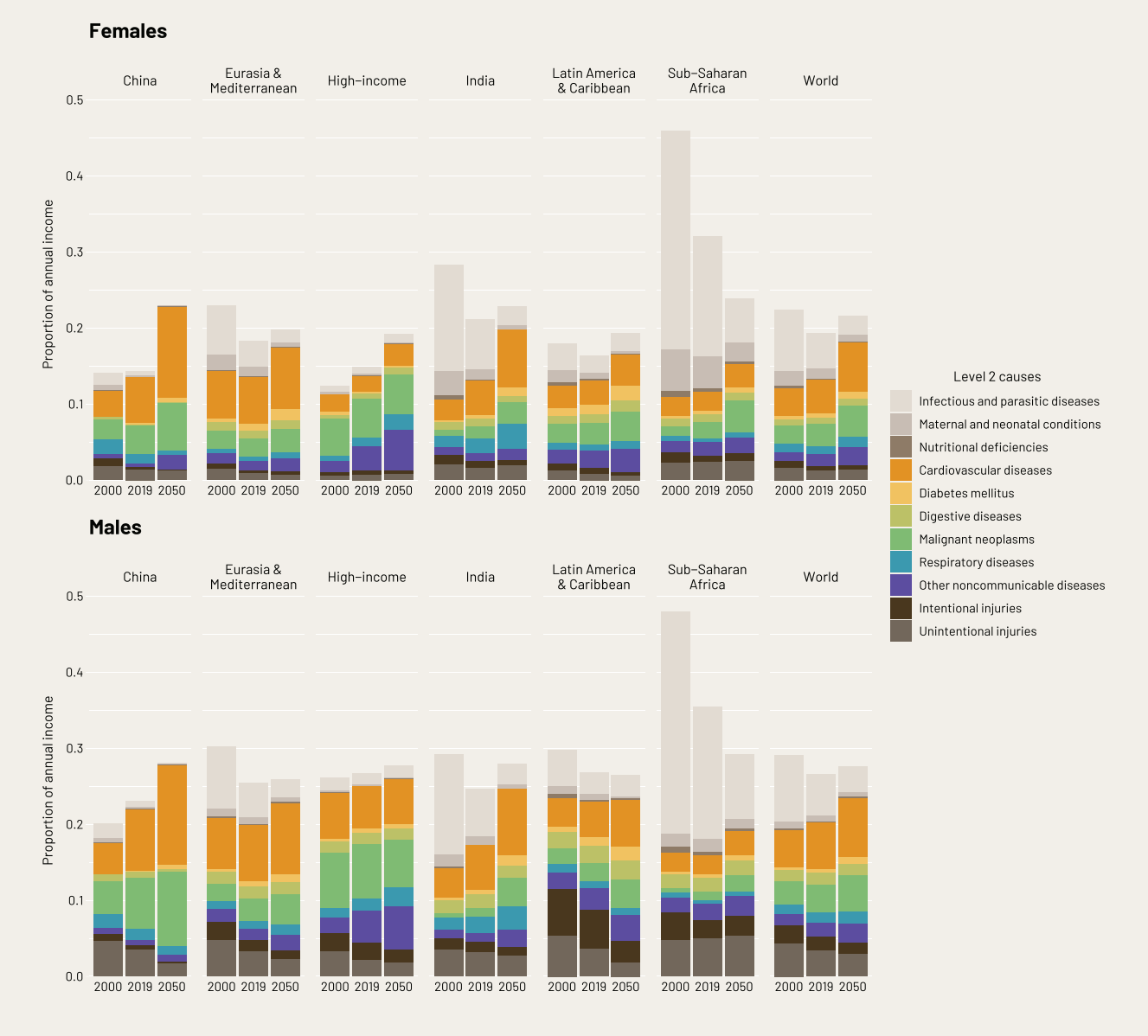
Cause of death	2000	2019	2050
Injuries	4.2%	2.9%	1.7%
Intentional injuries	0.9%	0.4%	0.1%
Unintentional injuries	3.3%	2.5%	1.6%
Road injury	1.5%	1.3%	0.6%
Other unintentional injuries	1.8%	1.2%	0.9%
Eurasia & Mediterranean			
Communicable, maternal, perinatal and nutritional conditions	9.1%	5.2%	2.8%
Infectious and parasitic diseases	7.3%	3.9%	2.0%
Maternal and neonatal conditions	1.5%	1.1%	0.6%
Nutritional deficiencies	0.2%	0.1%	0.1%
Noncommunicable diseases	12.8%	13.7%	17.8%
Cardiovascular diseases	6.4%	6.8%	8.7%
Ischaemic heart disease	3.3%	3.5%	4.8%
Stroke	2.3%	2.4%	2.8%
Other cardiovascular diseases	0.8%	0.8%	1.0%
Diabetes mellitus	0.5%	0.8%	1.3%
Digestive diseases	1.3%	1.3%	1.3%
Cirrhosis of the liver	0.9%	0.9%	0.9%
Other digestive diseases	0.3%	0.3%	0.4%
Malignant neoplasms	2.4%	2.8%	3.6%
Breast cancer	0.2%	0.3%	0.3%
Cervix uteri cancer	0.2%	0.2%	0.1%
Liver cancer	0.2%	0.3%	0.3%
Mouth and oropharynx cancers	0.2%	0.2%	0.3%
Oesophagus cancer	0.1%	0.1%	0.2%
Stomach cancer	0.2%	0.2%	0.2%
Trachea, bronchus, lung cancers	0.4%	0.5%	0.6%
Other malignant neoplasms	0.9%	1.1%	1.7%
Respiratory diseases	0.8%	0.8%	1.0%
Chronic obstructive pulmonary disease	0.5%	0.5%	0.7%
Other respiratory diseases	0.3%	0.3%	0.3%
Other noncommunicable diseases	1.5%	1.4%	1.9%
Injuries	4.7%	3.0%	2.2%
Intentional injuries	1.5%	0.9%	0.7%
Unintentional injuries	3.1%	2.2%	1.5%
Road injury	1.2%	1.1%	0.8%
Other unintentional injuries	1.9%	1.0%	0.7%
High-income			
Communicable, maternal, perinatal and nutritional conditions	1.6%	1.6%	1.8%
Infectious and parasitic diseases	1.2%	1.2%	1.4%
Maternal and neonatal conditions	0.3%	0.2%	0.1%
Nutritional deficiencies	0.1%	0.1%	0.1%
Noncommunicable diseases	14.1%	16.2%	19.2%
Cardiovascular diseases	4.1%	3.7%	4.3%
Ischaemic heart disease	2.8%	2.2%	2.2%
Stroke	0.6%	0.5%	0.7%
Other cardiovascular diseases	0.8%	1.1%	1.7%
Diabetes mellitus	0.4%	0.4%	0.5%

Cause of death	2000	2019	2050
Digestive diseases	0.9%	1.0%	1.1%
Cirrhosis of the liver	0.5%	0.5%	0.5%
Other digestive diseases	0.3%	0.4%	0.6%
Malignant neoplasms	6.2%	6.2%	5.8%
Breast cancer	0.6%	0.5%	0.4%
Cervix uteri cancer	0.1%	0.1%	0.0%
Liver cancer	0.3%	0.3%	0.3%
Mouth and oropharynx cancers	0.2%	0.2%	0.2%
Oesophagus cancer	0.2%	0.3%	0.2%
Stomach cancer	0.4%	0.3%	0.1%
Trachea, bronchus, lung cancers	2.1%	2.2%	1.5%
Other malignant neoplasms	2.6%	2.7%	3.1%
Respiratory diseases	0.9%	1.5%	2.3%
Chronic obstructive pulmonary disease	0.6%	0.9%	1.4%
Other respiratory diseases	0.3%	0.5%	0.8%
Other noncommunicable diseases	1.8%	3.7%	5.5%
Injuries	3.4%	2.9%	2.5%
Intentional injuries	1.3%	1.4%	1.0%
Unintentional injuries	1.9%	1.4%	1.4%
Road injury	1.1%	0.6%	0.5%
Other unintentional injuries	0.8%	0.8%	0.9%
India			
Communicable, maternal, perinatal and nutritional conditions	16.4%	7.8%	3.3%
Infectious and parasitic diseases	13.6%	6.4%	2.7%
Maternal and neonatal conditions	2.3%	1.2%	0.6%
Nutritional deficiencies	0.4%	0.1%	0.0%
Noncommunicable diseases	8.2%	11.6%	18.9%
Cardiovascular diseases	3.3%	5.2%	8.2%
Ischaemic heart disease	1.8%	3.2%	5.3%
Stroke	0.9%	1.3%	2.0%
Other cardiovascular diseases	0.6%	0.6%	0.8%
Diabetes mellitus	0.3%	0.6%	1.2%
Digestive diseases	1.4%	1.4%	1.2%
Cirrhosis of the liver	0.8%	0.9%	0.8%
Other digestive diseases	0.6%	0.4%	0.3%
Malignant neoplasms	0.7%	1.4%	3.4%
Breast cancer	0.0%	0.2%	0.3%
Cervix uteri cancer	0.1%	0.2%	0.2%
Liver cancer	0.0%	0.0%	0.1%
Mouth and oropharynx cancers	0.2%	0.4%	0.8%
Oesophagus cancer	0.1%	0.1%	0.2%
Stomach cancer	0.1%	0.2%	0.2%
Trachea, bronchus, lung cancers	0.1%	0.2%	0.4%
Other malignant neoplasms	0.2%	0.4%	1.4%
Respiratory diseases	1.6%	2.0%	3.2%
Chronic obstructive pulmonary disease	1.0%	1.4%	2.6%
Other respiratory diseases	0.5%	0.6%	0.6%
Other noncommunicable diseases	1.1%	1.1%	1.9%
Injuries	4.2%	3.6%	3.3%
Intentional injuries	1.3%	1.1%	0.9%

Cause of death	2000	2019	2050
Unintentional injuries	2.8%	2.5%	2.4%
Road injury	0.8%	0.9%	0.8%
Other unintentional injuries	2.0%	1.6%	1.5%
Latin America & Caribbean			
Communicable, maternal, perinatal and nutritional conditions	6.0%	3.6%	3.2%
Infectious and parasitic diseases	4.2%	2.6%	2.6%
Maternal and neonatal conditions	1.3%	0.8%	0.3%
Nutritional deficiencies	0.5%	0.2%	0.2%
Noncommunicable diseases	11.1%	12.8%	16.9%
Cardiovascular diseases	3.3%	3.9%	5.1%
Ischaemic heart disease	1.4%	1.9%	2.9%
Stroke	1.2%	1.1%	1.0%
Other cardiovascular diseases	0.7%	0.8%	1.1%
Diabetes mellitus	0.9%	1.3%	1.9%
Digestive diseases	1.5%	1.6%	1.9%
Cirrhosis of the liver	0.8%	0.7%	0.8%
Other digestive diseases	0.7%	0.9%	1.2%
Malignant neoplasms	2.3%	2.7%	3.8%
Breast cancer	0.2%	0.3%	0.4%
Cervix uteri cancer	0.3%	0.3%	0.2%
Liver cancer	0.1%	0.2%	0.2%
Mouth and oropharynx cancers	0.1%	0.1%	0.1%
Oesophagus cancer	0.1%	0.1%	0.1%
Stomach cancer	0.3%	0.3%	0.3%
Trachea, bronchus, lung cancers	0.3%	0.4%	0.5%
Other malignant neoplasms	1.1%	1.3%	2.2%
Respiratory diseases	1.0%	0.9%	1.0%
Chronic obstructive pulmonary disease	0.5%	0.5%	0.7%
Other respiratory diseases	0.5%	0.4%	0.4%
Other noncommunicable diseases	2.0%	2.5%	3.2%
Injuries	6.7%	5.1%	2.8%
Intentional injuries	3.4%	2.9%	1.6%
Unintentional injuries	3.3%	2.3%	1.2%
Road injury	1.6%	1.3%	0.6%
Other unintentional injuries	1.7%	1.0%	0.6%
Sub-Saharan Africa			
Communicable, maternal, perinatal and nutritional conditions	33.5%	20.0%	9.5%
Infectious and parasitic diseases	29.0%	16.6%	7.2%
Maternal and neonatal conditions	3.6%	3.0%	1.8%
Nutritional deficiencies	0.9%	0.4%	0.4%
Noncommunicable diseases	7.5%	8.5%	11.4%
Cardiovascular diseases	2.4%	2.5%	3.0%
Ischaemic heart disease	0.7%	0.8%	1.2%
Stroke	1.0%	1.0%	1.1%
Other cardiovascular diseases	0.7%	0.6%	0.7%
Diabetes mellitus	0.4%	0.5%	0.7%
Digestive diseases	1.4%	1.4%	1.4%
Cirrhosis of the liver	0.8%	0.8%	0.8%
Other digestive diseases	0.5%	0.6%	0.7%

Cause of death	2000	2019	2050
Malignant neoplasms	1.0%	1.7%	3.3%
Breast cancer	0.1%	0.3%	0.5%
Cervix uteri cancer	0.3%	0.3%	0.5%
Liver cancer	0.1%	0.1%	0.2%
Mouth and oropharynx cancers	0.0%	0.1%	0.1%
Oesophagus cancer	0.1%	0.1%	0.1%
Stomach cancer	0.0%	0.1%	0.1%
Trachea, bronchus, lung cancers	0.0%	0.0%	0.1%
Other malignant neoplasms	0.4%	0.8%	1.6%
Respiratory diseases	0.6%	0.5%	0.6%
Chronic obstructive pulmonary disease	0.2%	0.2%	0.3%
Other respiratory diseases	0.4%	0.3%	0.4%
Other noncommunicable diseases	1.7%	2.0%	2.4%
Injuries	6.0%	5.3%	5.7%
Intentional injuries	2.4%	1.5%	1.7%
Unintentional injuries	3.6%	3.8%	4.0%
Road injury	1.8%	2.1%	2.5%
Other unintentional injuries	1.7%	1.6%	1.5%
World			
Communicable, maternal, perinatal and nutritional conditions	10.1%	6.3%	3.9%
Infectious and parasitic diseases	8.4%	5.1%	3.0%
Maternal and neonatal conditions	1.5%	1.1%	0.7%
Nutritional deficiencies	0.3%	0.1%	0.2%
Noncommunicable diseases	11.0%	13.1%	17.5%
Cardiovascular diseases	4.2%	5.2%	7.0%
Ischaemic heart disease	1.9%	2.6%	3.8%
Stroke	1.6%	1.9%	2.1%
Other cardiovascular diseases	0.7%	0.7%	1.1%
Diabetes mellitus	0.4%	0.6%	1.0%
Digestive diseases	1.1%	1.1%	1.2%
Cirrhosis of the liver	0.7%	0.7%	0.7%
Other digestive diseases	0.4%	0.4%	0.5%
Malignant neoplasms	2.8%	3.4%	4.4%
Breast cancer	0.2%	0.2%	0.4%
Cervix uteri cancer	0.1%	0.2%	0.2%
Liver cancer	0.3%	0.3%	0.3%
Mouth and oropharynx cancers	0.2%	0.2%	0.3%
Oesophagus cancer	0.2%	0.2%	0.2%
Stomach cancer	0.4%	0.4%	0.2%
Trachea, bronchus, lung cancers	0.7%	0.9%	1.0%
Other malignant neoplasms	1.0%	1.2%	1.9%
Respiratory diseases	1.2%	1.2%	1.5%
Chronic obstructive pulmonary disease	0.8%	0.9%	1.1%
Other respiratory diseases	0.3%	0.3%	0.4%
Other noncommunicable diseases	1.4%	1.7%	2.5%
Injuries	4.6%	3.6%	3.2%
Intentional injuries	1.6%	1.1%	1.0%
Unintentional injuries	3.0%	2.4%	2.2%
Road injury	1.3%	1.2%	1.1%
Other unintentional injuries	1.7%	1.2%	1.1%

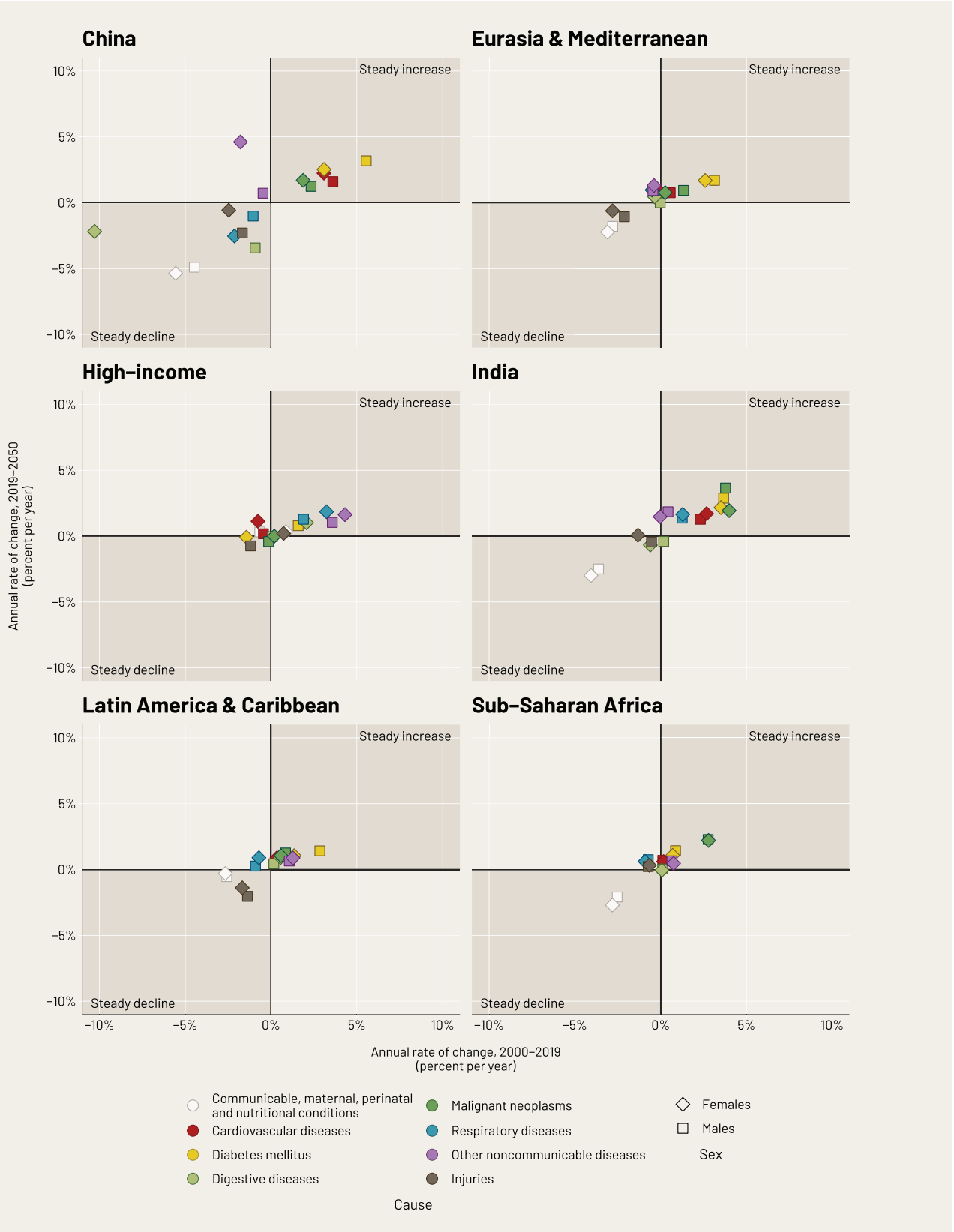
FIGURE 4.2 **Economic values of avoidable mortality,** *measured as proportion of annual income, assigned to selected causes of death for the six regions, in the years 2000, 2019, and 2050*



We note that the economic value attributable to the cause category "communicable, maternal, perinatal and nutritional conditions" would be very substantial in sub-Saharan Africa (20.4 percent for females, 19.6 percent for males, of annual income in 2019), and quite large, yet to a lesser extent in India (8.1 percent and 7.5 percent). This is notably due to large young populations, especially in sub-Saharan Africa (UN 2022), as well as to high mortality rates for these causes of death. The economic values for these causes of death would however be much smaller in the other four regions, particularly so in high-income (1.5 percent for females, 1.8 percent for males) and China (0.8 percent for females, 1.1 percent for males), geographical locations that are most advanced into the epidemiological transition from communicable to non-communicable diseases.

Lastly, in almost all regions, we could point to the rapid expansion of avoidable deaths associated with NCDs, in particular CVD and cancers, and to the fast compression of avoidable mortality from communicable, perinatal, maternal and nutritional diseases, into the future (from 2000 to 2019 and 2050; Figure 4.3). This is a testimony of the still advancing epidemiological transition from communicable to non-communicable diseases and of the ageing of populations.

FIGURE 4.3 **Rates of change (percent per year) of the economic values of avoidable mortality assigned to selected causes of death** *(communicable, maternal, perinatal and nutritional conditions; cardiovascular diseases; malignant neoplasms; injuries) for the six regions, over the time periods 2000-2019 and 2019-2050.*



Specifically, from 2000 to 2050, we observe steady declines in the economic value associated with avoidable mortality from communicable, perinatal, maternal and nutritional diseases coupled with steady expansions of the economic value of avoidable mortality from CVD (except for sub-Saharan Africa) and cancers in China, India, and sub-Saharan Africa. For the other regions, the extents of these CVD and cancer expansions would be smaller, especially so in High-income, which displays a rather stagnant picture. Overall, this dynamic evolution into the future crucially emphasizes the paramount challenges and economic losses ahead tied to the expansion of CVD and cancers, replacing communicable, perinatal, maternal and nutritional diseases, particularly in the emerging economies of China, India, and sub-Saharan Africa.

Sensitivity analyses

When using the lowest mortality rates (in place of the 10th percentile of the mortality rates; webappendix Figure C1) or when applying standard BCA sensitivity analyses (Robinson et al. 2019), we did not observe qualitatively distinct findings, though quantitatively the findings would be impacted. This was the case, whether we prescribed different income elasticities, of 1.0 and 1.5 (webappendix Figures C2, C3), where economic values would decrease (increase) with a higher (lower) income elasticity; or varied discount rates, to 1 and 5 percent per year (webappendix Figures C5, C6), where we observed modest changes; or we set an alternative baseline VSL-to-income ratio of 100 relative to OECD countries (instead of 160 relative to the United States; webappendix Figure C4), where economic values would decrease.

DISCUSSION

We described in this chapter analytical methods to compute the monetary values linked with mortality risk reductions associated with specific causes of death, across six regions. The economic framework presented provides a systematic monetary assessment of the burden of avoidable mortality, which can be useful in quantifying the costs and benefits of both health and non-health interventions, and allow comparisons within the health sector as well as beyond across sectors (e.g., health, education, transport, agriculture).

Our assessment shows that the implications of controlling NCDs and injuries could be substantial in terms of economic value and that the costs of inaction would be enormous, especially for CVD. Indeed, we found that the economic value associated with avoidable CVD mortality would be universally large, in the order of 3 to 7 percentage points of annual income in the year 2019 for example. We also observed that the economic value of avoidable cancer mortality would be large in high-Income and China; and, for injury, it would be substantial for males in Latin America & the Caribbean (intentional injuries) and males in sub-Saharan Africa (unintentional injuries).

While the extents of these hypothetical mortality reductions needed not be monetized, importantly, in computing these economic values, we assigned willingness to pay values for cause-specific mortality reductions and provided a metric (i.e., percent of annual income) that is directly comparable to GNIs and annual budgetary allocations. As such, we produced potential willingness to pay estimates (e.g., multipliers of GNIs per capita; Bertram et al. 2016, Woods et al. 2016) against which one could gauge the cost-effectiveness of interventions (say as potential "best-buys"). We also estimated sizeable monetary values for the mortality reduction gains that could be obtained with scaling up key interventions and benefit packages addressing NCDs and injuries (e.g., health taxes, primary and secondary prevention of CVD; NCD Countdown 2030 collaborators 2022). In sum, our dual focus on mortality frontiers and modulated monetary valuation of the size of mortality risk reductions provides a priority-setting dimension complementary to cause-of-death distributions (webappendix Figure D1).

Relatedly, a few similar studies (in spirit) have been conducted in the literature. Most importantly, Bloom and colleagues have pioneered comparable BCA methods and published seminal works as part of making the investment case for NCDs (Bloom et al. 2011). They have also led macroeconomic modeling to assess the economic losses attributable to NCDs in a few Asian nations including China, Japan, and South Korea (Bloom et al. 2020) and to cancers globally (Chen et al. 2023). These works, like ours, demonstrated the very substantial welfare impact of NCDs, at the global and regional levels. Also, Khadka &

Verguet (2021) further developed VSL approaches to quantify the monetary values associated with NCDs in a systematic manner, and like our assessment, estimated that the welfare losses associated with NCDs, particularly for CVD and cancers, would be very substantial in the coming decades for LMIC economies. Similarly, Arias and colleagues (2022) pointed to the potentially large economic losses tied to mental disorders using somewhat comparable approaches.

Nevertheless, our analysis presents important limitations. First, we used global estimates of cause-specific mortality, which are based on incomplete and uncertain data, particularly in low- and lower-middle income countries (WHO 2020a).

Second, we forecasted future trends (over the period 2020-2050) in age-cause-sex-specific frontier mortality rates and country groupings based on previous trends (over the period 2010-2019) using simple log-linear extrapolations into the future. A more complex modeling approach could be pursued, yielding probabilistic distributions of a space of plausible future outcomes (Kontis et al. 2017). Yet, this would likely bring additional complications for interpretation without, however, being further grounded within empirical data. Also, we did not consider the short- or long-term impacts of the COVID-19 pandemic on age-cause-specific mortality rates in our forecasts. In addition, for the estimation of the mortality frontiers, we mostly used high-income country data, because high-quality vital registration data for LMICs outside of the Latin America & Caribbean region remain scarce and because high-income countries would likely achieve the lowest mortality rates (WHO 2020a; IHME 2022). Such frontier trajectories could however be revisited as more data become available, and alternative mortality frontiers could be constructed (e.g., region-specific mortality frontiers in place of global mortality frontiers). Likewise, different percentiles (5^{th}, 20^{th}, 30^{th} or lowest) of mortality rates could be tested in place of the 10^{th} percentiles used here. The changes might quantitatively affect our findings, yet only likely to a modest level if, for example, we used the lowest mortality rates in place of the 10^{th} percentiles (webappendix Figures A1, C1). Relatedly, differences in cause-of-death patterns across geographies and over time may relate to quality and practices in cause-of-death assignments as opposed to real epidemiological differences, especially for related causes (e.g., diabetes and CVD). Our methods are based on quantification of the economic value of avoidable mortality, which by design excludes non-fatal conditions, such as mental conditions and sensory disorders (e.g., vision and hearing impairments). We likely underestimate the economic value of non-fatal conditions by looking only at avoidable mortality.

Third, there are major limitations with the implementation of VSL approaches for economic valuation, in particular the high sensitivity of the VSL estimates to income elasticity parameters (Viscusi & Aldy 2003; Robinson, Hammitt & O'Keeffe 2019; webappendix Figures C2, C3). Importantly, we have made a number of argued prescriptions regarding the parametrization of our estimations, including the specification of a modulating function varying with the extent of mortality risk reductions (using Chang et al. (2024), consistent with Hammitt (2020) and Cardoso & Dahis (2020)). In this respect, caution should be exercised when comparing the economic values associated with avoidable mortality across regions. Furthermore, to many, VSL approaches raise ethical dilemmas, that is, notably, to eventually yield a monetary value for life years. Yet, often, VSL estimates are misunderstood as economic values one society assigns to one life; while they rather capture the trade-offs individuals are willing to make in giving up a portion of their income in exchange for small reductions in their mortality risk over a given year (Robinson et al. 2019). Also, BCA is only one (among many other possible) method for priority setting, nonetheless attractive for making multisectoral comparisons. Critically, the quantitative values extracted from VSL estimates are sensitive to income elasticities and the income differentials across countries. Fourth, while we were able to compute monetary values associated with longevity losses due to specific causes of death, this only provides one element (i.e., a valuation of health gains) for use in BCAs. Evidently, we would also need the costing of interventions and the valuation of morbidity reduction and other non-health benefits (e.g., financial protection) (Verguet, Laxminaryan & Jamison 2015; Verguet & Norheim 2022), so as to fully assess the returns on investment from controlling NCDs and injuries.

In summary, we produced a systematic economic valuation of the burden of avoidable mortality by cause of death, with a focus on major NCDs and injuries, in LMICs. This economic framework can point to the very large economic value linked to NCDs and injuries, amounting to several percentage points of annual incomes. It can also be further adapted to estimate the economic returns from investing in the health sector and, in this particular study, toward NCD and injury interventions. In doing so, it allows both economic comparisons of such investments both within the health sector as well as across other sectors.

REFERENCES

1. Arias D, Saxena S, Verguet S. Quantifying the global burden of mental disorders and their economic value. eClinical Medicine 2022; 54:101675.
2. Baltussen R, Marsh K, Thakola P, et al. Multicriteria decision analysis to support health technology assessment agencies: benefits, limitations, and the way forward Value Health 2019; 22(11):1283-1288.
3. Bertram MY, Lauer JA, De Joncheere K, Edejer T, Hutubessy R, Kieny M-P, Hill SR. Cost-effectiveness thresholds: pros and cons. Bulletin of the World Health Organization 2016; 94(12):925-930.
4. Bloom, D.E., Cafiero, E.T., Jané-Llopis, E, Abrahams-Gessel, S, Bloom, L.R., Fathima, S, et al. The Global Economic Burden of Non-communicable Diseases [Internet]. Geneva: World Economic Forum; Available from: http://www3.weforum.org/docs/WEF_Harvard_HE_GlobalEconomicBurdenNonCommunicableDiseases_2011.pdf.
5. Bloom DE, Chen S, Kuhn M, McGovern ME, Oxley L, Prettner K. The economic burden of chronic diseases: Estimates and projections for China, Japan, and South Korea. The Journal of the Economics of Ageing. 2020 Oct 1;17:100163.
6. Cardoso DS, Dahis R. 2020. Value of a Statistical Life Under Large Mortality Risk Change: Theory and an Application to COVID-19'. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3599529.
7. Chang AY, Stevens GA, Cardoso DS, Cao B, Jamison DT. The economic burden of avoidable mortality, 2000-2050. In Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative. Washington, DC: World Bank. 2024.
8. Chen S, Cao Z, Prettner K, et al. Estimates and projections of the global economic cost of 29 cancers in 204 countries and territories from 2020 to 2050. JAMA Oncology 2023; 9(4):465-472.
9. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: the challenges ahead. Lancet 2009; 374:1196-1208.
10. Drummond MF, Sculpher MJ, Claxton K, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes (4th ed.). Oxford, UK: Oxford University Press; 2015.
11. Hammitt JK. 2020. Valuing Mortality Risk in the Time of COVID-19'. Journal of Risk and Uncertainty 61 (2):129-54.
12. Institute for Health Metrics and Evaluation (IHME). GBD 2019. Seattle: University of Washington, 2022. Available from: https://vizhub.healthdata.org/gbd-compare/.
13. Jamison DT, Summers LH, Alleyne G, et al. Global health 2035: a world converging within a generation. Lancet 2013; 382:1898-1955.
14. Jamison DT, Jha P, Laxminarayan R, Ord T. Infectious disease. In: Global problems, smart solutions: costs and benefits, Lomborg B (editor). Cambridge, UK: Cambridge University Press, 2013.
15. Jha P, Hum R, Nugent R, Verguet S, Bloom D. Chronic disease. In: Global problems, smart solutions: costs and benefits, Lomborg B (editor). Cambridge, UK: Cambridge University Press, 2013.
16. Khadka A, Verguet S. The economic value of changing mortality risk in low- and middle-income countries: a systematic breakdown by cause of death. BMC Medicine 2021; 19:156.
17. Kontis V, Bennett JE, Mathers CD, et al. Future life expectancy in 35 industrialised countries: projections with a Bayesian model ensemble. Lancet 2017; 389:1323-1335.
18. Mathers CD, Loncar D. 2006. Projections of Global Mortality and Burden of Disease from 2002 to 2030. PLoS Medicine 3 (11):e442.
19. Mathers CD, Stevens GA, Boerma T, White RA, Tobias MI. Causes of international increases in older age life expectancy. Lancet 2015; 385(9967):540-548.
20. Murray CJ, Acharya AK. Understanding DALYs (disability-adjusted life years). Journal of Health Economics 1997; 16(6):703-730.
21. NCD Countdown 2030 collaborators. NCD Countdown 2030: efficient pathways and strategic investments to accelerate progress towards the Sustainable Development Goal target 3.4 in low- and middle-income countries. Lancet 2022; 399:P1266-1278.
22. Neumann PJ, Sanders GD, Russell LB, Siegel JE, Ganiats TG. Cost-Effectiveness in Health and Medicine (2nd ed.). Oxford, UK: Oxford University Press; 2015.
23. Robinson LA, Hammitt JK, O'Keeffe L. Valuing mortality risk reductions in global benefit-cost analysis. Journal of Benefit Cost Analysis 2019; 10(suppl 1):15-50.
24. Robinson LA, Hammitt JK, Cecchini M, Chalkidou K, Claxton K, Hoang-Vu Eozenou P, de Ferranti D, et al. 2019. Reference Case Guidelines for Benefit-Cost Analysis in Global Health and Development, May, 126.
25. Partridge L, Deelen J, Slagboom PE. Facing up to the global challenges of ageing. Nature 2018; 561:45-56.
26. Spasova S, Baeten R, Vanhercke B. Challenges in long-term care in Europe. Eurohealth Observer 2018; 24(4):7-12.
27. Tynkkynnen L-K, Pulkki J, Tervonen-Goncalves, et al. Health system reforms and the needs of the ageing population – an analysis of recent policy paths and reform trends in Finland and Sweden. European Journal of Ageing 2022; 19:221-232.
28. United Nations. Department of Economic and Social Affairs. World Population Prospects 2022. New York, NY: United Nations, 2022. Available from: https://population.un.org/wpp/ (accessed April 26, 2022).
29. Vaupel JW, Villavicencio F, Bergeron-Boucher M-P. Demographic perspectives on the rise of longevity. PNAS 2021; 118(9):e2019536118.
30. Verguet S, Laxminarayan R, Jamison DT. Universal public finance for tuberculosis treatment in India: an extended cost-effectiveness analysis. Health Economics 2015; 24(3):318-332.
31. Verguet S, Hailu A, Eregata GT, et al. Toward universal health coverage in the post-COVID-19 era. Nature Medicine 2021; 27(3):380-387.
32. Verguet S, Norheim OF. Estimating and comparing health and financial risk protection outcomes in economic evaluations. Value in Health 2022; 25(2):238-246.
33. Viscusi K, Aldy JE. The value of a statistical life: a critical review of market estimates throughout the world. Journal of Risk and Uncertainty 2003; 27:5-76.

34. Viscusi K, Masterman CJ. Income elasticity and the global value of a statistical life. Journal of Benefit-Cost Analysis 2017; 8(2):226-250.
35. Watkins DA, Yamey G, Schaferhoff M, Adeyi O, Alleyne G, Alwan A, et al. Alma-Ata at 40 years: reflections from the *Lancet* Commission on Investing in Health. Lancet 2018; 392:P1434-1460.
36. Watkins DA, Qi J, Kawakatsu Y, Pickergill SJ, Horton SE, Jamison DT. Resource requirements for essential universal health coverage: a modelling study based on findings from *Disease Control Priorities*, 3rd edition. Lancet Global Health 2020; 8(6):e829-e839.
37. Weinstein MC, Torrance G, McGuire A. QALYs: the basics. Value in Health 2009; 12(2)(suppl 1):S5-S9.
38. Woods B, Revill P, Sculpher M, Claxton K. Country-level cost-effectiveness thresholds: initial estimates and the need for further research. Value in Health 2016; 19(8):929-935.
39. World Bank. World Development Indicators. Available from: https://datatopics.worldbank.org/world-development-indicators/ (accessed May 13, 2022).
40. World Health Organization. 2020a. Global Health Estimates. 2020. Available from: https://www.who.int/data/global-health-estimates.
41. Word Health Organization. 2020b. WHO methods and data sources for country-level causes of death 2000-2019. Available from: https://cdn.who.int/media/docs/default-source/gho-documents/global-health-estimates/ghe2019_cod_methods.pdf?sfvrsn=37bcfacc_5.

5

Rates of progress in mortality decline, 2000-2019

Daphne C. Wu[a], *Debapriya Chakraborty*[a], *Ryan Hum*[a], *Prabhat Jha*[a], *Dean T. Jamison*[b]

[a] Centre for Global Health Research, University of Toronto, Unity Health Toronto
[b] University of California, San Francisco

INTRODUCTION

Globally, mortality rates have been generally declining over time. The rates of decline, however, vary between ages and countries or country income levels (Norheim and others 2015). Mortality rates among children have declined remarkably since the 1990s, mostly owing to global as well as country-level efforts under the UN Millennium Development Goals (MDGs) (Cha 2017; Lozano and others 2011; Tanner and others 2016). Compared to child mortality, progress in reducing adult mortality has been much slower (Figure 5.1) (Norheim and others 2015; Wang and others 2017). The gap in mortality rates between low- and middle-income countries (LMICs) and high-income countries is converging for deaths at younger ages but diverging for older ages. In 2019, about 80 percent of deaths above 15 years globally are due to non-communicable diseases (NCDs); this proportion has been increasing over time across all ages (World Health Organization (WHO) 2020). Recognizing the increasing disease burden due to NCDs, the Sustainable Development Goals (SDGs), adopted in 2015 by the UN General Assembly, included target 3.4 to reduce mortality due to NCDs by one-third by 2030 (United Nations General Assembly 2015). However, progress has been slow and insufficient to meet the target, even prior to the COVID-19 pandemic (United Nations, Department of Economic and Social Affairs, Sustainable Development 2023).

The progress in mortality reduction not only varies by age, but also over time (NCD Countdown 2030 collaborators 2018). As shown in Figure 5.1, mortality rates decreased notably faster for ages under 70 during 1990-2010 compared to after 2010, at least in LMICs. The first section of this study seeks to examine and quantify the rates of progress in mortality reduction, by age group and country income levels, during 2010-09 and compare them to the rates during 2000-09. In the next section, we examine countries' performance in the rate of decline in mortality during 2010-19 compared to during 2000-09. The following section presents the progress by disease groups and age. Finally, the last section examines the trend in cost of saving a child vs. an adult life from 2000 to 2019.

FIGURE 5.1 **Change in risk of death at start of age range, by age group and country income level, 1990-2019**



Source: Original calculations for this publication

RATES OF PROGRESS OVER 2000-09 AND 2010-19

As we mentioned earlier, global progress on mortality reduction has been varying with time, country income levels, and age. Here, we use interrupted time series (ITS) analysis to examine and quantify the difference in the rates of progress in mortality reduction, by age and country income levels between 2010-19 and 2000-09. Annex 5.1 provides details of the ITS methodology. Actual mortality rates, by age, sex, and country income levels are presented in Annex Figure 5A.2.

Table 5.1 shows the results of the ITS analysis of the change in mortality rates from 2000-09 to 2010-19, by age and sex, and by country income level. Between 2000 and 2010, mortality rates declined significantly across all age groups irrespectively of country income level, except for males aged 70-84 years in lower-middle-income countries where the mortality rates increased but not significantly. Compared to ages 0-14, the mortality rate among those 50-69 years fell in low-income countries but rose substantially in middle-income countries in 2010. For almost all country income levels, the rate of decline in mortality between 2010 and 2019 was significantly slower than during 2000-09 for ages under age 70. The slowing of progress in the second decade was seen at all ages above 50, with the exception for ages 70-84 years, where the rate of decline was significantly faster during 2010-19 for males in low-income countries and males and females in middle-income countries.

TABLE 5.1 Results from interrupted time series analysis of the change in mortality rates (per 100,000 population) from 2000-10 to 2010-19, by country income, age, and sex

	Annual rate of change during 2000-09	Level change in 2010	Trend change in 2010-19 vs 2000-09	Constant	Number of observations
Under 15 years					
Low-income countries					
Males	**-66.67 (0.000)**	**30.51 (0.016)**	**32.00 (0.000)**	**1671.36 (0.000)**	20
Females	**-63.44 (0.000)**	**26.79 (0.013)**	**31.13 (0.000)**	**1514.51 (0.000)**	20
Lower-middle-income countries					
Males	**-25.81 (0.000)**	0.62 (0.897)	**7.50 (0.000)**	**827.21 (0.000)**	20
Females	**-26.90 (0.000)**	2.37 (0.676)	**8.33 (0.000)**	**812.14 (0.000)**	20
Upper-middle-income countries					
Males	**-10.54 (0.000)**	-1.10 (0.611)	**1.67 (0.001)**	**286.77 (0.000)**	20
Females	**-8.49 (0.000)**	0.19 (0.934)	**1.36 (0.010)**	**233.64 (0.000)**	20
High-income-countries					
Males	**-1.62 (0.000)**	**-1.94 (0.003)**	**0.48 (0.000)**	**70.66 (0.000)**	20
Females	**-1.19 (0.000)**	**-1.47 (0.005)**	**0.24 (0.008)**	**57.03 (0.000)**	20
15-49 years					
Low income-countries					
Males	**-18.72 (0.000)**	9.36 (0.113)	**13.09 (0.000)**	**703.94 (0.000)**	20
Females	**-18.17 (0.000)**	-11.10 (0.110)	**5.32 (0.000)**	**618.29 (0.000)**	20
Lower-middle-income countries					
Males	**-3.75 (0.000)**	-5.14 (0.055)	**-2.92 (0.000)**	**377.95 (0.000)**	20
Females	**-6.23 (0.000)**	-5.04 (0.164)	**1.49 (0.012)**	**307.49 (0.000)**	20
Upper-middle-income countries					
Males	**-5.06 (0.000)**	-6.47 (0.053)	0.12 (0.788)	**301.19 (0.000)**	20
Females	**-2.23 (0.000)**	**-6.09 (0.007)**	**-0.98 (0.002)**	**153.82 (0.000)**	20

	Annual rate of change during 2000-09	Level change in 2010	Trend change in 2010-19 vs 2000-09	Constant	Number of observations
High income-countries					
Males	**-3.82 (0.000)**	**-8.28 (0.017)**	**3.01 (0.000)**	**186.52 (0.000)**	20
Females	**-1.32 (0.000)**	**-2.77 (0.010)**	**0.96 (0.000)**	**89.38 (0.000)**	20
50-69 years					
Low income-countries					
Males	**-38.62 (0.000)**	**-54.43 (0.004)**	**8.06 (0.003)**	**2659.56 (0.000)**	20
Females	**-38.75 (0.000)**	-25.33 (0.060)	**5.82 (0.016)**	**2125.66 (0.000)**	20
Lower-middle-income countries					
Males	**-31.11 (0.000)**	14.51 (0.249)	**9.13 (0.002)**	**2204.67 (0.000)**	20
Females	**-30.21 (0.000)**	14.49 (0.122)	**21.05 (0.000)**	**1583.90 (0.000)**	20
Upper-middle-income countries					
Males	**-36.55 (0.000)**	**29.34 (0.002)**	**22.77 (0.000)**	**1768.85 (0.000)**	20
Females	**-26.82 (0.000)**	**24.03 (0.009)**	**16.68 (0.000)**	**992.49 (0.000)**	20
High income-countries					
Males	**-22.76 (0.000)**	5.59 (0.350)	**15.72 (0.000)**	**1236.70 (0.000)**	20
Females	**-10.91 (0.000)**	**7.88 (0.010)**	**9.18 (0.000)**	**641.12 (0.000)**	20
70-84 years					
Low income-countries					
Males	**-70.49 (0.000)**	**-149.27 (0.004)**	**-53.94 (0.000)**	**9818.88 (0.000)**	20
Females	**-104.62 (0.000)**	27.86 (0.138)	**41.76 (0.000)**	**7792.70 (0.000)**	20
Lower-middle-income countries					
Males	8.87 (0.106)	**-182.17 (0.000)**	**-123.27 (0.000)**	**8116.32 (0.000)**	20
Females	**-25.50 (0.000)**	**-86.54 (0.006)**	**-67.10 (0.000)**	**6147.70 (0.000)**	20
Upper-middle-income countries					
Males	**-64.09 (0.000)**	22.59 (0.380)	-13.57 (0.096)	**7137.03 (0.000)**	20
Females	**-64.32 (0.000)**	-24.61 (0.217)	**-18.41 (0.001)**	**4693.27 (0.000)**	20
High income-countries					
Males	**-93.53 (0.000)**	-24.93 (0.388)	**25.13 (0.000)**	**5457.30 (0.000)**	20
Females	**-55.57 (0.000)**	-79.32 (0.112)	17.15 (0.051)	**2917.58 (0.000)**	20

p-values are given in parenthesis.
Figures in bold indicate significance at 95 percent confidence interval.
The "annual rate of change during 2000-09" refers to the annual rate of change in mortality rates (per 100,000 population) during 2000 to 2009, "level change in 2010" refers to the change (increase or decrease) in mortality rate in 2010, and "trend change in 2010-19 vs 2000-09" refers to change in the mortality rate during 2010-19 from that during 2000-09. A positive trend change indicates a slower decline in mortality during 2010-19 compared to during 2000-09, while a negative trend change indicates a more rapid decline during 2010-19 than during 2000-09.

COUNTRIES' RATES OF PROGRESS DURING 2000-09 AND 2010-19

In this section, we examine performance, at the country level, in the rate of decline in mortality between 2000 and 2019. We used the framework of Verguet and Jamison (2014) to estimate performance in the rate of decline in under-five mortality in LMICs (Verguet and Jamison 2014). We define performance as the difference in the rate of decline in actual mortality compared to that predicted by a set of contextual factors. The analysis includes 71 LMICs that have a population of more than 7 million, which covers about 83 percent of the world population in 2019 (United Nations, Department of Economic and Social Affairs, Population Division 2022). High-income countries (HICs) were excluded, as the mathematical relationship between mortality rates and social, economic, and demographic characteristics markedly differs between HICs and LMICs. Details of the methodology used in provided in Annex 5.2.

Table 5.2 presents the top 10 and worst 10 LMICs in the performance in the rate of decline in mortality during 2010-19 and their ranking during 2000-09, by age and sex. Ranking of all 71 LMICs are provided in Annex Table 5A.2. We note that, across all ages, Haiti emerges as one of the top performers during 2010-19 but as one of the worst performers during 2000-10. This is due to the earthquake in 2010 that killed hundreds of thousands in Haiti. Similar situations of natural disasters and conflicts in Mozambique (flooding in 2000), and Afghanistan and Iraq (war during the 2000s) make them outliers in this analysis. The crisis countries are shown in the tables in italics. Excluding the crisis countries, across most, if not, all age groups, among the top performers were Rwanda and Cambodia during 2000-09, Russia during 2010-19, while among the worst was Zimbabwe during 2000-09, and Tunisia during 2010-19. In the 50-69 age group, among males, South Africa had the best performance during 2010-19, even after considering the substantial reduction in HIV infection that occurred during this period. A notable number of lower income African countries, including Tanzania and Zambia, were among the top 10 performers for mortality decline at ages 50-69 in both males and females. Among the worst performers at these ages were a number of middle-income countries in East Asia (Viet Nam and Malaysia) and Eastern Europe (Bulgaria and Uzbekistan) along with Kenya. In terms of gender differences in country performance, for both males and females, the best and worst performer countries correlate rather well for under 15 years (R2=0.94), but less at older ages (Annex Figure 5A.3).

We also examined performance transitions from 2000-09 to 2010-19. Performance transitions for the 71 LMICs and the distribution are given in Annex Table 5A.3. For ages 50-69 years, 64 out of the 71 LMICs (or 90 percent) fall in the moderate transition categories of +2.4 percent to -2.5 percent mortality decline per year. For ages under 70 years, Rwanda and Cambodia presented some of the poorest transitions of -2.5 percent to -5 percent per year.

TABLE 5.2 Top 10 and worst 10 performance rankings among 71 LMICs in the rate of decline of mortality, by sex and age: 2000-10 and 2010-19

Country	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10
Under 15 males			
Top 10 performance countries during 2010-19			
Russian Federation	46	1 (5.6)	33 (-0.4)
Haiti	610	2 (5.6)	71 (-8.8)
Azerbaijan	157	3 (5.1)	63 (-2.3)
Belarus	27	4 (4.6)	16 (0.7)
Kazakhstan	105	5 (4.6)	42 (-0.9)
China	71	6 (3.8)	25 (0.4)
Ukraine	55	7 (3.8)	64 (-2.4)
Bulgaria	55	8 (3.5)	67 (-3)
Malawi	392	9 (3.2)	8 (2.1)

Country	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10
Under 15 females			
Top 10 performance countries during 2010-19			
Haiti	474	1 (7.6)	71 (-10.2)
Russian Federation	37	2 (5.2)	52 (-1.8)
Azerbaijan	121	3 (5.2)	64 (-2.6)
Kazakhstan	74	4 (4.7)	51 (-1.8)
Belarus	20	5 (4.5)	34 (-0.4)
China	61	6 (3.8)	24 (0.5)
Ukraine	43	7 (3.8)	69 (-3.9)
Burundi	576	8 (3.4)	48 (-1.5)
Malawi	337	9 (2.6)	7 (2.5)

Country	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10
Under 15 males *(continued)*			
Worst 10 performance countries during 2010-19			
Burundi	685	10 (2.8)	50 (-1.6)
Malaysia	72	71 (-3.6)	31 (-0.3)
Viet Nam	245	70 (-3.1)	68 (-3.1)
Dominican Republic	272	69 (-2.7)	61 (-2.1)
Guinea	1054	68 (-2.2)	43 (-1)
Philippines	247	67 (-2)	51 (-1.6)
Nigeria	1377	66 (-1.8)	54 (-1.7)
Cote d'Ivoire	822	65 (-1.8)	40 (-0.9)
Benin	1005	64 (-1.7)	55 (-1.7)
Myanmar	438	63 (-1.6)	48 (-1.5)
Tunisia	152	62 (-1.6)	57 (-2)
15-49 males			
Top 10 performance countries during 2010-19			
Haiti	423	1 (7)	71 (-9.9)
Iraq	193	2 (4.6)	70 (-3.2)
South Africa	575	3 (4.5)	13 (1.2)
Tanzania	320	4 (3.6)	45 (-0.9)
Mozambique	522	5 (2.2)	62 (-2)
Zimbabwe	632	6 (2.2)	65 (-2.2)
Serbia	121	7 (2.1)	4 (1.6)
Belarus	301	8 (2.1)	27 (0.1)
Russian Federation	384	9 (2)	9 (1.4)
Sierra Leone	367	10 (1.7)	1 (2.8)
Worst 10 performance countries during 2010-19			
Afghanistan	530	71 (-3.5)	12 (1.2)
Mexico	340	70 (-2.9)	68 (-2.7)
Kenya	592	69 (-2)	60 (-1.9)
Viet Nam	314	68 (-2)	61 (-1.9)
Bulgaria	241	67 (-1.9)	41 (-0.7)
Burkina Faso	489	66 (-1.7)	40 (-0.6)
Tunisia	175	65 (-1.7)	63 (-2)
Ghana	471	64 (-1.7)	64 (-2.1)
Mali	450	63 (-1.4)	43 (-0.7)
Indonesia	253	62 (-1.3)	57 (-1.6)
50-69 males			
Top 10 performance countries during 2010-19			
Haiti	2271	1 (4)	71 (-4.9)
Iraq	1503	2 (2.7)	64 (-0.7)
South Africa	2453	3 (2.3)	43 (0.4)

Country	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10
Under 15 females *(continued)*			
Worst 10 performance countries during 2010-19			
South Africa	271	10 (2.4)	63 (-2.6)
Malaysia	61	71 (-4.4)	31 (-0.2)
Viet Nam	144	70 (-3.4)	67 (-3.2)
Dominican Republic	227	69 (-2.9)	65 (-2.8)
Guinea	954	68 (-2.3)	36 (-0.6)
Nigeria	1351	67 (-2.1)	57 (-2)
Philippines	194	66 (-1.8)	55 (-1.9)
Tunisia	125	65 (-1.7)	59 (-2.1)
Cote d'Ivoire	659	64 (-1.7)	38 (-0.7)
Kenya	347	63 (-1.5)	23 (0.5)
Benin	889	62 (-1.5)	53 (-1.8)
15-49 females			
Top 10 performance countries during 2010-19			
Haiti	246	1 (11.4)	71
South Africa	396	2 (6.9)	19
Mozambique	311	3 (4.7)	65
Tanzania	239	4 (3.1)	29
Ukraine	85	5 (2.9)	13
Zambia	310	6 (2.7)	7
Zimbabwe	478	7 (2.6)	70
Malawi	313	8 (2.3)	36
Iran	86	9 (2.3)	51
Sierra Leone	318	10 (2.2)	2
Worst 10 performance countries during 2010-19			
Kenya	443	71 (-3.3)	53 (-1.7)
Viet Nam	112	70 (-2.3)	60 (-2.1)
Mexico	121	69 (-2.1)	57 (-1.9)
Cambodia	195	68 (-1.9)	3 (1.9)
Nigeria	723	67 (-1.8)	63 (-2.7)
Cote d'Ivoire	525	66 (-1.7)	68 (-3.6)
Mali	407	65 (-1.7)	32 (-0.3)
Benin	415	64 (-1.5)	66 (-3.2)
Bolivia	185	63 (-1.5)	31 (-0.1)
Dominican Republic	136	62 (-1.5)	18 (0.7)
50-69 females			
Top 10 performance countries during 2010-19			
Haiti	1473	1 (5.8)	71 (-6.6)
Mozambique	1803	2 (2.2)	70 (-2.5)
Jordan	608	3 (2.1)	18 (0.7)

Country	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10
50-69 males *(continued)*			
Top 10 performance countries during 2010-19 (continued)			
Tanzania	1972	4 (1.8)	66 (-0.9)
Jordan	1076	5 (1.6)	19 (0.9)
Zambia	2218	6 (1.3)	10 (1.5)
Mozambique	2626	7 (1.3)	70 (-1.7)
Bangladesh	1396	8 (1.1)	68 (-1.3)
Algeria	861	9 (1.1)	1 (3.1)
Peru	1013	10 (0.8)	23 (0.8)
Worst 10 performance countries during 2010-19			
Viet Nam	1440	71 (-2.2)	18 (0.9)
Thailand	1343	70 (-1.7)	30 (0.6)
Mexico	1423	69 (-1.5)	44 (0.4)
Bulgaria	2047	68 (-1.4)	32 (0.6)
Malaysia	1496	67 (-1.3)	47 (0.1)
Rwanda	2205	66 (-1.2)	7 (1.8)
Kenya	2733	65 (-1.2)	65 (-0.8)
Tunisia	1239	64 (-1.2)	28 (0.6)
Philippines	1536	63 (-1.2)	31 (0.6)
Uzbekistan	1956	62 (-1)	13 (1.4)
70-84 males			
Top 10 performance countries during 2010-19			
Haiti	9175	1 (1.7)	71 (-2.8)
Sri Lanka	6941	2 (1.6)	42 (-0.3)
India	6301	3 (1.4)	53 (-0.5)
Russian Federation	7560	4 (1.4)	17 (0.3)
Iraq	7497	5 (1.2)	52 (-0.4)
Iran	6150	6 (1.2)	1 (1.1)
Türkiye	5929	7 (1.1)	18 (0.3)
Algeria	5195	8 (1)	3 (0.9)
Peru	5419	9 (1)	8 (0.6)
Sudan	6889	10 (0.9)	34 (-0.2)
Worst 10 performance countries during 2010-19			
Uzbekistan	9451	71 (-0.7)	68 (-1.5)
Mexico	5519	70 (-0.6)	66 (-1.3)
Tunisia	6478	69 (-0.5)	45 (-0.3)
Nigeria	9364	68 (-0.5)	27 (0)
Senegal	8854	67 (-0.5)	44 (-0.3)
Burkina Faso	9944	66 (-0.5)	20 (0.3)
Benin	8038	65 (-0.4)	43 (-0.3)
Niger	8924	64 (-0.4)	15 (0.4)

Country	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10
50-69 females *(continued)*			
Top 10 performance countries during 2010-19 (continued)			
Zambia	1581	4 (2)	8 (1.2)
Malawi	1677	5 (1.9)	58 (-1.1)
Algeria	590	6 (1.9)	1 (2)
Bangladesh	814	7 (1.9)	26 (0.3)
Tanzania	1463	8 (1.8)	55 (-1)
Ukraine	861	9 (1.8)	50 (-0.5)
South Africa	1554	10 (1.7)	32 (0.1)
Worst 10 performance countries during 2010-19			
Viet Nam	635	71 (-2.1)	27 (0.3)
India	1291	70 (-1.8)	25 (0.3)
Bulgaria	886	69 (-1.5)	31 (0.2)
Guatemala	1069	68 (-1.4)	59 (-1.1)
Cambodia	1051	67 (-1.3)	6 (1.4)
Cote d'Ivoire	2297	66 (-1.3)	65 (-1.5)
Malaysia	841	65 (-1.1)	21 (0.5)
Uzbekistan	1172	64 (-1)	19 (0.7)
Nigeria	2289	63 (-0.9)	67 (-1.9)
Kenya	1942	62 (-0.9)	52 (-0.7)
70-84 females			
Top 10 performance countries during 2010-19			
Haiti	7390	1 (2.6)	71 (-3.7)
Iran	3905	2 (1.7)	13 (0.5)
Ukraine	4680	3 (1.7)	48 (-0.5)
Morocco	5054	4 (1.6)	50 (-0.6)
Sri Lanka	3792	5 (1.5)	4 (0.9)
Türkiye	3684	6 (1.4)	34 (-0.2)
Peru	3764	7 (1.4)	27 (-0.1)
Colombia	3135	8 (1.3)	8 (0.7)
Russian Federation	4792	9 (1.1)	22 (0)
Bulgaria	4419	10 (1.1)	2 (1)
Worst 10 performance countries during 2010-19			
Nigeria	9121	71 (-0.8)	59 (-0.9)
Uzbekistan	7356	70 (-0.8)	69 (-1.6)
Azerbaijan	6212	69 (-0.7)	47 (-0.5)
Benin	7355	68 (-0.6)	64 (-1)
Mexico	4114	67 (-0.6)	70 (-1.8)
Cameroon	7592	66 (-0.6)	55 (-0.8)
Mali	8882	65 (-0.5)	19 (0.1)
Pakistan	6660	64 (-0.5)	26 (-0.1)

Country	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10
70-84 males *(continued)*			
Worst 10 performance countries during 2010-19 (continued)			
Pakistan	8329	63 (-0.4)	60 (-0.7)
Afghanistan	8730	62 (-0.3)	21 (0.3)

Country	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10
70-84 females *(continued)*			
Worst 10 performance countries during 2010-19 (continued)			
Uganda	9373	63 (-0.5)	67 (-1.2)
Guinea	7580	62 (-0.5)	37 (-0.3)

* Performance is defined as the difference between the actual rate of decline in mortality and the rate predicted by the multilevel regression model.
Countries in italics are those that encountered major crises such as hurricanes, earthquakes, flooding, tsunami, or war during 2000, 2005, 2010, 2015, or 2019, thereby showing a pseudo good or poor in performance during 2010-2019 relative to during 2000-2010.

RATES OF PROGRESS IN CAUSE-SPECIFIC MORTALITY

Country-level monitoring of mortality rates is important for monitoring trends over time. To reduce mortality rates, monitoring of death rates should be accompanied by deaths due to each disease cause. Globally, the proportion of deaths due to communicable, maternal, perinatal, and nutritional conditions (CMPs) are declining, while that from NCDs are increasing (WHO 2020). This is particularly so in LMICs, where CMPs, as a proportion of total deaths have declined from 39 percent in 2000 to 21 percent in 2019. Meanwhile, the contribution from NCDs have increased from 55 percent to 70 percent (WHO 2020). Here, we examine and quantify the rates of progress in cause-specific mortality for selected major causes of death, by country income levels and age, from 2000 to 2019. We measure rates of progress as average annual rates of reduction (AARR) calculated using the standard WHO methodology (UNICEF 2007).

We present in Table 5.3 the country income levels and age groups with the fastest and slowest progress, in terms of AARR, for males and females. Between 2000 and 2019, among CMPs, childhood-cluster diseases (based on the definition the 2019 WHO Global Health Estimates (WHO 2020): whooping cough, diphtheria, measles, and tetanus) among children aged 0-14 years in upper-middle-income countries showed the fastest rate of decline in mortality, with an AARR of about 9 percent. The slowest rates of decline among CMPs in LMICs was observed for malaria in lower-middle-income countries (AARR=0.4 percent for males and 1.1 percent for females). Compared to CMPs, progress in NCDs are much slower: the fastest rate of decline among NCDs was observed for respiratory diseases for ages 50-69 in upper-middle-income countries, with an AARR of about 5 percent (almost half the fastest rate for CMPs). The slowest progress was in tobacco-attributable cancers and breast cancer among those aged 70 years and older in low-income countries. Within injuries, drowning at ages under 15 in upper-middle-income countries showed the fastest rate of decline, while falls at ages 70 and over in upper-middle-income countries showed an average annual increase of about 2.3 percent.

We further estimated the number of deaths due to the selected major causes of death that would have been averted in 2019, had the rate of decline for each of the selected causes of death been equal to that of HIV/AIDS for ages under 49 years and tuberculosis for ages 50 years and over. These two causes of deaths were selected based on the fact that immense attention and efforts were invested towards these diseases during the 2000s which resulted in the remarkable drop in incidence and mortality from these causes (WHO 2015a, 2015c, 2015b). If similar levels of effort were spent on all causes and thus, expecting similar rates of progress, about 13.5 million deaths would have been averted globally. Out of this, about 4.6 million (or 34 percent) would been premature mortality under 70 years. The deaths avertable by causes and age groups in Annex Table 5A.4.

TABLE 5.3 Diseases and conditions showing country income level and age group with the fastest and slowest progress in mortality reduction, 2000-19

		Male						Female					
		Fastest			*Slowest*			*Fastest*			*Slowest*		
Disease/condition category	**Diseases/conditions**	**Region**	**Age group**	**AARR %**	**Region**	**Age group**	**AARR %**	**Region**	**Age group**	**AARR %**	**Region**	**Age group**	**AARR %**
All Causes		UMICs	0-14	4.6	UMICs	70+	0.7	UMI	0-14	4.6	HICs	70+	0.9
Communicable, maternal, perinatal and nutritional conditions	Tuberculosis	UMICs	70+	6.3	LICs	70+	4.1	HICs	50-69	6.3	HICs	70+	3.3
	HIV/AIDS	HICs	15-49	8.1	UMICs	15-49	1.9	LICs	15-49	8.0	UMICs	15-49	2.4
	Diarrhoeal diseases	UMICs	0-14	6.9	HICs	0-14	4.1	UMICs	0-14	7.2	HICs	0-14	4.1
	Childhood-cluster diseases	UMICs	0-14	9.1	LICs	0-14	5.2	UMICs	0-14	9.2	HICs	0-14	5.3
	Malaria	LICs	0-14	6.3	LMICs	15-49	0.4	LICs	0-14	6.4	LMICs	15-49	1.1
	Respiratory infections	UMICs	0-14	6.5	HICs	0-14	4.5	UMICs	0-14	6.5	HICs	40-14	4.5
	Maternal conditions							LMI	15-49	5.8	HICs	15-49	0.6
	Neonatal conditions	UMICs	0-28 days	4.8	HICs	0-28 days	2.2	UMICs	0-28 days	4.8	HICs	0-28 days	2.1
Non-communicable diseases	All cancers	HICs	50-69	1.8	LICs	70+	-0.2	UMICs	50-69	1.2	LICs	70+	-0.2
	Tobacco-attributable cancers[a]	HICs	50-69	2.1	LICs	70+	-0.4	UMICs	50-69	1.3	LICs	70+	-0.7
	Infection attributable cancers[b]	UMICs	50-69	4.1	HICs	70+	0.3	UMICs	50-69	2.2	HICs	70+	0.4
	Stomach cancer	HICs	50-69	3.9	LICs	70+	0.5	UMICs	50-69	3.4	LICs	70+	0.8
	Breast cancer							HICs	50-69	1.5	LICs	70+	-1.2
	Cardiovascular diseases (not stroke)	HICs	70+	2.3	UMICs	70+	-0.2	UMICs	50-69	2.5	LICs	70+	0.2
	Stroke	HICs	50-69	3.4	LICs	70+	0.9	HICs	50-69	3.9	LICs	70+	0.7
	Respiratory diseases	UMICs	50-69	4.8	HICs	50-69	0.7	UMICs	50-69	5.3	HICs	50-69	-0.3
Injuries	Road injury	HICs	15-49	3.5	LICs	70+	-1.2	HICs	70+	3.7	LICs	70+	-1.0
	Falls	LICs	50-69	1.1	UMICs	70+	-2.3	LICs	50-69	1.3	UMICs	70+	-2.3
	Drowning	UMICs	0-14	6.2	LICs	0-14	2.7	UMICs	0-14	7.6	LICs	0-14	2.8
	Suicide	UMICs	50-69	3.7	HICs	15-49	0.5	UMICs	15-49	6.2	HICs	15-49	-0.3

AARR = Average annual rate of reduction; LICs = low-income countries; LMICs = lower-middle-income countries; UMICs = upper-middle-income countries; HICs = high-income countries; [a]Mouth and oropharynx, Oesophagus, Trachea, bronchus, lung, and Larynx cancers; [b]Liver, Cervix uteri, and Corpus uteri cancers.

COST OF SAVING A LIFE OVER TIME

In 1975, Samuel Preston, in a classic paper, showed that life expectancy is related to national income (Preston 1975). He found that life expectancy increases with national income per capita in poorer countries, but plateaus at higher income levels. He also noted an upward and lateral shift in the curve over time, indicating that for the same level of income, life expectancy increases over time (Figure 5.2). This relationship was mathematically studied by Hum and colleagues in 2012 using the Michaelis-Menten enzyme kinetics (Hum and others 2012). Treating income as the substrate that is catalyzed to increase survival, Hum and colleagues investigated the change in the level of income that is needed to achieve half of the period-specific maximum survival ("critical income"). The study found that between 1970 and 2007, the critical income fell by 50 percent for children but doubled for men aged 15-59 years. Here, we extend the 2012 analysis by Hum and colleagues to assess the trend in the critical income for ages under 15, 15-49, and 50-69 from 1990 to 2019. We redefine critical income here as the income needed to achieve 80 percent of the global maximum life expectancy. We used five-year average to calculate the average critical income at a mid-point year (starting from 1992.5 for 1990-95 and 2017 for 2015-19). The analysis includes 71 LMICs with over 7 million population in 2019 (United Nations, Department of Economic and Social Affairs, Population Division 2022). Details of the model can be found in Annex 5.3.

Table 5.4 shows the coefficients in three-age specific mixed effects models. Expectedly, the maximum survival rates for children approximates a complete survival from birth to age 15 and was unchanged between 1992 and 2017. While for ages 15-49 and 50-69, the maximum survival rates increased by 0.6 percent and 4.4 percent, respectively. This change represents the technological advances for this age-group among HICs. In terms of critical income, the pattern of progress is reversed. The critical income for child survival fell from US$1,452 to US$800 (2017 PPP), representing a decline of 46 percent. For adults aged 15-49, this remained relatively constant over the last thirty years. Regrettably, that for ages 50-69 increased by about 26 percent from US$914 to US$1,180. This signifies that the technological gains in HICs to reduce mortality at middle and older ages lacks research on improving efficiency and cost-effectiveness.

Table 5.5 ranks the top five LMICs with the lowest critical income in the three age groups. Rwanda, Madagascar, Mozambique, Niger, and the Democratic Republic of Congo are among the top five countries with the lowest critical income across all three age-groups.

FIGURE 5.2 **Preston curve showing the relationship between life expectancy at birth and income (Preston 1975)**

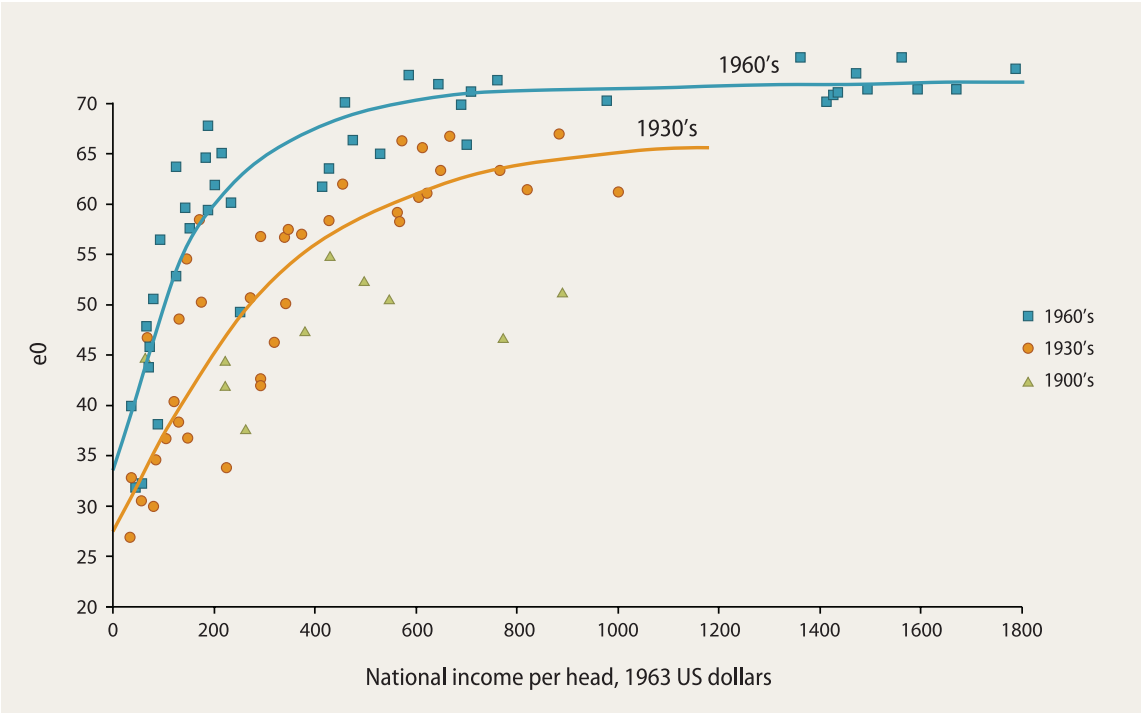


TABLE 5.4 Global maximum survival rates and critical income levels, 1990 to 2019

	Under 15 years		15-49 years		50-69 years	
Median years	1990-95	2015-19	1990-95	2015-19	1990-95	2015-19
Maximum survival rates (per 1000)	1,000.96 (2.89)	1,000.81 (0.83)	985.40 (1.68)	990.98 (1.16)	868.68 (6.78)	907.34 (5.96)
Critical income (2017 PPP)	1,452.56	800.16	400.40	412.52	914.36	1,179.56
AIC	778.16	629.19	650.38	621.15	810.04	845.44

Standard errors are given in parenthesis.

TABLE 5.5 Top five LMICs with the lowest critical income for ages under 15 years, 15-49 years, and 50-69 years

	Countries with the lowest critical income		
Rank	Under 15 years	15-49 years	50-69 years
1	Malawi	Niger	Niger
2	Rwanda	Congo, Dem. Rep.	Congo, Dem. Rep.
3	Madagascar	Madagascar	Madagascar
4	Mozambique	Bangladesh	Ethiopia
5	Uganda	Rwanda	Cambodia

REFERENCES

1. Cha, S. 2017. "The impact of the worldwide Millennium Development Goals campaign on maternal and under-five child mortality reduction: 'Where did the worldwide campaign work most effectively?'" *Global Health Action* 10 (1): 1267961.
2. Hum, R. J., P. Jha, A. M. McGahan, and Y. –L. Cheng. 2012. "Global divergence in critical income for adult and childhood survival: Analyses of mortality using Michaelis–Menten." *ELife* 1: e00051.
3. Lozano, R., H. Wang, K. J. Foreman, J. K. Rajaratnam, M. Naghavi, and others. 2011. "Progress towards Millennium Development Goals 4 and 5 on maternal and child mortality: An updated systematic analysis." *The Lancet* 378 (9797), 1139–165.
4. NCD Countdown 2030 collaborators. 2018. "NCD Countdown 2030: Worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4." *The Lancet* 392 (10152): 1072–88.
5. Norheim, O. F., P. Jha, K. Admasu, T. Godal, R. J. Hum, and others. 2015. "Avoiding 40% of the premature deaths in each country, 2010–30: Review of national mortality trends to help quantify the UN Sustainable Development Goal for health." *The Lancet* 385 (9964), 239–252.
6. Preston, S. H. 1975. "The changing relation between mortality and level of economic development." *Population Studies* 29 (2), 231–48.
7. Tanner, J., A. M. Aguilar Rivera, T. L. Candland, V. Galdo, F. E. Manang, and others. 2016. "Delivering the millennium development goals to reduce maternal and child mortality: A systematic review of impact evaluation evidence (English)." Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/920581467995896846/Delivering-the-millennium-development-goals-to-reduce-maternal-and-child-mortality-a-systematic-review-of-impact-evaluation-evidence.
8. UNICEF. 2007. "Technical Note: How to calculate average annual rate of reduction (AARR) of underweight prevalence." https://data.unicef.org/resources/technical-note-calculate-average-annual-rate-reduction-aarr-underweight-prevalence/.
9. United Nations General Assembly. "Transforming our world : the 2030 Agenda for Sustainable Development". 21 October 2015, A/RES/70/1. https://www.refworld.org/docid/57b6e3e44.html.
10. United Nations, Department of Economic and Social Affairs, Population Division. 2022. *World Population Prospects 2022*. New York: UN Department of Economic and Social Affairs, Population Division.
11. United Nations, Department of Economic and Social Affairs, Sustainable Development. 2023. *Goal 3 Ensure healthy lives and promote well being for all at all ages.* https://sdgs.un.org/goals/goal3.
12. Verguet, S., and D. T. Jamison. 2014. "Estimates of performance in the rate of decline of under-five mortality for 113 low- and middle-income countries, 1970-2010." *Health Policy and Planning* 29(2), 151–63.
13. Wang, H., A. A. Abajobir, K. H. Abate, C. Abbafati, K. M. Abbas, and others. 2017. "Global, regional, and national under-5 mortality, adult mortality, age-specific mortality, and life expectancy, 1970–2016: A systematic analysis for the Global Burden of

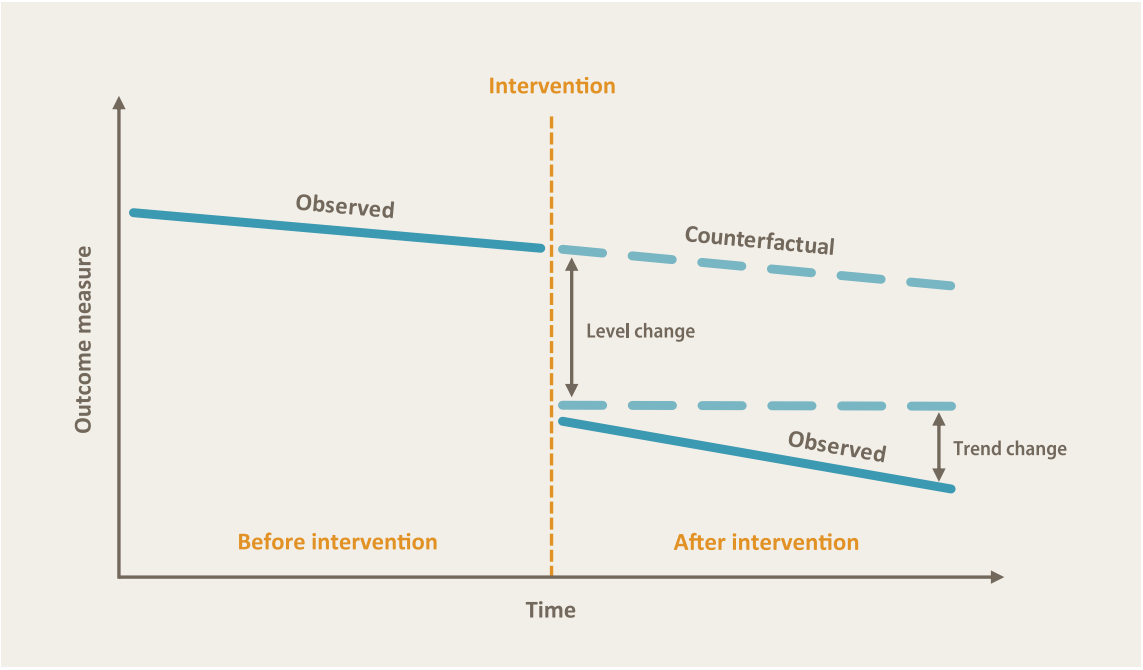
Disease Study 2016." *The Lancet* 390 (10100), 1084–150.
14. World Bank. 2021. World Bank Country and Lending Groups. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.
15. World Health Organization (WHO). 2015a. Accelerating progress on HIV, tuberculosis, malaria, hepatitis and neglected tropical diseases: A new agenda for 2016-2030. World Health Organization. https://apps.who.int/iris/handle/10665/204419.
16. World Health Organization (WHO). 2015b. Global health sector response to HIV, 2000– 2015: Focus on innovations in Africa: progress report. World Health Organization. https://apps.who.int/iris/handle/10665/198065.
17. World Health Organization (WHO). 2015c. Global tuberculosis report 2015, 20th ed. World Health Organization. https://apps.who.int/iris/handle/10665/191102.
18. World Health Organization (WHO). 2020. Global Health Estimates 2020: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2019. https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death.

ANNEX 5.1

Interrupted time-series (ITS) analysis methodology

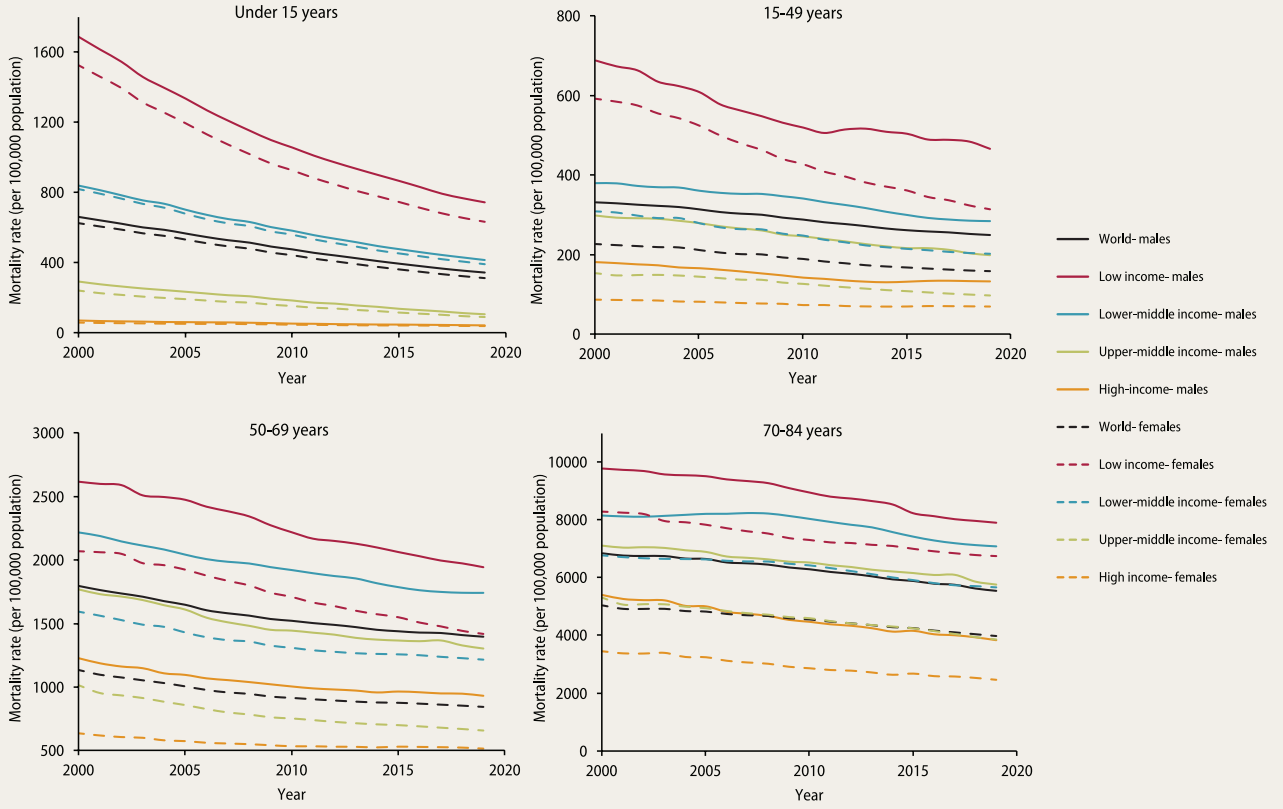
An ITS analysis provides a robust quasi-experimental design that can be used to evaluate changes in an outcome of interest after a particular time-point (Bernal and others 2017; Kontopantelis and others 2015). In an ITS analysis, a continuous series of observations on an outcome of interest for a population over time is used to establish a trend using a regression model; this trend is then interrupted (usually by an intervention) at a known time-point (Bernal and others 2017; Kontopantelis and others 2015). The difference in the trend before and after the time-point quantifies the effect of the intervention. Figure 5A.1 provides a schematic representation of an ITS analysis.

FIGURE 5A.1 **Schematic representation of an interrupted time series analysis**



For our current analysis, in the absence of intervention, we define the interruption point as 2010 to examine if there are notable difference in the rate of mortality decline in the second decade of 2000 compared to the first, using the logic that trends which had been established from 2000-2009 should accelerate after 2010 if more attention was given to health and action on health during the second.

FIGURE 5A.2 Mortality rate, global and by country income level, by age and sex, between 2000 and 2019



ANNEX 5.2

Methods used to estimate country performance during 2000 to 2019

We examine country performance in the rate of decline in mortality for ages under 15, 15-49, 50-69, and 70-84 years between 2000 and 2019. We used the framework of Verguet and Jamison (2014) to estimate performance in the rate of decline in under-five mortality in LMICs (Verguet & Jamison, 2014). We define performance as the difference in the rate of decline in actual mortality compared to that predicted a model using a set of contextual factors. We include 71 LMICs (based on the World Bank 2020 country classification (World Bank 2021)) that have a population of over 7 million, which covers about 83 percent of the world population in 2019. For population and actual mortality, we used data from the World Population Prospects (WPP) 2022 (United Nations, Department of

Economic and Social Affairs, Population Division 2022). For predicted mortality, we used a hierarchical linear model comprised of the contextual variables: time (year), income (gross domestic product per capita (GDPPC)), female education level (mean years of schooling by age 25), geography (percent population living within 100km off the coast), urbanization, electricity access, malaria incidence, and HIV prevalence. We allow for between-country variability by using a random-intercept term at the country level, and between-country variability in their uptake of knowledge and technologies (or "technical progress") using a country-specific slope on time (Jamison and others 2016). To examine the potential impact of public health provision on technical progress, we include in the model the percentage of births attended by skilled birth attendant and coverage of three doses of diphtheria, tetanus, and pertussis (DTP3) immunization among one-year-olds in 2000 as indicators of early adopters of mortality reduction technologies. Thus, the model can be mathematically written as:

$$\ln m_{it} = \gamma_{00} + \gamma_{10}\text{Time} + \beta_2 \ln(\text{GDPPC}) + \beta_3\text{FeEd} + \beta_4\text{Coast} + \beta_5\text{Urban} + \beta_6\text{Electricity} + \beta_7\text{Malaria} + \beta_8\text{HIV} + \beta_9\text{Skillbirth-2000} + \beta_{10}\text{DTP3-2000} + \mu_{0i} + \mu_{1i}\text{Time} + \varepsilon_{it}$$

where, γ are the country-invariant intercept and slope (time) components, μ are the country-specific terms, and ε_{it} is a random i.i.d. normally distributed disturbance (for details, see Jamison, Murphy, and Sandbu 2016 on the use of hierarchical model to account for technical progress to predict mortality).

Using the performances estimated over five years, we calculate 10-year performance as the average of two consecutive 5-year performance. Finally, we calculate the change in performance in the rate of decline in mortality in the second decade of 2000 relative to the first decade as the difference between the two consecutive 10-year performance.

Annex table 5A.1 shows the coefficients in the hierarchical model used to predict the mortality rates for ages under 15, 15-49, 50-69, and 70-84 years, disaggregated by sex.

Table 5A.1 **Results of the hierarchical model predicting levels of mortality, by age and sex**

Coefficient	Under 15 years				15-49 years				50-69 years				70-84 years			
	Males		Females		Males		Females		Males		Females		Males		Females	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Constant intercept (γ_{00})	9.510	0.361	9.588	0.387	7.608	0.357	7.636	0.337	8.847	0.206	8.840	0.207	9.200	0.143	9.336	0.158
Time (number of years since 1990, γ_{10})	-0.038	0.003	-0.037	0.003	-0.019	0.003	-0.019	0.002	-0.012	0.001	-0.014	0.001	-0.006	0.001	-0.008	0.001
ln(GDPPC)	-0.121	0.049	-0.132	**0.052**	**-0.117**	**0.048**	**-0.104**	**0.047**	**-0.117**	**0.027**	**-0.125**	**0.029**	0.024	0.019	0.013	0.021
FeEd	0.005	0.013	0.000	0.014	0.010	0.013	0.004	0.013	**0.021**	**0.008**	0.008	0.008	0.005	0.005	-0.002	0.006
Coast	**-0.004**	**0.001**	**-0.003**	**0.001**	**-0.004**	**0.001**	-0.002	0.001	**-0.003**	0.001	-0.002	0.001	-0.002	0.001	-0.001	0.001
Urban	0.000	0.003	0.001	0.003	0.002	0.003	0.001	0.002	0.001	0.002	0.000	0.002	-0.002	0.001	**-0.003**	**0.001**
Electricity	-0.001	0.001	-0.002	0.001	0.000	0.001	**-0.004**	**0.001**	**0.001**	**0.001**	0.000	0.001	0.000	0.000	0.000	0.000
Malaria	**0.000**	**0.000**	**0.000**	**0.000**	0.000	0.000	**0.000**	**0.000**	**0.000**	**0.000**	0.000	0.000	**0.000**	**0.000**	0.000	0.000
HIV	0.057	**0.012**	**0.056**	**0.012**	**0.059**	**0.012**	**0.088**	**0.010**	**0.030**	**0.007**	**0.048**	**0.006**	0.003	0.005	0.007	0.005
Skillbirth-2000	-0.011	0.003	-0.012	0.003	-0.001	0.003	-0.003	0.002	-0.001	0.002	-0.003	0.001	0.000	0.001	-0.001	0.001
DTP3-2000	**-0.013**	**0.003**	**-0.014**	**0.003**	-0.006	0.003	**-0.009**	**0.002**	-0.002	0.002	**-0.003**	**0.002**	-0.002	0.001	**-0.004**	**0.001**
Variance of country-specific intercept (μ_{0i})	0.111	0.023	0.128	0.027	0.121	0.024	0.052	0.014	0.045	0.009	0.028	0.006	0.022	0.004	0.026	0.005
Variance of country-specific slope (μ_{1i})	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AIC	-248.81		-191.82		-247.21		-196.43		-643.37		-588.00		-917.17		-853.47	

Values in bold indicate significance at 95% confidence interval.
Dependent variable is logged mortality rate.

TABLE 5A.2 Performance rankings of 71 LMICs in the rate of decline of mortality, by age and sex: 2000-10 and 2010-19

Country (ordered based on ranking during 2010-19)	Under 15 years					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Russian Federation	46	1 (5.6)	33 (-0.4)	37	2 (5.2)	52 (-1.8)
Haiti	610	2 (5.6)	71 (-8.8)	474	1 (7.6)	71 (-10.2)
Azerbaijan	157	3 (5.1)	63 (-2.3)	121	3 (5.2)	64 (-2.6)
Belarus	27	4 (4.6)	16 (0.7)	20	5 (4.5)	34 (-0.4)
Kazakhstan	105	5 (4.6)	42 (-0.9)	74	4 (4.7)	51 (-1.8)
China	71	6 (3.8)	25 (0.4)	61	6 (3.8)	24 (0.5)
Ukraine	55	7 (3.8)	64 (-2.4)	43	7 (3.8)	69 (-3.9)
Bulgaria	55	8 (3.5)	67 (-3)	52	17 (1.4)	62 (-2.6)
Malawi	392	9 (3.2)	8 (2.1)	337	9 (2.6)	7 (2.5)
Burundi	685	10 (2.8)	50 (-1.6)	576	8 (3.4)	48 (-1.5)
South Africa	319	11 (2)	65 (-2.7)	271	10 (2.4)	63 (-2.6)
Uzbekistan	154	12 (2)	27 (0.2)	114	14 (1.8)	25 (0.5)
Türkiye	77	13 (1.9)	2 (3.7)	66	11 (2.1)	2 (3.8)
India	255	14 (1.5)	20 (0.6)	266	13 (1.8)	22 (0.6)
Rwanda	398	15 (1.5)	1 (4.9)	345	18 (1)	1 (5.2)
Uganda	443	16 (1.4)	7 (2.2)	386	26 (0.5)	8 (2.3)
Morocco	167	17 (1.3)	29 (0.1)	134	15 (1.5)	29 (0.1)
Iran	122	18 (1.3)	62 (-2.2)	108	16 (1.5)	61 (-2.6)
Sri Lanka	61	19 (1.3)	41 (-0.9)	51	19 (1)	41 (-0.9)
Senegal	416	20 (1.2)	11 (1.4)	329	12 (2)	9 (1.9)
Thailand	78	21 (1.1)	34 (-0.4)	61	22 (0.9)	35 (-0.5)
Iraq	246	22 (1)	53 (-1.7)	197	30 (0.4)	46 (-1.4)
Egypt	167	23 (1)	37 (-0.6)	143	20 (0.9)	32 (-0.3)
Argentina	87	24 (0.8)	38 (-0.7)	74	23 (0.7)	40 (-0.8)
Ecuador	123	25 (0.8)	46 (-1.5)	97	24 (0.6)	50 (-1.7)
Jordan	131	26 (0.7)	58 (-2)	106	25 (0.6)	54 (-1.8)
Zimbabwe	516	27 (0.6)	70 (-4.4)	444	32 (0.3)	70 (-4.5)
Sierra Leone	1023	28 (0.5)	26 (0.3)	928	21 (0.9)	26 (0.4)
Mozambique	744	29 (0.3)	30 (0.1)	642	28 (0.4)	27 (0.3)
Indonesia	206	30 (0.3)	36 (-0.5)	173	27 (0.5)	33 (-0.4)
Tanzania	492	31 (0.3)	24 (0.5)	439	43 (-0.1)	18 (0.9)
Bangladesh	247	32 (0.3)	10 (1.6)	217	35 (0.1)	10 (1.6)
Niger	854	33 (0.2)	4 (3)	794	29 (0.4)	5 (3.2)
Cameroon	783	34 (0.2)	59 (-2.1)	656	31 (0.3)	56 (-2)
Guatemala	212	35 (0.1)	21 (0.6)	173	40 (-0.1)	20 (0.8)
Mexico	117	36 (0.1)	15 (0.8)	95	33 (0.1)	19 (0.8)
Peru	128	37 (0.1)	14 (0.8)	103	36 (0.1)	17 (0.9)
Brazil	128	38 (-0.1)	3 (3.2)	100	44 (-0.3)	4 (3.3)
Cambodia	287	39 (-0.1)	5 (2.7)	210	39 (0)	3 (3.6)

Country (ordered based on ranking during 2010-19)	Under 15 years *(continued)*					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Nepal	269	40 (-0.2)	6 (2.5)	220	38 (0)	6 (3.1)
Afghanistan	594	41 (-0.3)	32 (-0.3)	526	47 (-0.4)	39 (-0.7)
Mali	1006	42 (-0.3)	44 (-1.1)	924	45 (-0.3)	42 (-1)
Sudan	662	43 (-0.4)	47 (-1.5)	525	42 (-0.1)	47 (-1.4)
Pakistan	599	44 (-0.4)	52 (-1.6)	504	41 (-0.1)	43 (-1)
Laos	421	45 (-0.5)	35 (-0.4)	331	49 (-0.5)	30 (-0.1)
Tajikistan	306	46 (-0.5)	17 (0.7)	235	48 (-0.5)	16 (0.9)
Algeria	211	47 (-0.5)	69 (-3.5)	189	50 (-0.5)	68 (-3.8)
Serbia	49	48 (-0.5)	9 (2)	39	57 (-1.1)	11 (1.4)
Madagascar	582	49 (-0.5)	18 (0.7)	466	34 (0.1)	12 (1.4)
Chad	1440	50 (-0.5)	66 (-2.8)	1300	46 (-0.3)	66 (-2.8)
Honduras	153	51 (-0.6)	12 (1.4)	125	51 (-0.5)	13 (1.3)
Kenya	384	52 (-0.7)	22 (0.5)	347	63 (-1.5)	23 (0.5)
Ethiopia	603	53 (-0.8)	23 (0.5)	446	37 (0)	14 (1.3)
Burkina Faso	913	54 (-0.9)	39 (-0.8)	821	52 (-0.7)	37 (-0.7)
Colombia	124	55 (-1)	28 (0.2)	98	56 (-1.1)	28 (0.1)
Bolivia	341	56 (-1.1)	19 (0.7)	294	53 (-0.7)	21 (0.7)
Zambia	647	57 (-1.1)	13 (0.9)	539	59 (-1.1)	15 (1)
Congo, Dem. Rep.	1023	58 (-1.2)	45 (-1.2)	869	55 (-1)	45 (-1.3)
Papua New Guinea	420	59 (-1.2)	49 (-1.5)	365	58 (-1.1)	49 (-1.5)
Togo	711	60 (-1.3)	56 (-1.7)	672	61 (-1.3)	60 (-2.4)
Ghana	555	61 (-1.4)	60 (-2.1)	449	54 (-0.9)	58 (-2)
Tunisia	152	62 (-1.6)	57 (-2)	125	65 (-1.7)	59 (-2.1)
Myanmar	438	63 (-1.6)	48 (-1.5)	325	60 (-1.2)	44 (-1.3)
Benin	1005	64 (-1.7)	55 (-1.7)	889	62 (-1.5)	53 (-1.8)
Cote d'Ivoire	822	65 (-1.8)	40 (-0.9)	659	64 (-1.7)	38 (-0.7)
Nigeria	1377	66 (-1.8)	54 (-1.7)	1351	67 (-2.1)	57 (-2)
Philippines	247	67 (-2)	51 (-1.6)	194	66 (-1.8)	55 (-1.9)
Guinea	1054	68 (-2.2)	43 (-1)	954	68 (-2.3)	36 (-0.6)
Dominican Republic	272	69 (-2.7)	61 (-2.1)	227	69 (-2.9)	65 (-2.8)
Viet Nam	245	70 (-3.1)	68 (-3.1)	144	70 (-3.4)	67 (-3.2)
Malaysia	72	71 (-3.6)	31 (-0.3)	61	71 (-4.4)	31 (-0.2)

Country (ordered based on ranking during 2010-19)	15-49 years					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Haiti	423	1 (7)	71 (-9.9)	246	1 (11.4)	71 (-13.3)
Iraq	193	2 (4.6)	70 (-3.2)	132	12 (2.1)	62 (-2.6)
South Africa	575	3 (4.5)	13 (1.2)	396	2 (6.9)	19 (0.6)

Country (ordered based on ranking during 2010-19)	15-49 years *(continued)*					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Tanzania	320	4 (3.6)	45 (-0.9)	239	4 (3.1)	29 (0)
Mozambique	522	5 (2.2)	62 (-2)	311	3 (4.7)	65 (-2.8)
Zimbabwe	632	6 (2.2)	65 (-2.2)	478	7 (2.6)	70 (-4.6)
Serbia	121	7 (2.1)	4 (1.6)	66	11 (2.1)	5 (1.8)
Belarus	301	8 (2.1)	27 (0.1)	84	14 (1.9)	24 (0.2)
Russian Federation	384	9 (2)	9 (1.4)	104	13 (2)	6 (1.6)
Sierra Leone	367	10 (1.7)	1 (2.8)	318	10 (2.2)	2 (2)
Uganda	438	11 (1.7)	8 (1.4)	315	16 (1.6)	21 (0.4)
Tajikistan	186	12 (1.6)	37 (-0.4)	123	28 (0.6)	35 (-0.4)
Sri Lanka	198	13 (1.5)	14 (1.1)	89	41 (-0.2)	38 (-0.6)
Morocco	137	14 (1.5)	5 (1.6)	103	15 (1.6)	15 (0.9)
Laos	255	15 (1.5)	16 (0.8)	183	29 (0.5)	10 (1.2)
Jordan	105	16 (1.4)	33 (-0.3)	76	23 (1)	30 (-0.1)
Ukraine	315	17 (1.3)	11 (1.2)	85	5 (2.9)	13 (1.1)
Guatemala	304	18 (1.3)	34 (-0.3)	138	53 (-0.9)	27 (0)
Brazil	234	19 (1.2)	25 (0.3)	101	21 (1.1)	17 (0.7)
Zambia	488	20 (1.2)	10 (1.3)	310	6 (2.7)	7 (1.5)
Kazakhstan	337	21 (1.1)	18 (0.7)	134	27 (0.7)	42 (-0.9)
Türkiye	107	22 (1.1)	26 (0.2)	52	22 (1)	22 (0.3)
Iran	190	23 (1)	47 (-1.1)	86	9 (2.3)	51 (-1.4)
Egypt	161	24 (0.8)	39 (-0.6)	87	20 (1.1)	16 (0.8)
Algeria	128	25 (0.8)	7 (1.5)	93	18 (1.2)	14 (1)
Rwanda	358	26 (0.7)	2 (2.7)	250	31 (0.2)	1 (3.8)
Ecuador	236	27 (0.5)	58 (-1.7)	105	36 (0)	49 (-1.4)
Thailand	284	28 (0.4)	35 (-0.3)	105	25 (0.9)	33 (-0.4)
India	245	29 (0.4)	56 (-1.5)	163	50 (-0.6)	28 (0)
Malaysia	153	30 (0.4)	24 (0.3)	71	32 (0.2)	11 (1.1)
Nepal	242	31 (0.4)	23 (0.4)	177	40 (-0.2)	26 (0.1)
Azerbaijan	225	32 (0.3)	51 (-1.4)	113	44 (-0.4)	61 (-2.4)
Bangladesh	179	33 (0.3)	67 (-2.5)	135	39 (-0.2)	43 (-0.9)
Burundi	530	34 (0.2)	6 (1.6)	395	19 (1.2)	45 (-1)
Sudan	400	35 (0.2)	21 (0.5)	255	33 (0)	34 (-0.4)
Colombia	255	36 (0.1)	3 (2.3)	101	61 (-1.4)	23 (0.3)
Cameroon	470	37 (-0.1)	44 (-0.8)	394	43 (-0.4)	55 (-1.9)
Ethiopia	428	38 (-0.2)	32 (-0.1)	258	26 (0.9)	9 (1.3)
Argentina	156	39 (-0.2)	28 (0)	80	24 (1)	25 (0.1)
Niger	335	40 (-0.2)	20 (0.5)	314	35 (0)	20 (0.5)
Papua New Guinea	383	41 (-0.4)	50 (-1.4)	237	34 (0)	56 (-1.9)
Madagascar	413	42 (-0.4)	29 (-0.1)	277	30 (0.4)	8 (1.4)
Peru	214	43 (-0.4)	49 (-1.3)	112	38 (-0.1)	44 (-0.9)

Country (ordered based on ranking during 2010-19)	15-49 years *(continued)*					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Pakistan	250	44 (-0.4)	66 (-2.4)	163	49 (-0.6)	4 (1.8)
China	144	45 (-0.4)	53 (-1.4)	80	42 (-0.2)	40 (-0.7)
Senegal	282	46 (-0.5)	17 (0.7)	180	17 (1.4)	12 (1.1)
Malawi	553	47 (-0.5)	19 (0.5)	313	8 (2.3)	36 (-0.5)
Cambodia	323	48 (-0.6)	15 (0.8)	195	68 (-1.9)	3 (1.9)
Myanmar	400	49 (-0.7)	59 (-1.8)	215	37 (-0.1)	54 (-1.8)
Guinea	476	50 (-0.8)	48 (-1.3)	424	59 (-1.4)	37 (-0.6)
Congo, Dem. Rep.	536	51 (-0.9)	38 (-0.5)	405	46 (-0.5)	52 (-1.7)
Uzbekistan	222	52 (-0.9)	31 (-0.1)	130	48 (-0.5)	41 (-0.8)
Nigeria	720	53 (-1)	52 (-1.4)	723	67 (-1.8)	63 (-2.7)
Honduras	188	54 (-1)	30 (-0.1)	124	51 (-0.6)	46 (-1.1)
Dominican Republic	279	55 (-1)	22 (0.4)	136	62 (-1.5)	18 (0.7)
Chad	776	56 (-1)	69 (-3.1)	643	47 (-0.5)	67 (-3.3)
Cote d'Ivoire	542	57 (-1)	55 (-1.5)	525	66 (-1.7)	68 (-3.6)
Togo	456	58 (-1)	46 (-1.1)	470	58 (-1.4)	69 (-3.6)
Philippines	178	59 (-1)	42 (-0.7)	132	54 (-1)	47 (-1.3)
Bolivia	304	60 (-1)	36 (-0.4)	185	63 (-1.5)	31 (-0.1)
Benin	493	61 (-1.2)	54 (-1.4)	415	64 (-1.5)	66 (-3.2)
Indonesia	253	62 (-1.3)	57 (-1.6)	199	52 (-0.7)	58 (-1.9)
Mali	450	63 (-1.4)	43 (-0.7)	407	65 (-1.7)	32 (-0.3)
Ghana	471	64 (-1.7)	64 (-2.1)	342	56 (-1.2)	64 (-2.7)
Tunisia	175	65 (-1.7)	63 (-2)	82	55 (-1)	59 (-2)
Burkina Faso	489	66 (-1.7)	40 (-0.6)	385	60 (-1.4)	48 (-1.3)
Bulgaria	241	67 (-1.9)	41 (-0.7)	109	57 (-1.4)	50 (-1.4)
Viet Nam	314	68 (-2)	61 (-1.9)	112	70 (-2.3)	60 (-2.1)
Kenya	592	69 (-2)	60 (-1.9)	443	71 (-3.3)	53 (-1.7)
Mexico	340	70 (-2.9)	68 (-2.7)	121	69 (-2.1)	57 (-1.9)
Afghanistan	530	71 (-3.5)	12 (1.2)	256	45 (-0.5)	39 (-0.6)

Country (ordered based on ranking during 2010-19)	50-69 years					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Haiti	2271	1 (4)	71 (-4.9)	1473	1 (5.8)	71 (-6.6)
Iraq	1503	2 (2.7)	64 (-0.7)	1043	13 (1.3)	63 (-1.4)
South Africa	2453	3 (2.3)	43 (0.4)	1554	10 (1.7)	32 (0.1)
Tanzania	1972	4 (1.8)	66 (-0.9)	1463	8 (1.8)	55 (-1)
Jordan	1076	5 (1.6)	19 (0.9)	608	3 (2.1)	18 (0.7)
Zambia	2218	6 (1.3)	10 (1.5)	1581	4 (2)	8 (1.2)
Mozambique	2626	7 (1.3)	70 (-1.7)	1803	2 (2.2)	70 (-2.5)

Country (ordered based on ranking during 2010-19)	50-69 years *(continued)*					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Bangladesh	1396	8 (1.1)	68 (-1.3)	814	7 (1.9)	26 (0.3)
Algeria	861	9 (1.1)	1 (3.1)	590	6 (1.9)	1 (2)
Peru	1013	10 (0.8)	23 (0.8)	690	15 (0.9)	46 (-0.4)
Russian Federation	2437	11 (0.8)	8 (1.5)	962	28 (0.2)	20 (0.6)
Azerbaijan	1478	12 (0.8)	2 (2.8)	815	27 (0.2)	5 (1.6)
Türkiye	1222	13 (0.8)	9 (1.5)	550	20 (0.6)	13 (1)
Afghanistan	2120	14 (0.7)	25 (0.7)	1479	23 (0.4)	48 (-0.5)
Iran	1092	15 (0.6)	3 (2.4)	633	12 (1.3)	3 (1.7)
Sierra Leone	2122	16 (0.5)	16 (1.1)	1708	16 (0.8)	34 (0)
Laos	1829	17 (0.4)	15 (1.1)	1251	30 (0)	22 (0.5)
Zimbabwe	3044	18 (0.4)	33 (0.6)	2194	14 (1)	64 (-1.5)
Belarus	2545	19 (0.2)	38 (0.5)	855	29 (0)	40 (-0.1)
Ethiopia	1757	20 (0.2)	49 (0)	1222	19 (0.7)	16 (0.7)
Ukraine	2416	21 (0.2)	20 (0.9)	861	9 (1.8)	50 (-0.5)
Sri Lanka	1590	22 (0.2)	45 (0.3)	687	55 (-0.8)	24 (0.4)
Burundi	2043	23 (0.2)	12 (1.4)	1615	21 (0.6)	38 (-0.1)
Ecuador	957	24 (0.1)	21 (0.8)	669	38 (-0.2)	43 (-0.3)
Tajikistan	1625	25 (0.1)	14 (1.3)	1067	43 (-0.3)	2 (1.7)
Cameroon	2209	26 (0.1)	59 (-0.4)	1862	41 (-0.3)	62 (-1.4)
Papua New Guinea	2338	27 (0.1)	40 (0.4)	1349	17 (0.8)	53 (-0.7)
Morocco	1402	28 (0)	5 (1.9)	830	11 (1.5)	15 (0.8)
India	1685	29 (0)	29 (0.6)	1291	70 (-1.8)	25 (0.3)
Uganda	2535	30 (0)	22 (0.8)	1811	24 (0.4)	35 (0)
Brazil	1338	31 (0)	42 (0.4)	686	22 (0.6)	17 (0.7)
Kazakhstan	2308	32 (-0.1)	11 (1.4)	1099	35 (-0.2)	41 (-0.3)
Serbia	1735	33 (-0.1)	24 (0.7)	836	26 (0.2)	23 (0.4)
Senegal	1748	34 (-0.1)	26 (0.6)	1077	18 (0.7)	12 (1)
Egypt	2031	35 (-0.2)	67 (-0.9)	1247	56 (-0.8)	54 (-0.9)
Guinea	1919	36 (-0.2)	58 (-0.4)	1667	54 (-0.7)	42 (-0.3)
Nepal	1902	37 (-0.2)	39 (0.5)	1331	44 (-0.5)	44 (-0.3)
Congo, Dem. Rep.	2026	38 (-0.2)	48 (0)	1604	42 (-0.3)	60 (-1.3)
Mali	2160	39 (-0.2)	52 (-0.2)	1717	46 (-0.5)	45 (-0.3)
Nigeria	2462	40 (-0.3)	62 (-0.6)	2289	63 (-0.9)	67 (-1.9)
Malawi	2821	41 (-0.3)	57 (-0.4)	1677	5 (1.9)	58 (-1.1)
Chad	2516	42 (-0.3)	69 (-1.5)	2047	33 (-0.1)	66 (-1.9)
Argentina	1403	43 (-0.3)	27 (0.6)	716	25 (0.4)	57 (-1)
Cambodia	1376	44 (-0.4)	4 (2.3)	1051	67 (-1.3)	6 (1.4)
Sudan	1781	45 (-0.4)	41 (0.4)	1251	60 (-0.9)	28 (0.2)
Bolivia	2118	46 (-0.5)	55 (-0.3)	1306	51 (-0.7)	39 (-0.1)
Cote d'Ivoire	2525	47 (-0.5)	61 (-0.6)	2297	66 (-1.3)	65 (-1.5)

Country (ordered based on ranking during 2010-19)	50-69 years *(continued)*					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Honduras	1643	48 (-0.5)	35 (0.5)	969	40 (-0.2)	29 (0.2)
Togo	2140	49 (-0.5)	56 (-0.4)	1788	45 (-0.5)	68 (-1.9)
Guatemala	1467	50 (-0.6)	46 (0.2)	1069	68 (-1.4)	59 (-1.1)
Madagascar	1714	51 (-0.6)	17 (1.1)	1274	31 (-0.1)	10 (1.1)
Indonesia	1802	52 (-0.6)	34 (0.6)	1183	32 (-0.1)	51 (-0.6)
Colombia	953	53 (-0.6)	6 (1.9)	593	49 (-0.6)	4 (1.6)
Benin	1903	54 (-0.6)	60 (-0.4)	1587	47 (-0.6)	69 (-1.9)
Dominican Republic	1416	55 (-0.6)	50 (0)	816	61 (-0.9)	9 (1.1)
Pakistan	1866	56 (-0.7)	63 (-0.7)	1237	59 (-0.9)	30 (0.2)
Burkina Faso	2184	57 (-0.7)	53 (-0.2)	1609	52 (-0.7)	56 (-1)
Niger	1873	58 (-0.7)	37 (0.5)	1451	34 (-0.1)	37 (-0.1)
China	1129	59 (-0.9)	36 (0.5)	557	48 (-0.6)	14 (1)
Myanmar	2149	60 (-0.9)	51 (-0.2)	1349	57 (-0.8)	61 (-1.3)
Ghana	1849	61 (-1)	54 (-0.2)	1401	53 (-0.7)	47 (-0.4)
Uzbekistan	1956	62 (-1)	13 (1.4)	1172	64 (-1)	19 (0.7)
Philippines	1536	63 (-1.2)	31 (0.6)	1042	58 (-0.8)	49 (-0.5)
Tunisia	1239	64 (-1.2)	28 (0.6)	590	36 (-0.2)	33 (0.1)
Kenya	2733	65 (-1.2)	65 (-0.8)	1942	62 (-0.9)	52 (-0.7)
Rwanda	2205	66 (-1.2)	7 (1.8)	1551	39 (-0.2)	7 (1.2)
Malaysia	1496	67 (-1.3)	47 (0.1)	841	65 (-1.1)	21 (0.5)
Bulgaria	2047	68 (-1.4)	32 (0.6)	886	69 (-1.5)	31 (0.2)
Mexico	1423	69 (-1.5)	44 (0.4)	886	50 (-0.6)	36 (0)
Thailand	1343	70 (-1.7)	30 (0.6)	596	37 (-0.2)	11 (1.1)
Viet Nam	1440	71 (-2.2)	18 (0.9)	635	71 (-2.1)	27 (0.3)

Country (ordered based on ranking during 2010-19)	70-84 years					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Haiti	9175	1 (1.7)	71 (-2.8)	7390	1 (2.6)	71 (-3.7)
Sri Lanka	6941	2 (1.6)	42 (-0.3)	3792	5 (1.5)	4 (0.9)
India	6301	3 (1.4)	53 (-0.5)	5458	21 (0.6)	38 (-0.4)
Russian Federation	7560	4 (1.4)	17 (0.3)	4792	9 (1.1)	22 (0)
Iraq	7497	5 (1.2)	52 (-0.4)	6176	23 (0.6)	53 (-0.7)
Iran	6150	6 (1.2)	1 (1.1)	3905	2 (1.7)	13 (0.5)
Türkiye	5929	7 (1.1)	18 (0.3)	3684	6 (1.4)	34 (-0.2)
Algeria	5195	8 (1)	3 (0.9)	4537	13 (0.9)	24 (0)
Peru	5419	9 (1)	8 (0.6)	3764	7 (1.4)	27 (-0.1)
Sudan	6889	10 (0.9)	34 (-0.2)	5809	12 (1)	60 (-0.9)
Colombia	4649	11 (0.9)	11 (0.6)	3135	8 (1.3)	8 (0.7)

Country (ordered based on ranking during 2010-19)	70-84 years *(continued)*					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Morocco	6895	12 (0.8)	57 (-0.6)	5054	4 (1.6)	50 (-0.6)
Ecuador	4340	13 (0.6)	14 (0.4)	3149	27 (0.4)	20 (0.1)
Bulgaria	6815	14 (0.5)	12 (0.5)	4419	10 (1.1)	2 (1)
China	5556	15 (0.5)	23 (0.2)	3601	17 (0.7)	9 (0.7)
Ethiopia	7449	16 (0.5)	6 (0.7)	6100	16 (0.8)	1 (1.5)
Malaysia	5877	17 (0.5)	10 (0.6)	4581	28 (0.4)	11 (0.5)
Laos	8399	18 (0.4)	39 (-0.3)	6984	39 (0)	33 (-0.2)
Zimbabwe	8061	19 (0.4)	28 (0)	6106	14 (0.9)	40 (-0.4)
Tajikistan	8373	20 (0.4)	65 (-1.2)	6866	37 (0)	49 (-0.6)
Dominican Republic	5481	21 (0.3)	61 (-0.7)	3841	50 (-0.2)	7 (0.7)
Burundi	8116	22 (0.3)	2 (1)	7176	29 (0.4)	14 (0.5)
Honduras	7239	23 (0.3)	22 (0.2)	5214	25 (0.5)	23 (0)
Egypt	8712	24 (0.3)	67 (-1.4)	6846	59 (-0.5)	63 (-1)
Serbia	7387	25 (0.3)	37 (-0.2)	4778	18 (0.7)	46 (-0.5)
Belarus	9247	26 (0.3)	69 (-1.7)	4933	24 (0.6)	68 (-1.2)
Bangladesh	6926	27 (0.2)	70 (-2.2)	5012	11 (1)	62 (-1)
Brazil	5931	28 (0.2)	16 (0.4)	4111	32 (0.2)	18 (0.2)
Thailand	4113	29 (0.1)	4 (0.9)	2602	15 (0.8)	5 (0.9)
Tanzania	7678	30 (0.1)	30 (-0.1)	5560	19 (0.7)	21 (0.1)
South Africa	6871	31 (0.1)	50 (-0.4)	4961	33 (0.2)	44 (-0.5)
Argentina	6105	32 (0.1)	25 (0)	3585	30 (0.2)	45 (-0.5)
Rwanda	8410	33 (0)	9 (0.6)	7071	26 (0.4)	6 (0.8)
Jordan	6432	34 (0)	19 (0.3)	4391	22 (0.6)	12 (0.5)
Cambodia	6636	35 (0)	5 (0.8)	5628	55 (-0.3)	3 (0.9)
Ukraine	8323	36 (0)	35 (-0.2)	4680	3 (1.7)	48 (-0.5)
Kenya	6980	37 (0)	33 (-0.2)	5818	60 (-0.5)	29 (-0.1)
Bolivia	9084	38 (0)	54 (-0.5)	7063	44 (-0.1)	41 (-0.4)
Malawi	8664	39 (0)	31 (-0.1)	5616	20 (0.7)	17 (0.3)
Myanmar	8898	40 (0)	38 (-0.3)	7072	36 (0)	57 (-0.8)
Madagascar	7396	41 (0)	48 (-0.4)	6311	41 (-0.1)	31 (-0.2)
Azerbaijan	8282	42 (-0.1)	47 (-0.4)	6212	69 (-0.7)	47 (-0.5)
Nepal	8060	43 (-0.1)	51 (-0.4)	6770	49 (-0.2)	42 (-0.4)
Togo	9527	44 (-0.1)	46 (-0.4)	9072	35 (0.1)	65 (-1.2)
Congo, Dem. Rep.	8110	45 (-0.1)	24 (0)	7248	54 (-0.3)	51 (-0.7)
Viet Nam	6640	46 (-0.1)	58 (-0.6)	3867	56 (-0.3)	52 (-0.7)
Sierra Leone	9466	47 (-0.2)	26 (0)	8389	43 (-0.1)	30 (-0.2)
Chad	9794	48 (-0.2)	59 (-0.7)	8742	38 (0)	58 (-0.8)
Guinea	8213	49 (-0.2)	62 (-0.7)	7580	62 (-0.5)	37 (-0.3)
Guatemala	5312	50 (-0.2)	7 (0.6)	4238	47 (-0.1)	43 (-0.5)
Papua New Guinea	9407	51 (-0.2)	55 (-0.5)	7004	42 (-0.1)	61 (-0.9)

Country (ordered based on ranking during 2010-19)	70-84 years *(continued)*					
	Males			Females		
	Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in		Mortality rate in 2019 (per 100,000 population)	Performance ranking (performance*) in	
		2010-19	2000-10		2010-19	2000-10
Cameroon	7953	52 (-0.2)	49 (-0.4)	7592	66 (-0.6)	55 (-0.8)
Philippines	7483	53 (-0.2)	32 (-0.1)	6167	48 (-0.2)	39 (-0.4)
Zambia	9090	54 (-0.2)	29 (-0.1)	7412	46 (-0.1)	25 (0)
Kazakhstan	9169	55 (-0.2)	13 (0.5)	6547	40 (0)	56 (-0.8)
Mozambique	10186	56 (-0.2)	56 (-0.6)	8465	31 (0.2)	54 (-0.8)
Cote d'Ivoire	8452	57 (-0.2)	41 (-0.3)	6860	45 (-0.1)	36 (-0.3)
Mali	9678	58 (-0.3)	36 (-0.2)	8882	65 (-0.5)	19 (0.1)
Uganda	10496	59 (-0.3)	63 (-0.7)	9373	63 (-0.5)	67 (-1.2)
Ghana	7825	60 (-0.3)	64 (-0.8)	7010	61 (-0.5)	66 (-1.2)
Indonesia	8283	61 (-0.3)	40 (-0.3)	6260	53 (-0.3)	35 (-0.3)
Afghanistan	8730	62 (-0.3)	21 (0.3)	7194	52 (-0.3)	28 (-0.1)
Pakistan	8329	63 (-0.4)	60 (-0.7)	6660	64 (-0.5)	26 (-0.1)
Niger	8924	64 (-0.4)	15 (0.4)	8051	51 (-0.2)	15 (0.4)
Benin	8038	65 (-0.4)	43 (-0.3)	7355	68 (-0.6)	64 (-1)
Burkina Faso	9944	66 (-0.5)	20 (0.3)	8720	58 (-0.5)	32 (-0.2)
Senegal	8854	67 (-0.5)	44 (-0.3)	6985	34 (0.1)	16 (0.4)
Nigeria	9364	68 (-0.5)	27 (0)	9121	71 (-0.8)	59 (-0.9)
Tunisia	6478	69 (-0.5)	45 (-0.3)	3817	57 (-0.4)	10 (0.6)
Mexico	5519	70 (-0.6)	66 (-1.3)	4114	67 (-0.6)	70 (-1.8)
Uzbekistan	9451	71 (-0.7)	68 (-1.5)	7356	70 (-0.8)	69 (-1.6)

FIGURE 5A.3 Correlation between performance in mortality decline during 2010-19 among males and females

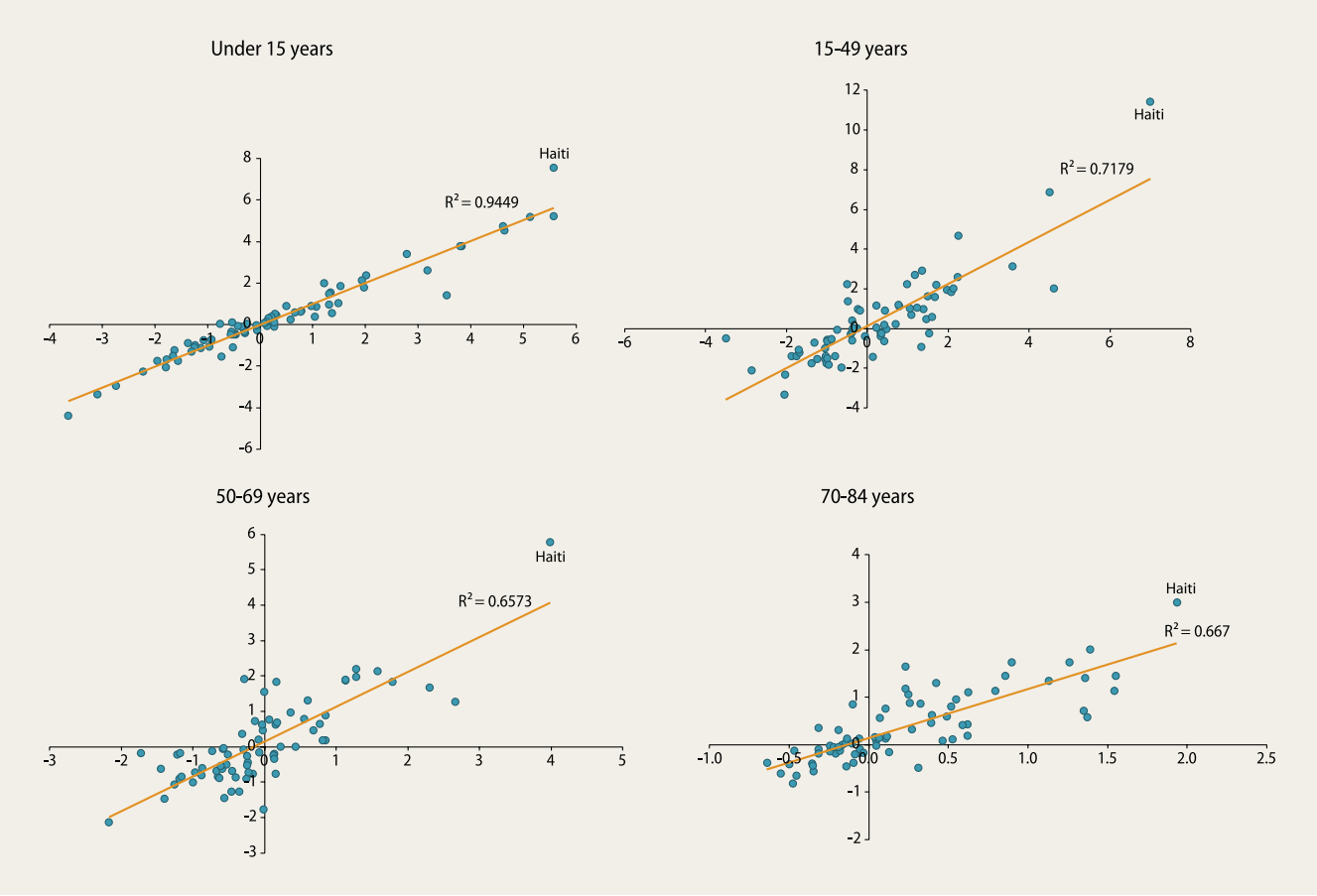


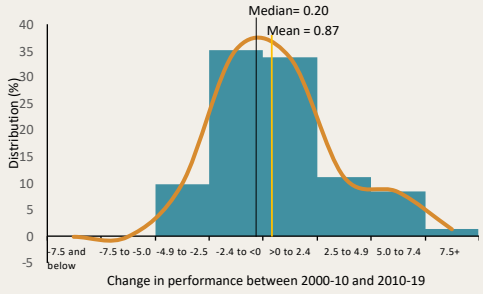
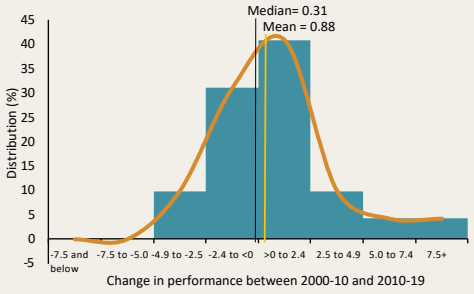
TABLE 5A.3 Change in performance in the annual rate of decline in mortality under 15 years, 15-49 years, 50-69 years, and 70-84 years, by sex from 2000-10 decade to 2010-2019 decade

a. Under 15 years

Change in performance in annual rate of decline of mortality under 15 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
7.5 and above (best transition)	***Haiti** (14.4)*	***Haiti** (17.7)* Azerbaijan (7.8) Ukraine (7.7)
5.0 to 7.4	Azerbaijan (7.4) Bulgaria (6.5) Ukraine (6.2) Russian Federation (5.9) Kazakhstan (5.5) Zimbabwe (5.0)	Russian Federation (7.0) Kazakhstan (6.5) South Africa (5.0)
2.5 to 4.9	South Africa (4.7) Burundi (4.4) Belarus (3.9) Iran (3.5) China (3.4) Algeria (3.0) ***Iraq** (2.7)* Jordan (2.7)	Belarus (4.9) Burundi (4.8) Zimbabwe (4.8) Iran (4.0) Bulgaria (4.0) Algeria (3.3) China (3.3) Chad (2.5)

a. Under 15 years *(continued)*

Change in performance in annual rate of decline of mortality under 15 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
>0 to 2.4	Chad (2.3) Cameroon (2.3) Ecuador (2.2) Sri Lanka (2.2) Uzbekistan (1.7) Egypt (1.6) Thailand (1.5) Argentina (1.4) Pakistan (1.2) Morocco (1.2) Sudan (1.1) Malawi (1.1) India (0.9) Indonesia (0.8) Mali (0.8) Ghana (0.7) Togo (0.4) Tunisia (0.4) Papua New Guinea (0.3) Sierra Leone (0.2) ***Mozambique** (0.2)* Benin (0.1) Viet Nam (0.0) ***Afghanistan** (0.0)*	Jordan (2.4) Cameroon (2.3) Ecuador (2.3) Sri Lanka (1.8) ***Iraq** (1.7)* Morocco (1.5) Argentina (1.5) Thailand (1.3) Uzbekistan (1.3) Sudan (1.3) India (1.2) Ghana (1.2) Egypt (1.2) Togo (1.1) Pakistan (0.9) Indonesia (0.9) Mali (0.6) Sierra Leone (0.4) Tunisia (0.4) Papua New Guinea (0.4) Congo, Dem. Rep. (0.3) ***Afghanistan** (0.3)* Benin (0.3) ***Mozambique** (0.2)* Philippines (0.2) Malawi (0.1) Senegal (0.1) Myanmar (0.1)
-2.4 to <0	Laos (0.0) Congo, Dem. Rep. (-0.1) Nigeria (-0.1) Myanmar (-0.1) Burkina Faso (-0.2) Tanzania (-0.2) Senegal (-0.2) Philippines (-0.4) Guatemala (-0.4) Dominican Republic (-0.6) Mexico (-0.7) Peru (-0.8) Uganda (-0.8) Cote d'Ivoire (-0.9) Colombia (-1.1) Tajikistan (-1.2) Madagascar (-1.2) Kenya (-1.2) Ethiopia (-1.2) Guinea (-1.3) Bangladesh (-1.3) Türkiye (-1.8) Bolivia (-1.8) Honduras (-1.9) Zambia (-2.0)	Nigeria (0.0) Burkina Faso (0.0) Viet Nam (-0.2) Dominican Republic (-0.2) Laos (-0.4) Mexico (-0.7) Peru (-0.8) Guatemala (-0.8) Tanzania (-1.0) Cote d'Ivoire (-1.0) Colombia (-1.2) Ethiopia (-1.3) Madagascar (-1.3) Tajikistan (-1.4) Bolivia (-1.4) Bangladesh (-1.5) Guinea (-1.6) Türkiye (-1.7) Uganda (-1.8) Honduras (-1.8) Kenya (-2.1) Zambia (-2.2)
-4.9 to -2.5	Serbia (-2.5) Nepal (-2.7) Niger (-2.8) Cambodia (-2.8) Brazil (-3.3) Rwanda (-3.4) Malaysia (-3.4)	Serbia (-2.6) Niger (-2.8) Nepal (-3.1) Brazil (-3.5) Cambodia (-3.6) Malaysia (-4.2) Rwanda (-4.2)

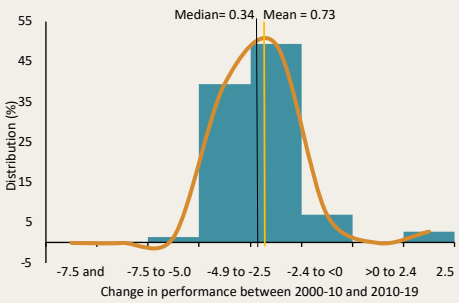
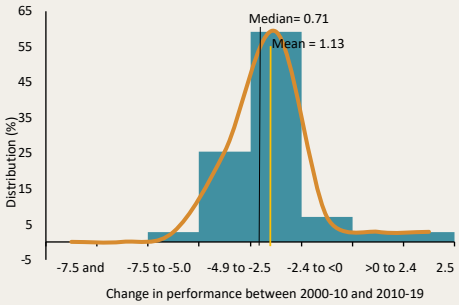
Change in performance in annual rate of decline of mortality under 15 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
-7.4 to -5.0		
-7.5 and below (worst transition)		
Distribution (%)		

Countries in italics are those that encountered major crises such as hurricanes, earthquakes, flooding, tsunami, or war during 2000, 2005, 2010, 2015, or 2019, thereby showing a pseudo good or poor in performance during 2010-2019 relative to during 2000-2010.

b. 15-49 years

Change in performance in annual rate of decline of mortality between 15 and 49 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
7.5 and above (best transition)	***Haiti*** *(16.9)* ***Iraq*** *(7.8)*	***Haiti*** *(24.7)* ***Mozambique*** *(7.5)*
5.0 to 7.4		Zimbabwe (7.2) South Africa (6.3)
2.5 to 4.9	Tanzania (4.5) Zimbabwe (4.4) ***Mozambique*** *(4.2)* South Africa (3.3) Bangladesh (2.8)	***Iraq*** *(4.7)* Iran (3.7) Tanzania (3.2) Malawi (2.8) Chad (2.7)
>0 to 2.4	Ecuador (2.2) Iran (2.1) Chad (2.1) Pakistan (2.0) Tajikistan (2.0) Belarus (2.0) India (1.9) Azerbaijan (1.7) Jordan (1.6) Guatemala (1.6) Egypt (1.4) Myanmar (1.0) Papua New Guinea (1.0) China (1.0) Peru (0.9) Brazil (0.9) Türkiye (0.8) Cameroon (0.8) Thailand (0.8) Laos (0.7) Russian Federation (0.6) Sri Lanka (0.5) Cote d'Ivoire (0.5) Serbia (0.5) Guinea (0.5) Nigeria (0.4) Kazakhstan (0.4)	Togo (2.3) Burundi (2.2) Azerbaijan (2.1) Papua New Guinea (2) Ukraine (1.9) Cote d'Ivoire (1.8) Myanmar (1.8) Belarus (1.7) Benin (1.6) Kazakhstan (1.6) Ghana (1.5) Cameroon (1.5) Ecuador (1.4) Thailand (1.4) Zambia (1.3) Indonesia (1.2) Uganda (1.2) Congo, Dem. Rep. (1.2) Jordan (1.1) Tajikistan (1.1) Tunisia (1.0) Nigeria (0.9) Argentina (0.8) Peru (0.8) Morocco (0.8) Türkiye (0.7) Bangladesh (0.7)

b. 15-49 years *(continued)*

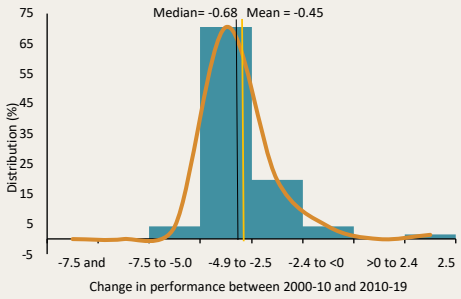
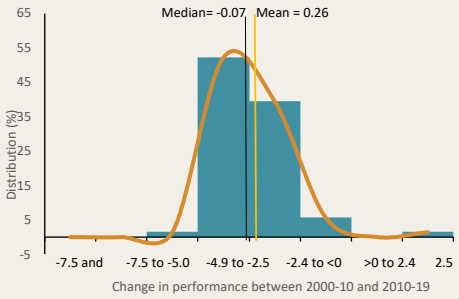
Change in performance in annual rate of decline of mortality between 15 and 49 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
>0 to 2.4 *(continued)*	Ghana (0.4) Tunisia (0.3) Uganda (0.3) Indonesia (0.3) Benin (0.2) Ukraine (0.1) Togo (0.1) Malaysia (0.1)	Sudan (0.5) China (0.5) Honduras (0.5) Sri Lanka (0.4) Russian Federation (0.4) Senegal (0.3) Egypt (0.3) Brazil (0.3) Philippines (0.3) Serbia (0.3) Uzbekistan (0.2) Algeria (0.2) Sierra Leone (0.2) ***Afghanistan** (0.1)* Bulgaria (0.1)
-2.4 to <0	Ethiopia (0.0) Nepal (0.0) Viet Nam (-0.1) Kenya (-0.1) Morocco (-0.1) Zambia (-0.2) Mexico (-0.2) Argentina (-0.2) Sudan (-0.2) Madagascar (-0.3) Philippines (-0.4) Congo, Dem. Rep. (-0.4) Mali (-0.7) Bolivia (-0.7) Algeria (-0.7) Niger (-0.7) Uzbekistan (-0.8) Honduras (-0.9) Malawi (-1.0) Sierra Leone (-1.1) Burkina Faso (-1.1) Senegal (-1.2) Bulgaria (-1.2) Burundi (-1.3) Dominican Republic (-1.4) Cambodia (-1.5) Rwanda (-2.0) Colombia (-2.2)	Burkina Faso (-0.1) Mexico (-0.2) Viet Nam (-0.2) Nepal (-0.3) Ethiopia (-0.4) Niger (-0.5) India (-0.6) Laos (-0.7) Guinea (-0.8) Malaysia (-0.9) Guatemala (-0.9) Madagascar (-1.0) Bolivia (-1.4) Mali (-1.5) Kenya (-1.6) Colombia (-1.7) Dominican Republic (-2.2) Pakistan (-2.4)
-4.9 to -2.5	***Afghanistan** (-4.7)*	Rwanda (-3.6) Cambodia (-3.9)
-7.4 to -5.0		
-7.5 and below (worst transition)		
Distribution (%)		

Countries in italics are those that encountered major crises such as hurricanes, earthquakes, flooding, tsunami, or war during 2000, 2005, 2010, 2015, or 2019, thereby showing a pseudo good or poor in performance during 2010-2019 relative to during 2000-2010.

c. 50-69 years

Change in performance in annual rate of decline of mortality between 50 and 69 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
7.5 and above (best transition)	***Haiti** (8.9)*	***Haiti** (12.4)*
5.0 to 7.4		
2.5 to 4.9	***Iraq** (3.4)* ***Mozambique** (2.9)* Tanzania (2.7)	***Mozambique** (4.7)* Malawi (3) Tanzania (2.8) ***Iraq** (2.7)*
>0 to 2.4	Bangladesh (2.4) South Africa (1.9) Chad (1.2) Egypt (0.8) Jordan (0.7) Cameroon (0.5) Nigeria (0.3) Ethiopia (0.2) Guinea (0.2) Malawi (0.1) Peru (0.1) Cote d'Ivoire (0.1) Pakistan (0.0) ***Afghanistan** (0.0)*	Zimbabwe (2.4) Ukraine (2.4) Chad (1.8) South Africa (1.6) Bangladesh (1.5) Papua New Guinea (1.4) Jordan (1.4) Togo (1.4) Benin (1.4) Argentina (1.4) Peru (1.3) Cameroon (1.1) Congo, Dem. Rep. (1.0) Nigeria (1.0) ***Afghanistan** (0.9)* Morocco (0.8) Sierra Leone (0.8) Zambia (0.7) Burundi (0.7) Uganda (0.5) Indonesia (0.5) Myanmar (0.5) Burkina Faso (0.3) Cote d'Ivoire (0.2) Egypt (0.2) Belarus (0.1) Ecuador (0.1) Kazakhstan (0.1) Niger (0.0)
-2.4 to <0	Mali (0.0) Bolivia (-0.1) Sri Lanka (-0.1) Togo (-0.2) Benin (-0.2) Zambia (-0.2) Zimbabwe (-0.2) Congo, Dem. Rep. (-0.3) Belarus (-0.3) Papua New Guinea (-0.4) Kenya (-0.4) Brazil (-0.4) Burkina Faso (-0.5) Sierra Leone (-0.5) Dominican Republic (-0.6) India (-0.6) Ecuador (-0.6) Russian Federation (-0.7) Laos (-0.7) Myanmar (-0.7) Nepal (-0.7) Türkiye (-0.7) Guatemala (-0.7) Ghana (-0.7)	Ethiopia (-0.1) Algeria (-0.1) Brazil (-0.1) Nepal (-0.1) Serbia (-0.2) Mali (-0.2) Kenya (-0.2) Tunisia (-0.3) Ghana (-0.3) Senegal (-0.3) Philippines (-0.3) Türkiye (-0.4) Guatemala (-0.4) Russian Federation (-0.4) Iran (-0.4) Honduras (-0.4) Guinea (-0.5) Laos (-0.5) Bolivia (-0.6) Mexico (-0.6) Pakistan (-1.0) Sudan (-1.1) Sri Lanka (-1.1) Madagascar (-1.1)

c. 50-69 years *(continued)*

Change in performance in annual rate of decline of mortality between 50 and 69 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
-2.4 to <0 *(continued)*	Ukraine (-0.7) Senegal (-0.8) Uganda (-0.8) Serbia (-0.8) Sudan (-0.8) Argentina (-0.9) Honduras (-1.1) Indonesia (-1.1) Tajikistan (-1.2) Niger (-1.3) Burundi (-1.3) Malaysia (-1.3) China (-1.4) Kazakhstan (-1.5) Madagascar (-1.6) Philippines (-1.7) Tunisia (-1.8) Mexico (-1.8) Iran (-1.8) Morocco (-1.9) Bulgaria (-2.0) Azerbaijan (-2.0) Algeria (-2.0) Thailand (-2.3) Uzbekistan (-2.4) Colombia (-2.5)	Thailand (-1.3) Azerbaijan (-1.4) Rwanda (-1.5) China (-1.6) Malaysia (-1.6) Bulgaria (-1.7) Uzbekistan (-1.7) Dominican Republic (-2) Tajikistan (-2.1) India (-2.1) Colombia (-2.2) Viet Nam (-2.4)
-4.9 to -2.5	Cambodia (-2.7) Rwanda (-3.0) Viet Nam (-3.1)	Cambodia (-2.7)
-7.4 to -5.0		
-7.5 and below (worst transition)		
Distribution (%)		

Countries in italics are those that encountered major crises such as hurricanes, earthquakes, flooding, tsunami, or war during 2000, 2005, 2010, 2015, or 2019, thereby showing a pseudo good or poor in performance during 2010-2019 relative to during 2000-2010.

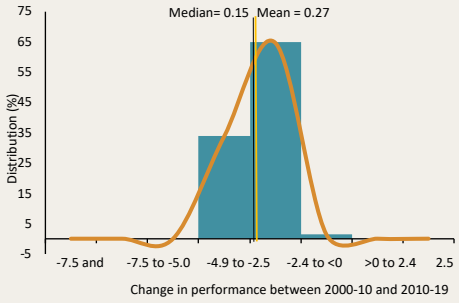
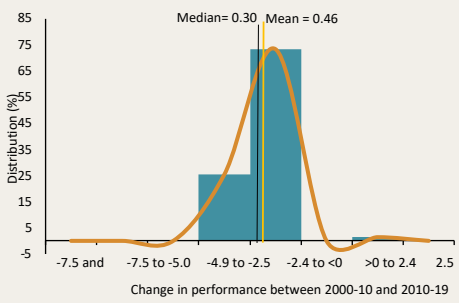
d. 70-84 years

Change in performance in annual rate of decline of mortality between 70 and 84 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
7.5 and above (best transition)		
5.0 to 7.4		***Haiti** (6.3)*
2.5 to 4.9	***Haiti** (4.5)*	
>0 to 2.4	Bangladesh (2.4) Belarus (1.9)	Morocco (2.3) Ukraine (2.2)

d. 70-84 years *(continued)*

Change in performance in annual rate of decline of mortality between 70 and 84 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
>0 to 2.4 *(continued)*	Sri Lanka (1.9) India (1.9) Egypt (1.7) ***Iraq** (1.7)* Tajikistan (1.6) Morocco (1.4) Sudan (1.1) Russian Federation (1.1) Dominican Republic (1) Türkiye (0.8) Uzbekistan (0.8) Laos (0.7) Mexico (0.6) South Africa (0.5) Serbia (0.5) Ghana (0.5) Guinea (0.5) Viet Nam (0.5) Chad (0.5) Bolivia (0.5) Zimbabwe (0.5) Uganda (0.4) Nepal (0.4) Papua New Guinea (0.4) Peru (0.4) Madagascar (0.4) ***Mozambique** (0.4)* Pakistan (0.3) China (0.3) Colombia (0.3) Azerbaijan (0.3) Togo (0.3) Myanmar (0.2) Ukraine (0.2) Cameroon (0.2) Tanzania (0.2) Kenya (0.2) Ecuador (0.1) Honduras (0.1) Iran (0.1) Algeria (0.1) Malawi (0.1) Cote d'Ivoire (0.1) Argentina (0.0) Indonesia (0.0)	Bangladesh (2) Sudan (1.9) Belarus (1.8) Türkiye (1.6) Peru (1.4) Zimbabwe (1.3) ***Iraq** (1.3)* Togo (1.3) Serbia (1.2) Mexico (1.2) Iran (1.2) Russian Federation (1.0) India (1.0) ***Mozambique** (1.0)* Algeria (0.9) Papua New Guinea (0.8) Chad (0.8) Myanmar (0.8) Uzbekistan (0.8) Kazakhstan (0.7) Argentina (0.7) Ghana (0.7) Uganda (0.7) South Africa (0.7) Tanzania (0.6) Tajikistan (0.6) Colombia (0.6) Sri Lanka (0.6) Egypt (0.5) Honduras (0.5) Viet Nam (0.4) Benin (0.4) Congo, Dem. Rep. (0.4) Malawi (0.4) Ecuador (0.3) Bolivia (0.3) Guatemala (0.3) Nepal (0.3) Philippines (0.2) Laos (0.2) Cote d'Ivoire (0.2) Cameroon (0.2) Madagascar (0.1) Sierra Leone (0.1) China (0.1) Bulgaria (0.1) Jordan (0.1) Nigeria (0.0) Indonesia (0.0) Brazil (0.0)
-2.4 to <0	Bulgaria (0.0) Mali (0.0) Benin (-0.1) Philippines (-0.1) Malaysia (-0.1) Zambia (-0.1) Congo, Dem. Rep. (-0.1) Senegal (-0.2) Tunisia (-0.2) Sierra Leone (-0.2) Brazil (-0.2) Jordan (-0.2)	Thailand (-0.1) Guinea (-0.1) Burundi (-0.1) Zambia (-0.1) Malaysia (-0.1) ***Afghanistan** (-0.1)* Azerbaijan (-0.2) Burkina Faso (-0.2) Senegal (-0.3) Kenya (-0.3) Rwanda (-0.3) Pakistan (-0.4)

d. 70-84 years *(continued)*

Change in performance in annual rate of decline of mortality between 70 and 84 years (% per year)	Males (change in performance per year)	Females (change in performance per year)
-2.4 to <0 *(continued)*	Ethiopia (-0.3) Nigeria (-0.5) ***Afghanistan** (-0.6)* Rwanda (-0.6) Burundi (-0.7) Burkina Faso (-0.7) Kazakhstan (-0.8) Niger (-0.8) Guatemala (-0.8) Cambodia (-0.8) Thailand (-0.8)	Niger (-0.6) Mali (-0.6) Ethiopia (-0.7) Dominican Republic (-0.9) Tunisia (-1.0) Cambodia (-1.2)
-4.9 to -2.5		
-7.4 to -5.0		
-7.5 and below (worst transition)		
Distribution (%)		

Countries in italics are those that encountered major crises such as hurricanes, earthquakes, flooding, tsunami, or war during 2000, 2005, 2010, 2015, or 2019, thereby showing a pseudo good or poor in performance during 2010-2019 relative to during 2000-2010.

ANNEX 5.3

Model using to estimate critical income

We used the methods of Hum and others (2012) for estimating critical income. We used country specific population by age groups (both sexes), and country specific deaths by age-groups, from World Population Prospects 2022 (United Nations, Department of Economic and Social Affairs, Population Division 2022), to derive a survival rate for children aged 0 to 14, adults 15 to 49, and seniors 50 to 69. For this analysis, we included only countries with a population of over 7 million (which covers 99.9 percent of the world population in 2019). We also calculated an average midpoint year (1992.5 and 2017, used a five- and four-year average). GDP per capita (PPP, constant $2017) was sourced from the World Bank (World Bank 2023). The five- and four-year averages were used to limit the influence of sudden, dramatic, changes in health or economic development in that country.

We adapted the Michaelis-Menten model for age-specific global critical income estimates (k_{inc}), and maximal survival rates, such that:

$$child\ survival\ = \frac{child\ survival_{,max} * GDP}{GDP + k_{child,inc}}$$

$$adult\ survival = \frac{adult\ survival_{max} * GDP}{GDP + k_{adult,inc}}$$

$$senior\ survival = \frac{senior\ survival_{max} * GDP}{GDP + k_{senior,inc}}$$

We used a mixed effect model to calculate the global, as well as country-level, critical incomes for all countries in the analysis. We also calculated the income required to achieve 80 percent of the maximal health in high income countries—which is mathematically, four times the critical income. Using the country-level critical incomes derived from the mixed-effects model, we ranked the top countries with the lowest critical income values for each age-grouping.

TABLE 5A.4 Deaths avertable globally in 2019 from specific causes of deaths and age groups if rate of decline was same as that from HIV/AIDS (ages 0-14, 15-49) and tuberculosis (ages 50-69, 70+)

			Male			Female		
Cause of Death (CoD)	Target Age group	Reference CoD + Age group	Reference AARR (%)	Actual AARR (%)	Deaths avertable	Reference AARR (%)	Actual AARR (%)	Deaths avertable
Malaria	15-49 years	Malaria, 0-14 years*	4.2	-0.3	17,995	4.4	0.4	10,144
Tobacco attributable cancers	50-69 years	Tuberculosis, 50-69 years	4.8	1.3	472,818	4.6	0.6	186,517
	70+ years	Tuberculosis, 70+ years	5.2	0.6	493,762	4.6	0.1	246,112
Infection attributable cancers	50-69 years	Tuberculosis, 50-69 years	4.8	2.7	70,734	4.6	1.3	127,536
	70+ years	Tuberculosis, 70+ years	5.2	1.6	67,814	4.6	1.1	99,394
Stomach cancer	50-69 years	Tuberculosis, 50-69 years	4.8	2.5	90,323	4.6	2.6	36,181
	70+ years	Tuberculosis, 70+ years	5.2	1.9	119,737	4.6	2.4	56,648
Breast cancer	50-69 years	Tuberculosis, 50-69 years				4.6	0.5	154,974
	70+ years	Tuberculosis, 70+ years				4.6	0.3	122,670
CVD (not Stroke)	50-69 years	Tuberculosis, 50-69 years	4.8	1.4	1,053,736	4.6	1.6	535,396
	70+ years	Tuberculosis, 70+ years	5.2	0.7	1,994,677	4.6	1.0	2,051,883
Stroke	50-69 years	Tuberculosis, 50-69 years	4.8	2.0	462,694	4.6	2.5	261,105
	70+ years	Tuberculosis, 70+ years	5.2	1.6	940,435	4.6	2.0	883,607
Respiratory diseases (COPD, Asthma, other)	50-69 years	Tuberculosis, 50-69 years	4.8	2.8	208,510	4.6	2.6	129,185
	70+ years	Tuberculosis, 70+ years	5.2	2.0	761,899	4.6	1.9	581,277
Road Injury	15-49 years	HIV/AIDS, 15-49 years	4.1	1.2	235,125	5.4	2.1	58,207
	50-69 years	Tuberculosis, 50-69 years	4.8	0.3	142,057	4.6	0.7	49,126
	70+ years	Tuberculosis, 70+ years	5.2	0.6	58,194	4.6	0.8	28,550
Falls	50-69 years	Tuberculosis, 50-69 years	4.8	0.4	58,962	4.6	0.6	28,721
	70+ years	Tuberculosis, 70+ years	5.2	-1.0	124,481	4.6	-0.8	145,487
Drowning	0-14 years	HIV/AIDS, 0-14 years	6.2	4.4	16,255	6.1	4.9	7,687
Suicide	15-49 years	HIV/AIDS, 15-49 years	4.1	2.0	99,838	5.4	3.6	39,369
	50-69 years	Tuberculosis, 50-69 years	4.8	2.4	50,435	4.6	2.1	22,584
	70+ years	Tuberculosis, 70+ years	5.2	1.9	32,751	4.6	2.5	13,146
Deaths avertable in 2019, 0-69 years					2,979,482			1,646,732
Deaths avertable in 2019, 70+ years					4,593,750			4,228,774
Total deaths avertable in 2019					7,573,232			5,875,506

*The reference group of malaria at ages 0-14 years was used for malaria deaths at ages 15-49 years, based on relevancy.

ANNEX REFERENCES

1. Bernal, J. L., S. Cummins, and A. Gasparrini. 2017. "Interrupted time series regression for the evaluation of public health interventions: A tutorial." *International Journal of Epidemiology* 46 (1), 348–55.
2. Hum, R. J., P. Jha, A. M. McGahan, and Y. –L. Cheng. 2012. "Global divergence in critical income for adult and childhood survival: Analyses of mortality using Michaelis–Menten." *ELife* 1: e00051.
3. Jamison, D. T., S. M. Murphy, and M. E. Sandbu. 2016. "Why has under-5 mortality decreased at such different rates in different countries?" *Journal of Health Economics* 48, 16–25.
4. Kontopantelis, E., T. Doran, D. A. Springate, I. Buchan, and D. Reeves. 2015. "Regression based quasi-experimental approach when randomisation is not an option: Interrupted time series analysis." *BMJ* 350, h2750.
5. United Nations, Department of Economic and Social Affairs, Population Division. 2022. *World Population Prospects 2022*. New York: UN Department of Economic and Social Affairs, Population Division.
6. Verguet, S., and D. T. Jamison. 2014. "Estimates of performance in the rate of decline of under-five mortality for 113 low- and middle-income countries, 1970-2010." *Health Policy and Plan-*

ning 29(2), 151–163.
7. World Bank. 2021. "World Bank Country and Lending Groups." Washington, D.C., The World Bank Group. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.
8. World Bank. 2023. "World Development Indicators." Washington, D.C., The World Bank Group https://databank.worldbank.org/source/world-development-indicators.

Behavior Change and Healthy Longevity

Chapter 6

Behavioral Aspects of Healthy Longevity

Chapter 7

Taxation of Harmful Products, including Tobacco, Alcohol, and Sugar-Sweetened Beverages (SSBs), and Related Topics



6

Behavioral Aspects of Healthy Longevity

Ana Maria Rojas [a,b], Ana Maria Munoz Boudet [a,b], Ellen Moscoe [a,b], Julian Jamison [c], and Carlos Riumallo Herl [a,b]

[a] World Bank, Poverty and Equity Global Practice
[b] Erasmus University, Rotterdam
[c] University of Exeter

INTRODUCTION

Poor health in old age comes at a high cost for individuals, households, and societies. Increases in life expectancy across countries have not always added years of healthy life. Accordingly, health promotion and disease prevention, particularly as they relate to preventable non-communicable diseases (NCDs) whose onset occurs later in life, have become a central focus of health policy. This agenda is challenging, as it relates to people's lifestyles and habits, which in turn influence NCD incidence and progression.

In 2019, the three leading causes of death around the world – cardiovascular diseases, neoplasms, and chronic respiratory diseases – were largely attributable to behavioral risk factors or lifestyle habits (Vos et al 2020). Habits such as unhealthy eating, smoking, alcohol consumption, and lack of exercise (in addition to delayed and inconsistent engagement with health care) have been linked across many studies to the development and persistence of risk factors such as hypertension, diabetes, high cholesterol, and high body-mass index (Forouzanfar et al 2016; Peel et al 2005). These are, in turn, among the top-ranking contributors to unhealthy aging and deaths from NCDs (Vos et al 2020). While many NCDs are not associated with aging, and similarly many NCDs are unrelated to health habits and "lifestyle" factors, this chapter will focus on the group of NCDs that typically develop later in life and can be prevented or delayed through changes in habits that address underlying risk factors.

There is, however, substantial complexity in the link between behavioral habits and subsequent NCD risk factors. Behavioral habits can lead to multiple risk factors, and specific risk factors can be caused by a combination of behavioral habits, and both are impacted by structural factors linked to unhealthy aging. Dissecting each habit and/or risk factor independently highlights this complexity. For example, unhealthy eating is associated with a high body-mass index (Rosenheck 2008), hypertension (Ibrahim and Damasceno 2012), and diabetes (Malik et al. 2010) – each of which is itself a risk factor for cardiovascular diseases. At the same time, hypertension is also influenced by smoking, alcohol consumption, and lack of exercise. Unhealthy eating is not only dependent on individuals' taste preferences or food choices, but also on foods' availability in their living environments and food costs (Ruhm 2012; Lu and Goldman 2010).

Despite the complex interactions linking behavioral habits and NCD risk factors, evidence shows that changes in underlying habits can reduce the prevalence of NCD risk factors (Blaga et al. 2018), and that this can be achieved via behavior change. According to the World Health Organization (WHO), 80 percent of premature heart disease and stroke are preventable with either changes in individual behavior or with adherence to appropriate treatment guidelines (World Health Organization 2014). Interventions that address health behaviors as a means to reduce the burden of NCDs have been identified as among the most cost-effective solutions for low- and middle-income countries (LMICs) (Watkins et al. 2022). Thus, if behaviors and in turn their outcomes are modifiable, there is an opportunity for policies to address health habits in the context of promoting healthy longevity.

Even in the face of existing knowledge regarding the magnitude of the link between behavioral habits, NCD risk factors, and disease prevention, it remains the case that a large share of deaths can be attributed to behavioral risks. One explanation for this is the set of barriers that individuals face when attempting to either modify their habits, access care, or manage their risk factors adequately.

Traditional neoclassical economics suggests possible explanations such as a lack of relevant information or large countervailing costs. In turn, policy makers and researchers have often focused on the health system, user fees, or information, in seeking to remove external obstacles and encourage healthy behaviors. But, while effective, these actions alone have been insufficient to address the full complexity of health behavior change and habit formation. Relative ignorance or limited knowledge of these issues might once have been widespread and undoubtedly still exist among certain population groups. However, in most countries, the majority of adults are now aware of the health risks of, for example, tobacco and alcohol use (e.g., see WHO Global Adult and Youth Tobacco Surveys). Hence, lack of knowledge is unlikely to be a driving explanation of unhealthy behaviors. Similarly, although for some people in some situations the actual cost of

a behavior change (e.g., giving up smoking) might be high enough that the "rational" decision is not to do so, this is not the case across all such behaviors, nor for most people. A modest reduction in unhealthy behaviors such as high calorie consumption, or a modest increase in healthy behaviors such as walking more, generally has both a low cost and often also some direct near-term benefits such as improved energy and sleep, entirely independent of long-term health outcomes. Hence this is again unlikely to be a driving explanation, and indeed many people report that they wish they acted differently in these respects (Faries 2016), strongly suggesting that they are not in fact optimizing their utility according to the traditional framework.

Policy efforts towards behavioral and psychological obstacles that influence unhealthy lifestyles and habit formation are needed. Unlike many other causes of morbidity and mortality, NCDs are typically delayed—in the sense that negative outcomes occur years or even decades after the precipitating behaviors—and are often only weakly linked to identifiable individual moments in time. Why would I then change my behavior today for something that might (or might not) happen in the future? On the other hand, both accidents and communicable diseases tend to impact one's life in the short-run (sometimes immediately) and are, for the most part, possible to link to a single causal event -which is therefore both salient and clearly amenable to prevention. This feedback can and often does trigger a suite of self-initiated behavioral adjustments to reduce recurrence.

Behavioral biases (Tversky and Kahneman, 1974) such as impatience, time inconsistency, and over-optimism are more congruent with weighting long-term consequences in a mistakenly low manner, evaluated by the lights of the individuals themselves. Similarly, other relevant individual biases predict heightened difficulty to assess very small probabilities, as well as a tendency to focus disproportionately on concrete, identifiable consequences at the expense of diffuse accumulated outcomes.

Behavioral science insights into psychological barriers, mental models, biases, and other factors at play in individual decision-making and action can add to the understanding on how to modify habits that lead to NCDs and support a policy and intervention agenda to inform long-term investments in healthy longevity. Long-run flourishing depends as much on what individuals do or do not do as it does on their interactions with health systems—from seeking and obtaining preventive care to treatment adherence and follow-up. Both domains display the same characteristic of delayed and uncertain consequences that leave people vulnerable to inaction and/or repeated deferral.

Furthermore, by applying a behavioral lens to groups as well as individuals, elements such as peer effects and social norms can be considered. Mental health is directly affected by, among other factors, a sense of community connectedness and of agency and confidence about the future (not to mention the emotional disposition of the members of one's network). Physical health is at minimum indirectly affected by local information flows and self-efficacy: only if someone believes that their actions can make a difference to their well-being, and ideally observes this narrative in others, is there an impetus to make healthier decisions. In some sense the behavioral perspective centers on how people see themselves in relation to their worlds, which is crucial for robust aging.

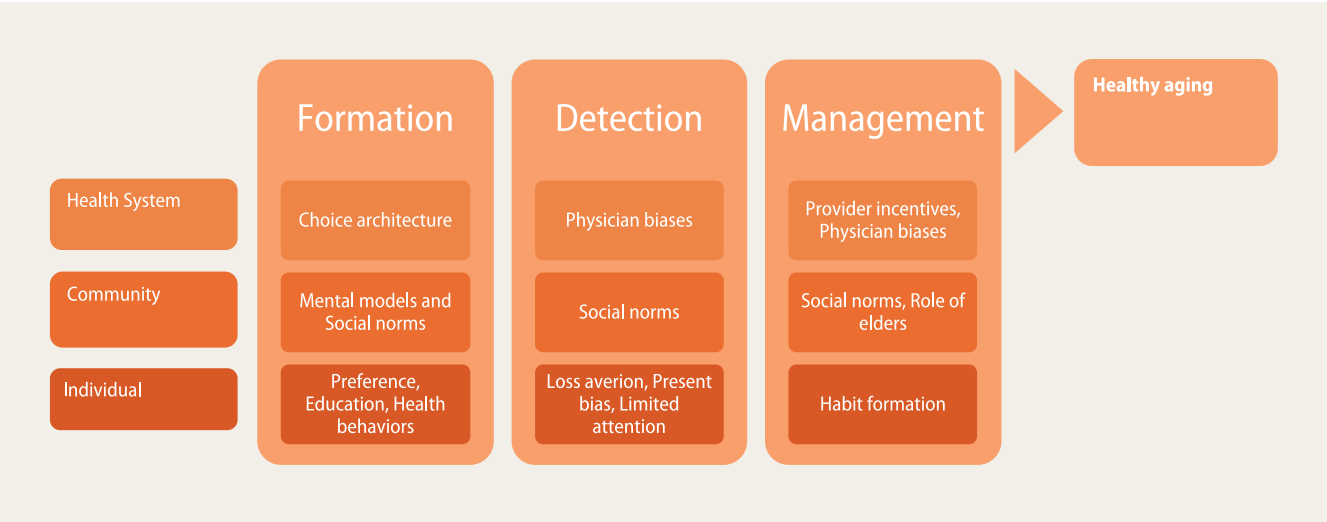
Focusing on NCDs, this study develops a framework of the relation between factors behind individuals' behaviors and the achievement of healthy longevity at the individual, community, and health systems levels. It then uses the framework to discuss policy lessons from the behavioral science literature that can aid efforts to reduce the incidence of NCDs and improve the effectiveness of treatment. These policy lessons are not seen as replacing traditional policy tools, such as taxation, but as complements to increase their efficacy and impact.

The chapter is organized as follows. The next section presents the framework. The following three sections apply it to different stages of NCD trajectories (formation, screening, and management) through individual, community-level, and health system perspectives. The last section presents policy recommendations stemming from behaviorally informed intervention studies across different fields.

A BEHAVIORAL SCIENCE FRAMEWORK FOR NCD POLICIES

We can identify three main stages in people's NCD trajectories: (1) formation - when and how the disease starts occurring; (2) detection - when and how it is identified, both by the individual (i.e., symptoms) and medical professionals; and (3) management - the many actions that are required once the disease is identified to slow its progression, manage symptoms, minimize disability, and support the patient's quality of life. These stages refer to the individual or patient journey (Devi et al. 2020). At each of these stages, we can identify behavioral factors (biases, mental models, beliefs, norms, and others) that are at play at different levels: individual, community, and health system. Drawing on the behavioral science literature, we propose a framework that categorizes the behavioral factors operating at each level and stage (Figure 6.1).

FIGURE 6.1 Conceptual model of traditional and behavioral determinants of NCDs and healthy aging



Individual factors refer to characteristics including a person's capabilities, opportunities, and motivation (adapting the COM-B approach from Michie et al. 2011). Our framework assumes that for (desired) behaviors to take place, a mix of elements is required that can be classified under these three headings. Capabilities primarily encompass the knowledge and skills needed to engage in the desired behavior. Opportunity includes factors such as physical and social resources that are generally not controlled by the individual but facilitate the behavior: for example, having access to health services or to a market where fruits and vegetables are sold. Motivation is not only the intention to act, but the reasons that direct the individual to act, including goals, the ability to make decisions, emotions, habits, identity, and other related mental processes. These three components are interconnected and reinforce each other.

While information is part of the last set of factors, given the cross-cutting role it plays, we distinguish it as a standalone factor. This is because information is not only one of the main elements of policies, and a basic requirement for behavior change, but also the main connector between individuals, social contexts, and health systems. Social and behavioral change campaigns (SBCC) and health communications more broadly are their own category of intervention; therefore we do not focus on SBCC interventions specifically in this study; rather, we include information-related interventions when they leverage a specific behavioral insight of interest. The type of information—including its source, framing, format, and the timing of exposure—will influence the knowledge it generates in an individual, and thus whether information turns into effective communication.

Socio-demographic determinants of health, such as socio-economic status and education, are also included among individual factors. While the proposed framework, and this chapter, do not focus on socio-demographic determinants in detail, they are strong moderators of behaviors and habits. Behavioral biases, understood as behavior patterns that do not conform with expected rational behavior (Gilovich et

al. 2002), for the most part occur at this level. Some of the most salient include cognitive biases such as loss aversion (weighing a loss more heavily than an equivalent gain) and present bias (impatience, weighing the immediate future disproportionately over more distant events). Individual factors related to limited attention are also included at this level. These are factors which describe the inability to focus on a large set of important decisions and information, including cognitive overload (Mullainathan and Shafir 2013).

Community-level factors refer to social norms, roles in society, and other factors that structure choices and behavior.[1] Individuals are embedded in community and social contexts that provide constant flows of information about different behaviors. The context and how the community relates to or views a specific behavior will affect the individual's capabilities, motivation, and opportunities. We understand the community as the network of relevant social cues for individual decision-making stemming from reference and influence groups associated with the individual's identity and belonging (i.e., their neighborhood, family, and friends, but also those who share certain core identity elements, for example gender, role in the family, profession, ethnicity, and other factors). According to Akerlof and Kranton (2000), people hold multiple identities and conforming to them creates intrinsic utility that results in people's following a subgroup norm. Norms evolve as shared practices and identities shaping and reinforcing perceptions and behaviors. Community influences can stem directly from peers or be more diffuse. For the most part, they are either normative or provide a framework for action or decision.

Regarding NCD risk and healthy aging, social norms and mental models of choice are the two most salient channels of community impact. In many cases, social norms and expectations, as well as mental models (how the world is seen) can, instead of contributing to healthy aging outcomes, inhibit or prevent them. One channel for such effects is *conformity traps* that can reinforce health-detrimental actions.[2] For example, some cultures strongly encourage people, often men or youth, to conform to a lifestyle centered around drinking, smoking, and other risky behaviors. In other cases, norms about women's mobility might restrict their physical exercise or limit other behaviors that promote health.

Health system factors include the structure and characteristics of the health system that influence healthy behaviors and the detection and management of NCDs. People's interactions with the health system and health workers are affected by their prior experiences with the system and the behaviors of those who work in it. Relevant factors include health workers' perceptions about the need for and potential benefits of a given intervention, their confidence in their ability to deliver a solution, and their views about their patients (Abry et al. 2013; Durlak and DuPre 2008).

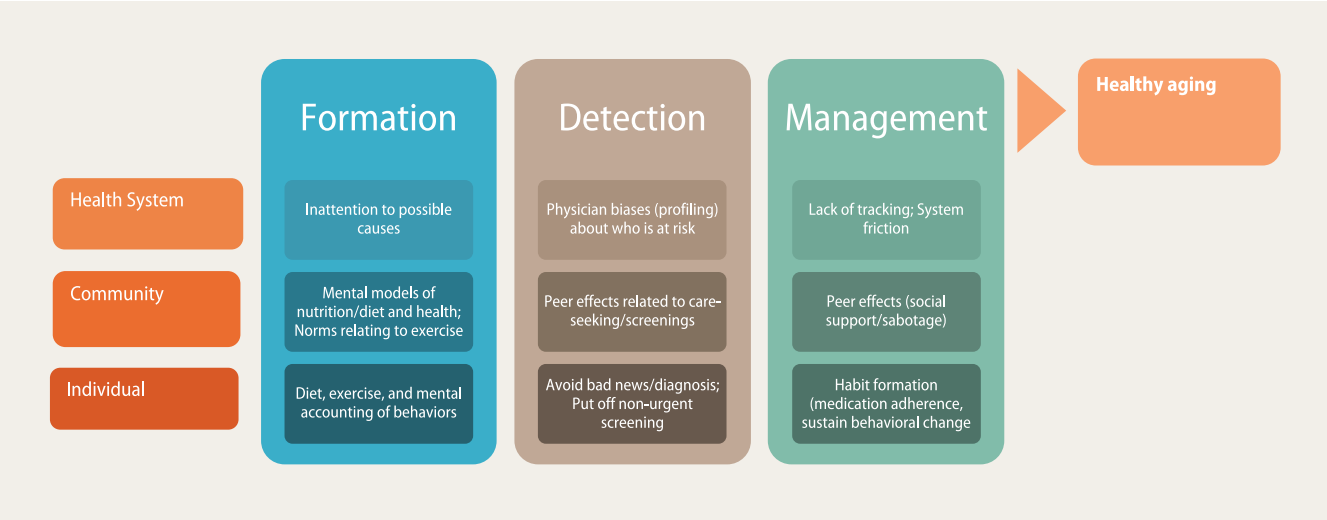
Pricing and provider incentives play a role here, as does choice architecture, or how the system is structured to motivate decision-making. Issues of bias also affect health care providers. Health workers, like all people, are subject to the biases, heuristics, and mental shortcuts described above, and their decision-making around patient care is impacted by these factors. Similarly, norms and mental models associated with their identity as health care providers are at play as part of the health system environment.

Figure 6.2 provides an example of how the framework can be applied to the formation, detection, and management of hypertension.

1 Social norms refer to the unwritten rules of behavior that guide social interactions and are critical for policy makers who attempt to shift behavior, as many health behaviors are adopted to conform to social norms. Choice architecture refers to the ways in which structures influence decision making, including health behaviors and other behaviors impacting healthy longevity.

2 Andreoni et al. (2017) define conformity traps as those that keep groups and individuals in a bad equilibrium despite knowledge of inefficiency and preferences for a different status quo. The trap is due to the pressure to conform to the behavior of the majority and the resistance to being the first deviant from the established norm. Hence a norm will persist because of the strength of the social payoff to compliance.

FIGURE 6.2 **Example of specific biases affecting hypertension formation, detection, and management**



A behavioral focus is not foreign to the health sector. However, our proposed framework expands on what has typically been the approach to behavior change in health policy and program implementation, largely related to information and communications. Traditional behavior-change interventions in health have centered on making information available to encourage appropriate action by individuals, communities, and health system actors. Our framework enriches this model using a behavioral science lens. As such, it serves two purposes. First, it allows us to unpack and organize what is known about interventions that address behavioral barriers related to NCD formation, detection, and management (and also to identify knowledge gaps). Second, it facilitates an assessment of the presence and strength of behavioral elements in health policies. This could enable policy makers and program designers to identify interventions that target different challenges, as well as different kinds of potential beneficiaries. For example, interventions could be crafted to focus on motivation for those groups that already possess capability and opportunity factors, while investing in comprehensive packages for those that do not.

Smoking provides one example of an important NCD risk behavior. Many factors that could predict the decision to engage in such behaviors have been extensively studied across different disciplines (Grossman 1972; Becker and Murphy 1988; Orphanides and Zervos 1995; Cawley and Ruhm 2011). If we understand such behaviors as actions, or deliberate inactions, that affect the individual's health or that of others (Cawley and Ruhm 2011), it seems insufficient to see such behaviors as an outcome of trade-offs between the individual's "stock of health capital" and short-run increases in welfare or future discounting. In the classic model, if the individual perceives that the benefit of smoking is greater than the risk of suffering a heart attack or lung cancer in the future, then he or she will be more likely to engage in this risky/unhealthy activity. Seen in this way, the engagement in risky behaviors should depend solely on the weight that the individual gives to the discounted value of his/her life expectancy or future well-being (Grossman 1972; Cawley and Ruhm 2011; Lundberg and Shapira 2014). However, this is not the case. Risk perceptions are left to the future (time inconsistent preferences leading to present bias), while group pressures, social norms, and role models (what others do) take precedence and motivate behavior. Classic tobacco control policies—providing information about risks, imposing smoking bans, raising excise taxes, and other measures—increase frictions to the behavior by making it more difficult and costly. These established policy approaches can be complemented and made more effective by incorporating insights from behavioral science. This is the perspective that the next sections take. In them, we use concepts from behavioral economic theory that describe the biases, mental models, and heuristics affecting decision-making that are most relevant to healthy aging and NCDs.[3] The review is not exhaustive and does not cover all the possible behavioral factors at play. Rather, it prioritizes the more prevalent and those best analyzed in the literature.

3 Annex Table 6A.1 summarizes the relevant biases and provides examples related to aging and NCDs.

NCD FORMATION: HEALTHY LIFESTYLE AND HABIT FORMATION

This section examines how behavioral biases influence health behaviors which affect the formation of NCDs. We focus on some of the main risky behaviors, including physical inactivity, tobacco use, and alcohol use, but the discussions extend beyond these. Following the framework presented above, we disaggregate the policy-relevant factors at work into health system, community, and individual.

Health system factors that affect NCD formation

More and more health systems, at least in middle- and high-income countries, have started focusing on NCD prevention, as well as treatment. However, many of these efforts appear to assume that it is enough to create prevention programs or formally include preventative health in primary health care models, in order for doctors to deliver such services effectively and for individuals to use them. This has not proven to be the case. As discussed with regard to individual-level factors, providing information (i.e., generating knowledge) may not by itself be sufficient, because individuals may not act on that information. People might lack the motivation to obtain care for a variety of attitudinal reasons such as perceived need, distrust in physicians or medical institutions, dissatisfaction with previous medical care, and fear of being diagnosed with something (Bairey Merz et al. 2017; Friedman 1994; Hall et al. 2001).

These obstacles can be exacerbated by system features (design, focus on disease versus prevention, complicated processes) that can increase people's "hassle perception" about engaging with the health system, health insurance, and related institutions and processes (Liebman and Zeckhauser 2008). Markets for medical care are characterized by uncertainty and by asymmetric information between physician and patient (Frank 2007). How patients obtain information about the health system and doctors prior to an initial contact, how referrals are obtained, how easy or difficult it is to deal with health insurance: all these factors play central roles in the formation of "priors" or pre-existing beliefs and the decision to engage with the health system.

Disease prevention efforts must confront individuals' priors on the health system and physicians, which may stem from personal experiences and/or reports from family and friends (whether or not related to the dimensions of care that most directly affect their health outcomes). The formation of priors can be explained through two behavioral concepts. The first is the "law of small numbers" bias (Rabin 1998, 2002): people's tendency to assume that information derived from observing a small number of events reflects the experience of the larger "population" from which those events are drawn. The second is the availability heuristic, the reliance on more vivid or memorable evidence to construct a prior about the probability of a particular characteristic or outcome: for example, that a physician is high quality, will exert adequate effort, or would detect a worrisome health condition (Tversky and Kahneman 1973). Reliance on reports from family and friends may thus create distortions. If the system does not address these issues (and/or dismisses them), they are reinforced.

The health system, in its "external" presentation, is largely seen as focused on diseases. This means, from an individual point of view, a signal that you only seek healthcare, even if preventative, when you have a disease (or symptoms of it). The difficulty of making appointments, the unpleasantness of clinics or hospitals where those around you are ill, and many other factors can act as disincentives to seek preventative health care. Countries have started addressing some of these priors and biases by creating "healthy living centers" or similar support structures (whether online or in person), that remove the disease label from preventative health.

The health system is largely associated with a specific set of individuals: medical professionals. Physicians, like other persons, fall prey to behavioral biases. Partly based on training, they are more prone to mental shortcuts that associate symptoms with diseases than to connecting current habits with future events, including NCDs. This reflects a common inclination toward the status quo and inertia, referring to people's tendency to maintain the current status of things. This status is used as a reference point, and any change regarding this point is seen as a loss.

Physicians are habitual in their processes when it comes to a patient, and new processes or actions might not be salient to them. Reminders and checklists can work to disrupt automaticity. The literature suggests that more patients receive preventive care when doctors are reminded to order, deliver, or prescribe appropriate preventive care measures such as vaccinations (Austin et al. 1994; Davis et al. 1995; Hunt et al. 1998). For example, a recent systematic

review, covering 3,502 individual studies investigating behavior change interventions among primary health care (PHC) physicians, found that reminders improve the rate of screening and vaccination while reducing unnecessary imaging for lower back pain (Chauhan et al. 2017). Other systematic reviews also found a positive relationship between physician reminders and uptake of screening services (Dexheimer et al. 2008).

The health sector's performance when it comes to the added task of preventing future diseases can benefit from more motivated workers. A study investigating major factors influencing job motivation among public health staff in Viet Nam found that recognition by managers, colleagues, and the community was the most important motivating factor to improve job performance (Dielaman et al. 2003). Similarly, peer comparison can operate as additional motivation for the system to increase delivery of preventive care services such as vaccinations (Barton and Schoenbaum 1990; Briss et al. 2000). Peer comparison feedback can also boost referrals to other preventative services. For example, in a study on the likelihood that physicians will refer tobacco users to a local smoking quit line, benchmarking doctors against the top 10 percent of performers increased their likelihood of refer-ring patients (Bentz et al. 2007).

Community-level factors that affect NCD formation

People follow reference and influence groups and conform to identities and norms because it creates intrinsic utility (Akerlof and Kranton 2000). More dominant identities and strong social norms have been found to promote or discourage certain behaviors. While relevant research on NCD formation has been limited, evidence suggests that reference groups and peers play an important role (see for example Serrano Fuentes et al. (2019) for a review on obesity and social ties). For example, research has consistently shown that men are more likely than women to engage in certain risky behaviors, such as smoking and drinking, and that such behaviors are linked to masculine identity and peer pressure (see for example Keenan et al. 2015).

Social norms can also trigger aspirational consumption, i.e., the purchase of goods or foods prompted by relative deprivation and inequality (Bellet and Colson-Sihra 2018; Elgar et al. 2005). Examples include aspirational smoking as a sign of emancipation or freedom among women or youth (Amos and Haglund 2000; Toll and Ling 2005) or increased rates of obesity among the poor as a result of aspirational food consumption (Schneider et al. 2020). Community-level signals of what is an accepted or desired behavior do not come only from individuals. Physical cues such as ashtrays in public places, "smoking-friendly" labels, unhealthy or highly caloric foods at social gatherings, and others are all cues in social settings that normalize unhealthy behaviors, more so when they are also associated with identity elements.

Social references and cues are particularly strong for the initiation of behaviors at early ages, such as adolescence and early youth. In considering these issues, behavioral science distinguishes between *injunctive norms* (people's perceptions of what behaviors are approved or disapproved) and *descriptive norms* (people's observations of what behaviors are performed in reality). A systematic review examining evidence of the longitudinal associations between different types of social norms towards smoking and youth smoking uptake (initiation and escalation) finds that descriptive norms relating to parents' and close friends' smoking behavior appeared to be consistent predictors of youth smoking initiation, more so than the descriptive norms of more distal social networks and injunctive norms (East et al. 2021). A study comparing adolescent men in the capital cities of Armenia and India found that, in Armenia, adolescent men were more likely to have a smoking father and were 20 times more likely to accept and smoke a cigarette from pressuring peers than male adolescents in India, where smoking prevalence among the adult population is lower (Pandey et al. 2011). Among youth in England, Canada, and the United States, East et al. (2019) find positive social norms around vaping associated with use, with perceived peer approval of vaping being double that of smoking. The same authors explored whether current smokers' social norms towards smoking and electronic cigarettes varied across a wider set of European countries, including Romania, Spain, Hungary, Poland, Greece, Germany, and England (East et al. 2018). At the time of the study, England had the lowest smoking prevalence among these countries. Accordingly, smokers from England had the least pro-smoking norms. Peer smoking broadly aligned with country-level smoking rates, while the approv-

al of e-cigarette use in public similarly aligned with country-level e-cigarette use.[4]

Similarly, community-level factors that affect alcohol use, such as parents' alcohol-related behavior, frequently spending time with friends who drink, and the drinking norms observed in the wider social environment have been found to increase the risk of excessive drinking (Kuntsche et al. 2017). Halim et al. (2012) studied norms influencing alcohol use among college students, considering both descriptive norms (i.e., the individual's perception of the prevalence of alcohol consumption) and injunctive norms (i.e., the individual's perception of whether drinking is approved by their peers). Further distinguishing between distal (socially distant peers) and proximal (socially close peers), the researchers found that descriptive norms, proximal injunctive norms, and social motives all independently predicted alcohol consumption. Kremer and Levy (2008) find that peers (roommates) influence college students' alcohol use and academic performance, hypothesizing that peers exert influence via their impact on preferences and habits. The adverse effects tend to be particularly large for students who drank heavily in high school and are paired with a roommate who drank heavily.

Christakis and Fowler (2007) find that social ties and obesity prevalence are connected. They tracked over 12,000 individuals over the course of more than 30 years, finding clear evidence that obesity spreads through social connections. For example, the risk of an individual's becoming obese increased by 57 percent if a friend became obese in a given timeframe.

Individual decision-making that affects NCD habit formation

When it comes to caring for one's health, individuals are asked to make frequent decisions, often without adequate information or the ability to interpret and use information. Behaviors may not be viewed as health risks, or may be driven by a motivation completely unrelated to health. For example, lack of knowledge on the nutritional content of a meal can lead to unhealthy eating, either due to a misperception of the nutritional content of a given meal, or because the decision was made without nutrition as a salient factor. The same is true for lack of knowledge about how to interpret nutritional information or to connect information (e.g., about calories and protein) with foods and serving amounts using the information provided on food labels. Interventions that have changed food labeling by simplifying it and increasing salience suggest that information presentation is as important as its provision. For example, a regulatory change in Chile mandated that a simple warning about high calories and high sugar be placed in front of products in store displays. This change led to a reduction in the consumption of sugary cereals by consumers adjusting their beliefs regarding how healthy certain cereals were (Barahona et al. 2020; Araya et al. 2020).

Information, however, needs to be aligned with individual motivational factors that can affect NCD formation. These factors are related to the internal, both reflective and automatic, processes influencing decision making and human behavior. Present bias, our tendency to value instant gratification more than future benefits, and time inconsistency, our tendency to be impatient when choosing between receiving benefits today and receiving them in the future, are two examples of these automatic processes. The emphasis on the short term at the expense of the long term occurs because people perceive the present as tangible, while the future is abstract and hypothetical. Present bias creates self-control problems that affect many health behaviors, from exercising, eating healthy foods, and getting a mammogram to other preventive or protective health behaviors (defined by effort today and benefits tomorrow). Benefits today versus costs tomorrow factor in when people smoke, overeat, skip health visits, and more (Luoto and Carman 2014). A short-term gratification focus is at odds with healthy habit formation. Reflexive thinking that continuously prioritizes instant gratification (watch television over exercising) or impulses to smoke, drink, or eat unhealthy foods can end in unhealthy habits being formed.

Another psychological barrier informing NCD formation is overconfidence; both overestimating one's performance and over-ranking one's performance relative to others. Overconfidence explains

4 Regulations and laws, such as gradually banning smoking in public places, may also alter social norms (Acemoglu and Jackson 2014). Laws change material payoffs and thereby affect the factual behavior of the group understood as an equilibrium object, and thus the descriptive social norm associated with it. Laws may also provide information about societal values (Benabou and Tirole 2011).

risk-taking behavior, including risky health behaviors. Some people understand heart attack and cancer risks from unhealthy behaviors such as overeating and smoking but tend to believe themselves less vulnerable to negative outcomes than their peers, even if they adopt risky behaviors (Khwaja et al. 2007, 2009). Della Vigna and Malmendier (2006) show overconfidence in habit formation related to exercise: many gym members overpay, as they exercise too little, and propose overconfidence about future self-control as one possible explanation for such observed behavior.

Arni et al. (2021) measured health perception biases -- their label for overconfidence -- using objectively measured cholesterol and blood pressure in Germany and found that 30 percent of the population have biased perceptions about their cholesterol levels. The researchers also found that about 30 percent of respondents overestimated their rank in the population health distribution by at least 30 ranks relative to a reference group. Furthermore, greater overestimation of own health was associated with more engagement in unhealthy behaviors, such as consuming unhealthy food, not exercising, and sleeping fewer hours. This is akin to saying: *"Because I believe I am very healthy and can afford it, I eat more fast food and exercise less."* Notably, this study finds that smoking is not correlated with biased health perceptions.

The finding concerning smoking is consistent with Darden (2017), who finds that cardiovascular biomarker information provided at repeated health exams does not significantly alter smoking behavior. Cognitive dissonance, our tendency to often hold contradictory opinions, may explain these results. People smoke, for example, even when knowing of its danger. This self-contradiction is unpleasant (causes dissonance), so people develop cognitive tools that justify the contradiction. The most obvious way to address the contradiction, of course, is to stop smoking, but that is difficult to do (Rice 2009). Instead, people use other strategies, such as exaggerating how much pleasure they get out of smoking (that is, overweighting the present) or underestimating the future costs (e.g., *"Aunt Anna smoked her whole life and lived to age 89 without health problems"*). Another possible explanation is that signals and information about own health, be they objective as in Darden (2017) or perceived as in Arni (2021), are not powerful drivers of smoking behavior, possibly because its addictive nature prevents the proper evaluation of the health consequences of smoking.

Other biases to consider in disease formation at the individual level are loss aversion — the idea that a loss causes greater distress than the happiness caused from a gain of similar magnitude; the endowment effect — the overvaluation of a good when we possess it; and framing effects — the tendency to draw different conclusions depending on how the information is presented. Cawley (2011) found that subsidizing healthy food options was less effective in promoting healthy eating than was taxing the unhealthy food options. People viewed the discount on healthy foods as a gain, which was subsequently valued less than the loss of having to pay more for the unhealthy food. Another example from Kahneman (2011) is that cold cuts described as "90% fat-free" sound a lot better than cold cuts that have "10% fat."

Many of the aspects previously cited also influence the information and motivation dimension. However, individual biases can also impact opportunity factors that lead to NCD formation. These are related to external factors that make execution of a behavior possible. Physical opportunity, opportunities provided by the environment, and social opportunity, for instance to perform regular exercise, can promote or diminish healthy behaviors. For example, Zimmerman (2011) argues that obesity is not a rational choice, and that weight gain is not the result of people maximizing their utility given fixed preferences, but rather it relates primarily to the influence of food-producing companies, which attempt to change people's tastes toward fatty and high-calorie foods. This takes several forms, including direct advertising, product placement, and advertising in schools. It is important to note that this does not explain increasing obesity in low- and middle-income countries. In such contexts, the growth of income per capita as well as the increasing affordability of fast food relative to healthy food have been important drivers in the growth of unhealthy eating habits. Consequently, behavioral factors such as the one described for obesity are more likely to explain larger variations in high-income countries than in low- and middle-income countries.

Finally, individual capabilities, skills, and abilities also affect NCD formation. Decision fatigue and cognitive overload, for instance, make the decision-maker prone to poorer decisions. In marketing, sweets or other foods that people might not specifically search for in a supermarket are placed near the checkout aisles: customers having already made dozens of decisions on what to buy have reduced

mental resources available, thus becoming more prone to impulse buying (known as ego depletion) (Cohen 2012a, 2012b; Baumeister 2002). Examples of cognitive overload and food choices have been tested experimentally, for example by asking study participants to choose between cake and fruit salad while having to remember a number. Compared with a two-digit number, those with a seven-digit number were 50 percent more likely to choose cake over fruit (Shiv and Fedorikhin 1999).

Decision fatigue does not have to emerge from a single domain of decision-making. While some individuals might face decision overload in a given moment, others may confront a constant demand to make decisions due to limited opportunities. Poor people are particularly subject to decision fatigue because so many of their decisions involve significant trade-offs that even the smallest decision can have far-reaching monetary and welfare implications (Spears 2011; Mani et al. 2013). As suggested by Bertrand et al. (2004) and Shah et al. (2012), among others, poor individuals may exhibit the same basic weaknesses and biases as do people from other walks of life, except that, in poverty, with its narrow margins for error, the same behaviors often manifest themselves in more pronounced ways and can lead to worse outcomes. Material scarcity, for example, has been found to change the allocation of attention, promoting tunnel vision and forcing people to focus on immediate needs over longer-term goals (Mullainathan and Shafir 2013). In these situations, health decisions, if not obviously critical, might take second place to many other, more urgent and immediate needs. Similarly, consumption of what is available now (whether healthy or not) and impulsive behavior might be a simpler choice.

This section has so far discussed how different behavioral biases can impact the formation of NCDs along the pathway to healthy ageing. However, it is important to highlight that behavioral biases—and therefore the toolkits discussed in later sections—may be different when dealing with positive habit formation as opposed to eliminating negative habits. Different behavioral biases may become dominant in certain circumstances, and therefore the tools required to address them need to adapt to the setting. Most positive habits, such as beginning to exercise regularly, require fairly prolonged exposure and often convenient access to an appropriate contextual environment, so overconfidence (in time management and/or self-efficacy) is a common issue. While stopping some negative behaviors (such as unhealthy eating) may follow a similar dynamic, many behaviors in this category are instead more like smoking or other addictions, where loss aversion and present bias, for example, can make it difficult to overcome the initial hurdle.

NCD DETECTION: SCREENING

The second main phase of the individual journey to healthy aging has to do with screening and identification of illnesses. As in the previous section, our analysis follows health system, community, and individual-level factors and discusses, within each, behavioral barriers and biases influencing health-seeking behavior and screening and detection practices.

Health system factors that affect NCD screening

The role of health system factors in the uptake of NCD screenings involves both the doctor-patient interaction and broader system characteristics. In each of these areas, we find behavioral components that influence the appropriate uptake and use of NCD screening.

The doctor-patient relationship is often presented as an agency relationship: the physician makes informed decisions on behalf of the patient (McGuire 2000). Under this model, the physician makes decisions in line with the patient's preferences- including with regard to risk and time. However, such a decision-making process is also prone to potential behavioral biases that may influence the physician's choices.

Several studies have highlighted how physician risk preferences impact treatment and screening decisions. Some show, for example, that physician risk aversion is strongly associated with patient charges and expenditures over time (Allison et al. 1998; Fiscella et al. 2000). This highlights how, independent of the patient's preferences, physician risk preferences and biases could impact people's health care-seeking behaviors. Even though a recent

study found that risk preferences between patients and physicians were generally aligned (Galizzi et al. 2016), they may be misaligned in certain settings or when patients inaccurately estimate their own risks, and this possible misalignment may help explain why NCD screening remains low.

In contrast to the risk preference scenario, a field experiment in Greece found a significant difference in time preferences between patients and their physicians (Galizzi et al. 2016). This study highlights that, while improving communication between physicians and patients could improve the uptake of screening, it is of even greater importance to integrate a wide set of characteristics in the communication process, including the potential mismatch in time preferences.

Physicians are important drivers of patients' health care-seeking choices insofar as they are the choice architects for patients within the health care realm. A mixed-method study in the United States highlighted how physicians determine patients' choice possibilities, even though doctors proved not to be fully competent in their roles as choice architects (Hart et al. 2021). This reaffirms the physician-patient interaction as a key stage in which physician biases can influence the appropriate uptake of screenings and other procedures.

Physicians themselves are, as part of the system, affected by coordination failures and social influence. A systematic review of health care provider barriers to hypertension awareness, treatment, and follow up found that a common barrier was social influence in the form of a lack of care coordination with colleagues, along with social pressures and conflicting roles within a medical practice. Professional identity, expressed as a lack of trust in the evidence on which guidelines were based, was also found to influence hypertension treatment (Khatib et al. 2014).

Health care accessibility issues, particularly direct costs and opportunity costs are a primary reason why individuals forego screenings. In a recent review of the cost-effectiveness of interventions to reduce NCDs in LMICs, Watkins et al. (2022) find that increased screenings for diabetes and cervical cancer are among the most cost-effective. Reducing barriers within the health system itself will be crucial to increasing screening for these and other conditions. While health system accessibility is mainly influenced by policies, there is an interaction between access and personal biases that further reduces the likelihood of people's accessing screening services. A large share of biases also falls within the motivation dimension from the individual perspective. For instance, higher access or opportunity costs have routinely been linked with a greater likelihood of delaying screening (Lagarde et al. 2007). One explanation for this is the simple demand and supply theory, whereby higher prices discourage people from seeking health care, but another behavioral explanation is that higher costs counterbalance discounted future benefits. This issue links back to individual motivation, but it is important to note that health system factors such as prices or distance to health care establishments can further strengthen behavioral biases that hinder access to screening services.

Community-level factors that affect NCD screening

As social and community forces sometimes support unhealthy or risky behaviors that can, over time, lead to an NCD, they might also play a role in when and for what reasons people seek health care. While preventative care is not always offered when individuals show no signs of illness, screening might not take place even when these signs are present. Despite widespread evidence of the benefits of screening, many cultural norms may deter individuals from pursuing it. For instance, men seem to be less likely to seek mental health services, as doing so clashes with traditional masculine identity around strength and self-sufficiency (Pattyn et al. 2015). Similarly, as discussed earlier, if social networks and communities are formed by individuals with similar characteristics (e.g., people who smoke or are overweight), these networks are less likely to see the behavior and/or its consequences as warning signs to seek help.

The role of norms has been tested when making them salient in, for example, reminders to attend screenings or other health messages that refer to peer behaviors (Camilloni et al. 2013). A recent study in Armenia found that messages appealing to peer behaviors increased screening attendance about 15 percentage points for hypertension and diabetes (De Walque et al. 2020). However, the personalized invitation referencing peer behaviors did not have an add-on impact compared to standard personalized invitation.[5] A further study with the

5 The intervention tested 1) personalized invitations from a physician, 2) personalized invitations with information about peer screening behavior, 3) personalized invitations with a labeled but unconditional financial incentive, and 4) personal invitations with a conditional financial incentive.

same population found that participants described learning that neighbors and peers attended screenings as a potential motivator for service use, more so if the screening helped uncover a disease or obtain treatment (Gong et al. 2020). Social norms may not only influence initial access or use of screening services, but are probably also relevant to the subsequent interactions that occur within the health system, which can then influence the full uptake of screening options. Cultural aspects like personal health beliefs and qualities linked to interpersonal relationships, such as distance, trust, and directness, influenced patients' judgment of a physicianpatient interaction (Gao et al. 2009).

Stigma and fear are related to social norms and community assessment of health-seeking behaviors and can operate as enforcement mechanisms of prevailing norms. Early work highlighted how structural stigma- a social phenomenon with roots in social structures- exerted substantial influence in health care-seeking behavior for many causes (Hatzenbuehler 2014). Even though evidence on stigma remains scarce in the literature, a growing number of studies now highlight how social perceptions of a disease, its causes, and its consequences can influence individual health care-seeking behavior. A recent systematic review found that blame, shame, and fear were the main factors behind stigma for diseases such as cancer and that this had social, behavioral, psychological, and medical consequences (Rai et al. 2020).

Fear of stigma as a community judgement can stem from different conditions. Conventional body image norms and failure to meet these may deter people, especially women, from seeking screening services (Kilpela, et al. 2015; Fingeret et al. 2014). In the United States, as in many other countries, the uptake of disability programs became stigmatized to the extent that it discouraged participation in the screening process for individuals to be declared disabled (Hansen et al. 2014). Stigma can also influence the uptake of cancer screening. For example, McCaffery et al. (2006) report that, in the UK, screening and testing positive for the human papillomavirus (HPV) — a risk-factor for certain forms of cancer — was accompanied by feeling stigmatized. Stigma associated with mental diseases is among the leading reasons for the underuse of mental health services (Evans-Lacko et al. 2012). Similarly, the stigma associated with degenerative diseases like Alzheimer or other forms of dementia is likely to discourage individuals from following a screening procedure, for fear of the consequences that might follow it.

Individual decision-making that affects NCD screening and identification

In the case of ageing-related diseases, two behavioral factors are largely responsible for the low uptake of prevention. The first is that, in contrast to other illnesses, most NCDs remain asymptomatic for a long period of time (Bovet et al. 2015) and lack early saliency. The second is inaccurate individual beliefs and overconfidence, which lead people to undervalue the benefits of screening (Baicker et al. 2015).

Even with a clear understanding of which risk factors lead to NCDs, individuals tend to underestimate their likelihood of suffering from an NCD. This issue relates to the risk-taking behaviors described earlier concerning the formation of NCDs, whereby individuals believe themselves to be less likely than their peers to suffer such poor fortunes (Khwaja et al. 2007, 2009). Evidence demonstrates that actual risk and perceived risk for cardiovascular diseases were weakly correlated, with most high-risk individuals being incorrectly optimistic (Van der Weijden et al. 2007), and that people under-estimate their own risk for high cholesterol while overestimating the risk of others (Arni et al. 2021). As individuals underestimate their own risk, they are then less likely to value the benefits of screening and to consider that these benefits are larger than the costs of attending a screening session.

This highlights the role of present bias in the low uptake of screening. People generally tend to be time-inconsistent and delay screenings, and the reduced value that people attribute to screenings reinforces the impact that present bias can have in postponing appropriate preventive care. A theoretical study using US data found that time-inconsistent health investment behaviors, including with regard to screenings, could explain a loss of about four years in life expectancy (Strulik and Wener 2021). Further studies have also shown that high discount rates are associated with lower screening rates for cancer and measurements of blood cholesterol (Bradford 2010). It is important to emphasize the relevance of motivation in terms of healthy ageing, since preventive screenings are not a onetime process. Usually, screening for NCDs needs to be conducted annually after certain ages. Therefore, these biases can have long-term consequences if motivation for screening uptake remains low.

Loss aversion also influences the motivation to attend health screenings in a subtle way. Even people with accurate perceptions may not take up screening to avoid the realization of a foreseeable

bad outcome. A qualitative study in the United States found that fatalism and negative outcome perspectives were important barriers to participation in screening for breast cancer (Peek et al. 2008). Similar findings were obtained across multiple countries, linking fatalism to lower attendance at cancer screening programs (De Los Monteros and Gallo 2011). Another literature review based on the UK population found fear of a negative outcome as one of the reasons individuals did not attend the regular health checks proposed by the National Health Service (NHS) (Harte et al. 2018). While one might think that loss aversion would only affect voluntary attendance at screenings, other studies suggest that this fear also leads people to reject explicit invitations to screening programs (Witte and Allen 2000). More importantly, loss aversion does not only have a personal impact. A field experiment in Australia showed that loss aversion among relatives can influence an individual's enrollment in health management programs (Beatton et al. 2021). Overall, these studies emphasize that loss aversion is an important driver in declining motivation and procrastination around screening.

Finally, decision fatigue and cognitive overload can also lead to poor decision-making processes with regard to screening. A potential diagnosis of a chronic condition that would entail regular expenditures may lead to unmanageable situations in poorer households. As in the case of habit formation, households unable to afford possible treatment in the future may prefer to avoid attending a screening consultation (Spears 2011). Cognitive overload can also have an impact on an individual's capability to follow up on the different stages of a screening process. Even though invitation letters increase the uptake of preventive screening programs, often they contain an overwhelming amount of information, limiting the potential of the invitation to increase screening uptake.

NCD MANAGEMENT

This section discusses how behavioral factors influence the long-term management of NCDs via sustained lifestyle changes, medication adherence, continued medical care, and other measures necessary for managing chronic conditions.

Health system factors that affect NCD management

Traditional behavioral change approaches to better align clinical practice with guidelines have mainly focused on improving access to information and guidelines. These methods are based on conventional economic theory and presume that physicians are perfectly rational decision-makers whose main barrier is lack of information.

Physicians, however, make numerous complex decisions on diagnostic and treatment plans daily, often with limited information and under time pressure (Blumenthal 2015). When making a high volume of decisions under conditions of uncertainty, the decision-making process may be guided by environmental cues and heuristics (Blumenthal 2015; Scott et al. 2017). These make physicians especially vulnerable to systematic cognitive biases (Saposnik et. al. 2016), for example, distorting probability estimation and impairing information synthesis (Wang and Groene 2020).

Behavioral science can help explain why, for example, prescription rates of guideline-directed therapies seem to be lower than appropriate (McCarthy 2019; Greene et al. 2018; Salami et. al. 2017d) or why physicians treating cardiovascular disease under-prescribe statins and fail to intensify treatment when indicated (Asch et al. 2015). Due to the cognitive biases impacting their decision-making in the context of NCD treatment, doctors may judge risk to be low without available personal experiences (for example, knowing someone or experiencing themselves the consequences of under- or over-prescription), may be less careful than expected when not observed, and may falter without an injunction from authority (Doctor et al. 2018). Such biases may explain why physicians sometimes continue to deliver care that robust evidence has shown to be of low value (Scott et al. 2017).

Community-level factors that affect NCD management

Some of the community-level factors mentioned in prior sections — social norms, peer pressure, roles, identities, and stigma — also affect NCD manage-

ment, both through patient and provider behavior.

On the providers' side, norms about treating "someone else's patient," identity related to health providers' scope of work (i.e., nurse vs. doctor), and shared beliefs about treatments, medications, clinical guidelines, and actual capabilities to help patients manage and control NCDs can hinder how much providers engage with patients in their ongoing care. Khatib et al. (2014) find evidence that providers doubt the efficacy of certain hypertension medications, are reluctant to initiate aggressive anti-hypertensive drug treatment due to possible side effects, and question whether following clinical guidelines would improve outcomes.

On the patients' side, shared beliefs, myths and misinformation, social norms, and community practices can also hinder appropriate treatment and medication adherence. For example, in the United States, African American and Latino patients' beliefs about the effectiveness and side-effects of medications have been found to lower adherence (Wexler et al. 2009; Peters et al. 2008). In Zimbabwe, poor awareness from both patients and the community has been found to result in the use of alternative, and potentially harmful, remedies (Kamvura et al. 2022). Community suspicion of government has also been found to hinder NCD management (Heller et al. 2019).

Lack of social support, mainly from family and friends, is an important barrier to treatment and medication adherence and healthy lifestyle changes (Devassy et al. 2020; Khatib et al. 2014). The ability to make lifestyle changes to control NCDs in many cases involves changing social practices. Improving eating patterns, for instance, may entail new cooking patterns within a household or having to cook a healthier meal for oneself (Khatib et al. 2014). Social interactions that involve smoking or drinking exert peer pressure on the person undergoing treatment. The opposite holds, as well: a positive social environment and good social support have been shown to have a significant impact on compliance with the medical management of chronic disease (Basu and Millett 2013).

Finally, apprehension about stigma and stereotypes, often stemming from past negative interactions with the health system, can lead patients to fear discrimination based on factors including race/ethnicity, age, gender, and weight. This has been associated with higher distrust of physicians and dissatisfaction with health care, poorer mental and physical health (including self-rated health, hypertension, and depressive symptoms), and lower odds of receiving the influenza vaccine (Abdou et al. 2016).

Individual decision-making that affects NCD management

Management of NCDs in most cases requires adherence to medications, ongoing follow-up medical care, and sustained changes to lifestyle and health behaviors, such as physical activity or smoking, which are difficult to achieve. Adherence to one regime (medicines) might displace cognitive resources from these additional sets of changes and new habits, potentially enabling other biases related to decision-making to take hold. Cognitive biases particularly relevant to NCD management are those that affect how people perceive losses (Kahneman and Tversky 1979), value the present vs. the future (O'Donoghue and Rabin 1999), and understand ambiguity (Fox and Tversky 1995; Fox and Weber 2002). In cases where habit change is difficult, the immediate negative side effects of giving up certain unhealthy behaviors (tobacco or specific foods, for example) may be perceived as worse than the potential long-term consequences of non-adherence to the recommended behaviors, even though those consequences are in fact greater, even when accounting for their occurrence in the distant future (Luoto and Carman 2014).

Even when people are motivated, limited attention can interfere with medication adherence, care seeking, and lifestyle changes. The limited ability to notice, store, and process information can help explain the difficulty many individuals have in adhering to a prescribed course of treatment (Kessler and Zhang 2014). The formation of habits (or changing existing ones) requires self-efficacy, effort, and investment in the creation of an opportunity "event" that links the needed healthy behavior to an environmental cue or trigger, such as placing medicines in a visible location in the morning, even when the motivation (feeling sick or fear of future consequences) becomes less salient.

As people also rely upon knowledge that is salient and easy to retrieve from memory when judging probabilities and making decisions (Tversky and Kahneman 1973; Bruine de Bruin et al. 2016), the salience of a given piece of information, or the degree to which that piece of information stands out relative to other information, can also affect decisions related to medication adherence and habit change. If a piece of information is not particularly salient or becomes less salient over time, it might be overlooked or more easily forgotten. The salience of symptoms and of the treatment itself can influence medication adherence (Kessler and Zhang 2014). Over time, if a medication's beneficial effects become less noticeable, adherence can fade, as in the case of low adherence to tuberculosis treatment regimes (Munro et al. 2007; Pradipta et al. 2020).

RECOMMENDATIONS FOR A POLICY TOOLKIT

Behaviorally informed interventions for NCD formation, detection, and management

Traditional policy tools based on the rational subject model have been moderately effective in changing unhealthy behaviors. In the case of tobacco use, for instance, raising prices through taxes on cigarettes, providing information about the perils of smoking, and introducing barriers to the purchase and use of tobacco have curbed the behavior, but large shares of the population continue to smoke. Similarly, information about the risks of overeating, drinking alcohol, sedentary lifestyles, and other unhealthy habits does not seem to be enough to inflect these behaviors. Insights from the behavioral sciences can complement these traditional tools, increasing their efficacy and impact.

Behavioral interventions that aim to address the factors behind risky behaviors appear to support the reduction of NCD lifestyle risk factors. Systematic reviews have assessed the evidence around these interventions. Blaga et al. (2018) reviewed the effectiveness of strategies used to promote tobacco cessation, reduce alcohol consumption, promote healthful diets, and increase physical activity, finding promising results with potential impact on NCDs. Möllenkamp et al. (2019) studied the effectiveness of behavioral interventions in improving self-management among adults with chronic diseases and reported positive impacts. These reviews and other studies find that the most commonly tested (and successful) behavioral interventions are reminders, planning prompts, nudges (i.e., indirect influencers inspired by cognitive biases and boundaries), and feedback focused on self-management. Most financial subsidies, fines, and other attempts to directly change the cost-benefit calculation of a decision do not count as behavioral, but small financial incentives constitute a nudge if they work primarily via salience or signaling of norms. Other reviews have focused on behavioral tools such as choice architecture (Hollands et al. 2013; Skov et al. 2013; Thapa and Lyford 2014), finding promising but under-researched impacts. Moderate impacts have been found on time discounting when it comes to obesity (Barlow et al. 2016), while altering default settings and providing social reference points have been found to have positive effects on changing physician behavior (Wang and Groene 2020). Ongoing management of NCDs, mainly via medication adherence, is among the most cost-effective strategies for NCD control (Watkins et al. 2022); the policy tools discussed here can support adherence by addressing barriers that currently prevent individuals from entering and remaining in care, thereby improving the effectiveness of such interventions.

The behavioral science toolkit is large. No single policy tool can address the complexity of behavioral barriers across the whole journey towards healthy aging. Nor should these be considered stand-alone interventions that can operate independently of other services, health system resources, and other structural factors. It is in the combination of a strong structure of opportunities to adjust behaviors and habits, supported by motivation and a sense of ability to act, that behavior change can take place and be sustained over time. The policy toolkit outlined here is both ample and complimentary to existing policy efforts. These efforts include classical interventions such as taxation, subsidies, or restrictions. The purpose of this review is not to compare the effects of behavioral and classical interventions; however, we emphasize the need for future studies to evaluate how different combinations of behavioral and classical tools can maximize the effect to achieve healthy ageing.

In terms of interpretation, the tools described below can be linked to the original framework by way of identifying the *"Behavioral Phenotype"* of a given policy's intended target population. This means identifying and segmenting the target population not only by risk characteristics or sociodemographic traits but based on a larger set of profile elements, including behavioral and psychological variables, motivation, ability, and opportunity factors. While for some people reminders are all that is needed to close gaps in treatment adherence, for others more complex interventions to inform, motivate, and create adequate social support might be required.

The tools and literature presented in this section are a selection of the relevant evidence that speaks to the three stages of NCD formation, detection, and management. We leveraged randomized field interventions and systematic reviews to showcase the behavioral toolkit available to policymakers to tackle NCDs. However, the selection is not the result of a systematic review. The literature search strategy comprised English-language, peer-reviewed electronic records from Google Scholar published

between 2000 and 2022. Reference lists of relevant studies were also hand searched for eligible papers. The approach prioritized studies from low- or middle-income countries and was supplemented with evidence from high-income countries. The selected field studies, mega-studies, and systematic reviews conducted or assessed randomized control trials (RCT) to measure the interventions' effectiveness.

We gave precedence to mega-studies and systematic reviews to ensure the external validity or generalizability of the tools. However, there are gaps where evidence is mixed or very limited, and this is reflected in the toolkit. There is more robust evidence base related to financial incentives on a wide range of behaviors, as compared with salience or plan-making. We also have little information about the persistence of the reported effects for even the most successful interventions, as studies of this kind rarely follow participants for more than a few months after the intervention. This limitation is most important for interventions that aim to build habits, for example around exercise, as opposed to interventions focused on one-time (or infrequent) behaviors such as screenings.

The review does not include interventions focused on leveraging peer effects (e.g., role models) or community mechanisms (e.g., support groups): not because these don't exist, but because the strategies presented below (incentives, goal setting and planning, reminders, and others) can all benefit from a community focus to increase support for healthy behaviors and reduce the potential negative impacts of social networks. Continuing efforts to communicate and inform for behavior change, and to update people's perceptions of beliefs or behaviors among their peers, can complement strategies more focused on the individual.

Small financial incentives

Financial incentives have been tested as means to reward healthy behaviors across a variety of contexts, and as a strategy that works to promote healthy behaviors, particularly among less well-off populations (Vlaev et al. 2019, Haff et al. 2015). Interventions have been successful to promote exercise (Charness and Gneezy 2009; Cawley and Price 2013), weight loss (Sen et al. 2017; Cawley and Price 2013; John, et al. 2011; Volpp et al. 2008a), smoking cessation (Volpp et al. 2009), and adherence to chronic disease medications (Volpp et al. 2008b). Overall, financial incentives seem to promote healthy behaviors in the short term, but effects disappear when the incentives are removed. Combinations with other behavioral insights such as peer and framing effects tend to render better lasting results. One study focused on US school children found that incentives can increase rates of fruit and vegetable consumption, particularly among lower-income children, who are most likely to benefit (Just and Price 2011).

Financial incentives to patients and physicians are increasingly used to manage NCDs. According to a meta-analysis by Haff et al. (2015) and a mapping review by McGill et al. (2018), contemporary incentive designs that leverage people's "decision biases" may improve the efficacy of incentive interventions. A meta-analysis of financial incentives including 23 RCTs to promote physical activity found that modest incentives (US$1.40/day) increased mean daily step counts during the intervention periods for interventions of short and long durations and after incentives were removed (Mitchell 2020).

An additional body of evidence supports the notion that financial incentives could motivate weight loss (Finkelstein et al. 2007, 2017; Volpp et al. 2008b; John et al. 2011; Kullgren et al. 2013; Adams et al. 2017). Finkelstein et al. (2016) found that participants who received a FitBit and cash-based financial incentives had significantly more minutes of moderate to vigorous physical activity compared with a control group (29 additional minutes weekly), but participants who received a FitBit and charity-based financial incentives, or a FitBit alone, did not (Finkelstein et al. 2016)—providing evidence that financial incentives may be more effective when received directly. Kullgren et al. (2013) examined individual versus group-based financial incentives for promoting weight loss among obese employees. A group-based financial incentive was more effective than an individual incentive and monthly weigh-ins at promoting weight loss among obese employees at 24 weeks.

Financial incentives have also been tested for treatment management. Volpp et al. (2008b) conducted a randomized trial of the use of financial incentives to encourage greater adherence to warfarin, a blood thinning medication. This study found that a variable rewards mechanism — incentivizing people with a daily lottery that offered a small chance of a large payout — resulted in a significant reduction in the fraction of missed doses. However, after the variable rewards were removed 28 weeks later, adherence returned to baseline levels. John et al. conducted an extended version of

the same intervention in 2011 and replicated the pattern that incentivized participants lost significantly more weight by 32 weeks but that this effect was not significantly sustained at 68 weeks (John et al. 2011). In 2020, Barankay et al. conducted a trial where participants were given lottery-framed financial incentives when adherent to statins. Each intervention group had a significantly higher rate of statin adherence compared to the control group at six months but mean reductions in low-density lipoprotein cholesterol (LDL-C) levels were non-significantly different between the intervention groups and control group at 12 months.[6]

These interventions' designs included many insights from behavioral economics, including people's tendency to overestimate small probabilities and be particularly emotionally attracted to small probabilities of large rewards, therefore often preferring a lottery-based incentive over a known, consistent incentive amount. Also, the daily lottery incentive provided regular feedback, which addressed present bias, as even small rewards and punishments can have large effects on behavior when they occur immediately. This feedback also addressed people's tendency to wish to avoid regret, because people found out each day if they would have won had they been compliant (Luoto and Carman 2014).

In an intervention tying physician financial incentives to clinical goals to increase attention to patient lipid management, primary care physicians were randomly assigned to control, physician incentives, patient incentives, or shared physician-patient incentives. In primary care practices, shared financial incentives for physicians and patients, but not incentives to physicians or patients alone, resulted in a statistically significant difference in reduction of LDL-C levels at 12 months (Asch et al. 2015).

To examine the effect of combining financial incentives with a team-based approach, Patel et al. (2016a) conducted a randomized clinical trial where financial incentives were delivered to participants when they met their step counts as individuals, teams, or a combination of both. The combined financial incentive arm had a significantly greater mean proportion of participants achieving their step goal as compared with the control group (35 percent vs. 18 percent), highlighting the power of both social norms and individual accountability to influence physical activity. Similarly, but leveraging gamification, Patel et al. (2017) found that families who received a daily intervention that assigned points and levels based on step counts achieved step goals on a significantly higher proportion of days compared with the control group (53 percent vs. 32 percent) and had significantly higher mean step counts compared with their baseline (1661 vs. 636). Relatedly, Patel et al. (2016b) examined peer comparisons in a trial where participants received team-based step count feedback compared with either the 50th or 75th percentile, with or without financial incentives. The peer comparison to the 50th percentile and financial incentives were most effective at increasing physical activity.

Incentive framing can also impact NCD management. Patel et al. (2016) conducted a subsequent study to test the efficacy of "gain-framed," "loss-framed," and lottery-based financial incentives (Patel et al. 2016). Only participants in the loss-framed arm achieved a significantly greater mean proportion of days meeting their step goal compared with the control group, revealing the importance of framing when delivering. In 2019, Chokshi et al. replicated the finding that loss-framed financial incentives are the most effective at increasing physical activity but in patients with ischemic heart disease (Choksi et al. 2019). A pilot study by Riegel et al. (2020) examined the impact of loss-framed financial incentives on patients' adherence to aspirin following admission for acute coronary syndrome. At 90 days, the incentive-receiving patients had a nonsignificant higher rate of aspirin adherence compared with the usual care group (90 percent vs. 81 percent) and a nonsignificant lower rate of rehospitalization (13 percent vs. 24 percent).

Contingency management is another tool offered to provide incentives, for instance, to addicts to abstain from consuming the addictive good (Cawley and Ruhm 2011; Higgins et al. 2002). It reinforces or rewards individuals with vouchers exchangeable for retail goods and services or the opportunity to win prizes to promote positive behavioral change (Petry 2011). A meta-analysis of voucher-based reinforcement therapy found overwhelming evidence of increased abstinence; the vouchers raised compli-

6 The discrepancy in statistical significance between the intervention's impact on statin adherence and the more clinically meaningful metric of LDL-C levels highlights the continued need for similar studies to directly measure health outcomes in addition to the health behaviors which lead to such outcomes (Hare 2021).

ance by an average of 30 percent, with larger effect sizes for rewards that were more valuable or were delivered immediately (Lussier et al. 2006). However, there is some evidence that contingency management may be more effective at treating the use of opiates and cocaine than tobacco (Prendergast et al. 2006). A striking feature of these programs is the relatively high success rates obtained for small vouchers – as little as US$2.50 for a single negative test for cocaine (Higgins et al. 2002; Petty and Martin 2002), suggesting that the immediacy of the re-ward is enough to overcome the urge to use.

One important caveat regarding the financial incentives described above is the ambiguity concerning their long-term impact. Most of the studies cited here examine the effect of financial incentives on NCD management or the uptake of health care services only in the short term. More importantly, even some of these short-term studies find evidence that the appropriate behavior often stops once the financial incentives end. This brings into question the potential long-term effects of such incentives and emphasizes that their usefulness may be limited to cases where short-term but "sticky" habit formation is required. This caveat should be taken as a cautionary note, since many governments in low- and middle-income countries still consider financial incentives - whether conditional or unconditional - as a silver bullet for many problems. The studies above highlight that the long-term effects of these tools are not certain and that such approaches might therefore only offer temporary solutions.

Commitment contracts – devices

Another tool for curbing unhealthy behaviors is commitment contracts, for example encouraging people to sign contracts to quit smoking and providing rewards for those who do. In the Philippines, Gine et al. (2010) randomly assigned 2,000 regular smokers into two groups - one that was offered the opportunity to join a commitment program and one that was not. The program (CARES) offered individuals a savings account into which they deposited funds for six months, after which they took a urine test for nicotine and cotinine. If these substances were not detected, the money was returned to them; otherwise, their money was confiscated and donated to a pre-chosen charity. The group that received CARES (includes both populations who accepted and did not accept the program) were 3.5 to 5.7 percentage points more likely to pass the 12-month urine test than those in the control group, who were only informed about the consequences of continuing to smoke. This result was (marginally) significant. However, those who used CARES were 31 to 53 percentage points more likely to pass the 12-month urine test than the control group.

Commitment contracts have also been used to encourage other forward-looking behaviors, including weight loss (Volpp, et al. 2008). Obese participants from the United States were randomly assigned to one of three treatments: monthly weigh-ins, a lottery, or a "deposit contract incentive system." In the deposit contract incentive system, participants committed between US$0 and US$252 per month of their own money towards the goal of losing weight. The money would be returned to them with a 1:1 incentive match upon meeting their goal (losing 16 pounds in 16 weeks), but they would forfeit the money if they failed to meet their weight loss goal. Such a contract incorporates the behavioral economic findings of overconfidence and optimism bias, as people are ex-ante overly optimistic about achieving their weight loss goals and therefore more likely to enter the contract than they otherwise might be. This incentive design also takes advantage of loss aversion because, once the money is committed, the motivation to lose weight is heightened by the motivation to avoid the loss of the funds. Finally, the contract can potentially appeal to those who are sophisticated about their present-biased preferences: their "planner" selves today will sign up their future "doer" selves for the hard work of following through on the binding commitment. Although the study was based on very small sample sizes, it revealed that both incentive systems worked. Average weight loss was 13 to 14 pounds across both types of incentive programs, compared with just four pounds in the control group that underwent monthly weigh-ins. Furthermore, nearly 90 percent of participants chose to participate in the deposit contract. However, in both treatments, participants were found to regain the weight upon withdrawal of the incentives (John et al. 2012).

In South Africa, Schwartz et al. (2014) tested a voluntary self-control commitment device to help grocery shoppers make healthier food purchases. Participants, who were already enrolled in a large-scale incentive program that discounts the price of eligible groceries by 25 percent, were offered the chance to put their discount on the line. Agreeing households pledged that they would increase their purchases of healthy food by 5 per-

centage points above their household baseline for each of six months. If they reached that goal, their discount was awarded as usual; otherwise, their discount was forfeited for that month. Thirty-six percent of households that were offered the binding commitment agreed; they subsequently showed an average 3.5-percentage-point increase in healthy grocery items purchased in each of the six months; households that declined the commitment and control-group households that were given a hypothetical option to precommit did not show such an increase (Schwartz et al. 2014).

The basic principle explaining why commitment contracts are hypothesized to work is that committing oneself today to a behavior tomorrow can overcome hyperbolic discounting and present bias (Luoto and Carman 2014). That is, it is easy to plan to start dieting or exercising tomorrow. If your present self can precommit your future self to follow through on such behaviors, intentions and actions can align where they otherwise might deviate.

Saliency and vividness

Saliency and vividness have also been found effective in highlighting the risks of unhealthy behaviors and inflecting those behaviors. For example, the government of Uruguay implemented a major non-price tobacco campaign with measures including programs to treat nicotine dependence at health centers, banning tobacco advertising nationwide, rotating warnings with pictograms on each pack of cigarettes, restricting brands to a single presentation, and increasing the size of pictograms to 80 percent of the front and back of each pack. Results from the program evaluation indicate that, from 2007 to 2012, the proportion of pregnant women who had quit smoking by their third trimester increased markedly, from 15 to 42 percent. Quitting smoking by the third trimester increased birth weight by an estimated 163 grams (Harris et al. 2015). Although the Uruguayan campaign has elements that operate at both the individual level and the system level (e.g., access to treatment programs), overall saliency is about the decision-making context and can therefore be considered most closely linked to other community-level interventions.

Another randomized trial tested the role of feedback in the form of mHealth SMS messages in encouraging greater adherence to self-monitoring in a weight loss regimen. The two-year study found that daily SMS feedback messages enhanced adherence to self-monitoring and increased weight loss (Burke et al. 2012). However, the overall effects on weight loss were small, around 2 percent of bodyweight, on average. Barnes et al. (2012) found that using symbols such as stars, rather than presenting numbers, was easier for most people to comprehend. In addition to this, applications or processes that rely on sending SMS can also suffer from user fatigue. This means that such an approach can have a strong effect in the short term, due in part to its novelty, but that the intervention's effectiveness can decrease and even disappear as the novelty wears off, if users unsubscribe or withdraw from the messaging system.

Reminders and saliency applied to health workers can also promote medication adherence. Using a randomized controlled trial format, Doctor et al. (2018) monitored the effect of notifying physicians who had a patient die of opioid overdose within 12 months of a prescription. The physicians received an injunction to prescribe safely from their county's medical examiner. The hypothesis behind this intervention was that, as people rely upon knowledge that is impactful, recent, and easy to retrieve from memory when judging probabilities and making decisions (Tversky and Kahneman 1973; Bruine de Bruin et al. 2016), decisions to avoid harms could occur more frequently after receipt of the letter, because the effects of opioid harms would be more readily available to memory. Clinicians are also disproportionately exposed to patients who return to their clinics uneventfully for an opioid refill. The letter alerted clinicians to those patients who do not return, owing to death via an overdose. Clinicians would then prescribe with greater care, if they perceived that they are being watched, particularly by figures of authority (Cialdini 2003). To receive a message communicating a patient's overdose death from the medical examiner would have particular weight. This intervention led to reductions in high-intensity prescribing, reductions in the likelihood that an opioid-naïve patient would receive a prescription, and a reduction in overall cumulative opioid intake (Doctor et al. 2018).

Plan-making

Plan-making can also make adherence more salient. Milkman et al. (2011) designed a field experiment to test whether suggesting that individuals write down when they intended to get an influenza vaccine (thus making it more salient) increased rates of vaccination. This approach aligns two behavioral tools frequently used together to promote better

behaviors regarding NCD management, namely mental contrasting with implementation intentions (MCII). During mental contrasting, people first are prompted to indicate a wish (what they want to achieve) and then to imagine what fulfilling that wish would feel like. This is followed by an identification of the obstacle(s) to fulfilling the wish in present reality, and by the identification of a plan to address such obstacles (e.g., a wish to be healthier to be able to play with a grandchild, obstructed by a lack of regular exercise today, that would be tackled by a daily walk after lunch). By focusing on the motivation factors - wish and outcome of the wish - and identifying an obstacle and plan to address it that is under the individual's control, effort toward the desired future is strengthened (Oettingen et al. 2001; Oettingen 2015). The technique has been shown to reduce drinking (Wittleder et al. 2019), improve healthy food consumption (Loy et al. 2016), increase physical activity and weight loss (Marquardt et al. 2017), and reduce smoking (Mutter et al. 2020). Stadler, Oettingen, and Gollwitzer (2009) found that women who used MCII doubled their amount of weekly moderate-to-vigorous physical exercise (about one hour more per week) and that the effect was sustained for four months.

Reminders

To tackle limited memory and forgetfulness, electronic reminders are increasingly being used by the health system to address poor medication adherence and appointment attendance rates. These reminders alert individuals by either providing an auditory or visual reminder or by sending an automatic electronic message such as a text message (Kessler and Zhang 2014). A randomized evaluation in Cordoba, Argentina, found that sending this kind of reminder significantly improved attendance at appointments (by 29.4 percent), an increase from 50.6 percent (control group) to 65.5 percent (experimental group) ($p<.05$) (Bonino et al. 2020). A study in Australia showed that a scheduled reminder intervention through telephone calls improved attendance by 16.3 percent (Ritchie et al. 2000). Another investigation evidenced a 17.6 percent increase in the rate of attendance at scheduled controls among outpatients of an endoscopy clinic who received reminders (Lee and McCormick 2003).

Alternative reminders such as personal phone calls can increase adherence but often require costly time investment and personal commitment from health care providers. Some studies have compared the effects of different technologies for sending shift reminders. Results indicate that text messages, telephone calls, and even reminders made in person present similar rates of reduction in absenteeism (Perron et al. 2013; Mugo et al. 2016). Vervloet et al. (2012) reviewed 13 randomized controlled trials that test the effectiveness of different electronic reminders for increasing adherence to various types of chronic medication. They found evidence suggesting that electronic reminders encourage medication adherence in the short run (less than six months) but are less effective over the long run. Furthermore, effectiveness can vary across medications for a given type of electronic reminder. While text messages are an effective tool for increasing adherence among adult patients with HIV (Hardy et al. 2011; Pop-Eleches et al. 2011) or children requiring influenza vaccinations (Stockwell et al. 2012), they have mixed effects on adherence for women taking oral contraceptives (Hou et al. 2010; Castano et al. 2012).

Choice architecture

A favorite approach for behavioral economists to mitigate present bias is simply to remove the temptation from one's choice set, or to make the healthy and unhealthy options equally convenient. Choice architecture refers to the practice of influencing choice by "organizing the context in which people make decisions" (Thaler et al. 2013, p. 428). A systematic review by Blaga et al. (2018) found 10 studies that employed choice architecture to improve nutrition by making changes to serving lines, vending machines, or by indicating healthful and unhealthful foods using traffic-light-like labels. Like salience, all these adjustments change the environment in which people make health-relevant choices and should be considered as community-level interventions within the framework presented, in comparison to many of the individual-level ideas described above.

Another study looked at the use of portion control plates for dispensing meals to obese patients in Canada. Anchoring patients on smaller plate sizes resulted in a significantly greater weight loss and less need for diabetes medications after six months among those assigned to the intervention group vs. a control group that was given the usual care, or dietary teaching (Pederson, Kang, and Kline 2007).

Anchoring bias has also been used to encourage healthier shopping at grocery stores. In a study in grocery stores, researchers put a piece of duct tape

across the top of shopping carts with a sign indicating that fruits and vegetables should go in front of the tape and behind was reserved for everything else. Fruit and vegetable sales more than doubled without affecting the store's profitability (Bannister 2010).

Similarly, another study included the design of a menu featuring healthful options on the front page and unhealthy options at the back of the menu (Downs et al. 2009). This treatment harnessed the status quo bias by making the healthy options the implicit default, given that one had to look in the back of the menu to find the unhealthy fare. Those who received the menu highlighting healthy fare were 48 percent more likely to purchase a low-calorie sandwich relative to the standard menu that had a mix of healthy and unhealthy options. A third group was given a menu that highlighted unhealthy fare, and as a result they were 47 percent less likely to purchase a low-calorie sandwich. The results suggest that highlighting the healthy options can improve people's chances of selecting more healthful fare.

In the field of suicide prevention, changes in the choice architecture have been implemented to deter paracetamol overdose. In 1998, the UK changed its laws on paracetamol packaging, making it illegal for pharmacies to sell the drugs in large containers. This change in legislation presented only a small barrier, as people could still buy packs in other outlets. Nonetheless, friction costs led to an estimated 43 percent reduction in suicides in the 11 years following the introduction of the legislation (Hallsworth et al. 2016).

CONCLUSION

This chapter proposes a framework for integrating insights from behavioral science into policies aimed at reducing NCDs and improving healthy longevity. As NCDs become a key focus of global health policy, a framework and toolkit for understanding the role of various behavioral biases and barriers become crucial to designing effective interventions that produce lasting impacts. Despite existing knowledge regarding the magnitude of the link between behavioral habits, NCD risk factors, and disease prevention, it remains the case that a large share of deaths can be attributed to behavioral risks.

The framework presented in this study has aimed to clarify the relationship between individual behaviors and the achievement of healthy longevity through entry points at the individual, community, and health systems levels for the three main stages of the NCD journey: formation, detection, and management. The study used this framework to unpack the main behavioral barriers identified for each of these levels and stages. It then documented how behaviorally informed policies—for instance involving framing, timeliness, motivation, or future focus—can support healthy longevity. The central insight from behavioral science lies in identifying the obstacles and barriers that constrain people's ability to realize their aspiration toward healthy aging, whatever the form of the subsequent optimal policy. This chapter has outlined a framework and roadmap for diagnosing these underlying issues. The policy toolkit then proposes key areas of intervention that can be used across NCDs to reduce their formation, improve their detection, and ameliorate their management, and that can be adapted to different population groups.

While different groups in different contexts are likely to benefit from different interventions, and in some sense, this is especially true for behaviorally informed policies, it is still the case that the fundamental insights, and many of the corresponding barriers, are universal. All humans care about what others think of them, even if the specific reference class (peers, religious leaders, or other categories) varies by age and culture. One implication is that most of the biases discussed, as well as the impacts of targeted programs, don't differ greatly by gender or income, for example. That said, women may be especially receptive to interventions based on aspirations (for themselves or their children), while men are especially unlikely to seek health care and may need additional support in that domain.

Finally, it is worth facing the fact that all interventions, behavioral or otherwise, involve making tradeoffs and considering opportunity costs; this is particularly true in resource- and capacity-constrained settings across much of the world. Fortunately, many behavioral "nudges" can be implemented essentially for free, making them even more relevant in such contexts. This still requires the capacity to take the initiative and to know what to do, for which there are existing sources of external support (such as the World Bank's eMBeD team)

but also a growing number of internal units (see OECD Interactive BI Unit Map). Behavioral organizations exist at either the national or sub-national level in Brazil, Chile, Colombia, India, Lebanon, Peru, South Africa, Tanzania, Tunisia, and Zambia – among others. It should be reiterated that all these policy approaches can be viewed as complements to, not substitutes for, traditional approaches (Bryan et al. 2017). Behavioral measures are often used to build on or leverage existing frameworks, which can therefore ease their adoption from both a financial and political perspective.

REFERENCES

1. Abdou, C. M., Fingerhut, A. W., Jackson, J. S., & Wheaton, F. (2016). Healthcare stereotype threat in older adults in the health and retirement study. *American journal of preventive medicine*, *50*(2), 191-198.
2. Acemoglu, D., & Jackson, M. O. (2017). Social norms and the enforcement of laws. *Journal of the European Economic Association*, 15(2), 245-295.
3. Adams MA, Hurley JC, Todd M, Bhuiyan N, Jarrett CL, Tucker WJ, Hollingshead KE, Angadi SS. Adaptive goal setting and financial incentives: a 2 × 2 factorial randomized controlled trial to increase adults' physical activity. BMC Public Health. 2017;17(1):286.
4. Allison, J. J., Kiefe, C. I., Cook, E. F., Gerrity, M. S., Orav, E. J., & Centor, R. (1998). The association of physician attitudes about uncertainty and risk taking with resource use in a Medicare HMO. Medical Decision Making, 18(3), 320-329.
5. Amos A & Haglund M. From social taboo to "torch of freedom": the marketing of cigarettes to women. Tob Control 2000;9:3–8.
6. Asch, D. A., Troxel, A. B., Stewart, W. F., Sequist, T. D., Jones, J. B., Hirsch, A. G., ... & Volpp, K. G. (2015). Effect of financial incentives to physicians, patients, or both on lipid levels: a randomized clinical trial. Jama, 314(18), 1926-1935.
7. Austin, S. M., E. A. Balas, J. A. Mitchell, and B. G. Ewigman. 1994. "Effect of Physician Reminders on Preventive Care: Meta-Analysis of Randomized Clinical Trials." *Proceedings. Symposium on Computer Applications in Medical Care* 121–24.
8. Baicker, K., Mullainathan, S., & Schwartzstein, J. (2015). Behavioral hazard in health insurance. The Quarterly Journal of Economics, 130(4), 1623-1667.
9. Bairey Merz, C. Noel, Holly Andersen, Emily Sprague, Adam Burns, Mark Keida, Mary Norine Walsh, et al. 2017. "Knowledge, Attitudes, and Beliefs Regarding Cardiovascular Disease in Women: The Women's Heart Alliance." *Journal of the American College of Cardiology* 70 (2): 123–32.
10. Barankay I, Reese PP, Putt ME, Russell LB, Loewenstein G, Pagnotti D, Yan J, Zhu J, McGilloway R, Brennan T, Finnerty D. Effect of Patient Financial Incentives on Statin Adherence and Lipid Control: A Randomized Clinical Trial. JAMA Network Open. 2020;3(10):e2019429.
11. Barlow, P., McKee, M., Reeves, A., Galea, G., & Stuckler, D. (2017). Time-discounting and tobacco smoking: a systematic review and network analysis. International journal of epidemiology, 46(3), 860-869.
12. Barlow, P., Reeves, A., McKee, M., Galea, G., & Stuckler, D. (2016). Unhealthy diets, obesity and time discounting: a systematic literature review and network analysis. Obesity reviews, 17(9), 810-819.
13. Barnes AJ, Hanoch Y, Wood S, Liu P-J, Rice T. 2012. One fish, two fish, red fish, blue fish: effects of price frames, brand names, and choice set size on Medicare Part D insurance plan decisions. Med. Care Res. Rev. 69: 460–73.
14. Barton, M. B., and S. C. Schoenbaum. 1990. "Improving Influenza Vaccination Performance in an HMO Setting: The Use of Computer-Generated Reminders and Peer Comparison Feedback." *American Journal of Public Health* 80 (5): 534–36.
15. Basu S, Millett C. Social epidemiology of hypertension in middle-income countries. Hypertension. 2013;62(1):18–26.
16. Baumeister RF. "Yielding to Temptation: Self-Control Failure, Impulsive Purchasing, and Consumer Behavior." Journal of Consumer Research 2002, vol. 28, pp. 670-676.
17. Beatton, T., Moores, C. J., Sarkar, D., Sarkar, J., Silva Goncalves, J., & Vidgen, H. A. (2021). Do parental preferences predict engagement in child health programs?. Health Economics, 30(11), 2686-2700.
18. Bellet, C., & Colson-Sihra, E. (2018). *The conspicuous consumption of the poor: Forgoing calories for aspirational goods*. Working paper
19. Benabou, R., & Tirole, J. (2011). Laws and norms (No. w17579). National Bureau of Economic Research.
20. Bentz, Charles, Bruce Bayley, Kerry Bonin, Lori Fleming, Jack Hollis, Jacquelyn Hunt, Benjamin LeBlanc, Tim McAfee, Nicola Payne, and Joseph Siemienczuk. 2007. "Provider Feedback to Improve 5A's Tobacco Cessation in Primary Care: A Cluster Randomized Clinical Trial." *Nicotine & Tobacco Research* 9 (3): 341–49.
21. Bernal, P., & Martinez, S. (2020). In-kind incentives and health worker performance: Experimental evidence from El Salvador. Journal of health economics, 70, 102267.
22. Blaga, O.M., Vasilescu, L. and Chereches, R.M., 2018. Use and effectiveness of behavioural economics in interventions for lifestyle risk factors of non-communicable diseases: a systematic review with policy implications. Perspectives in public health, 138(2), pp.100-110.
23. Blumenthal-Barby, J. S., & Krieger, H. (2015). Cognitive biases and heuristics in medical decision making: a critical review using a systematic search strategy. Medical Decision Making, 35(4), 539-557.
24. Bonino PM, Salvia N, Nocetti G, Michelini Y, Parker DG. Efecto del envío de recordatorios sobre la asistencia a los turnos en pacientes bajo tratamiento de consumo de sustancias en la ciudad de Córdoba (Argentina). Rev. Salud Pública (Córdoba) [Internet]. 30 de octubre de 2020 [citado 23 de noviembre de 2021];24(3):95-101.
25. Bovet, P., Chiolero, A., Paccaud, F., & Banatvala, N. (2015). Screening for cardiovascular disease risk and subsequent man-

agement in low and middle income countries: challenges and opportunities. Public health reviews, 36(1), 1-15.
26. Bradford, W. D. (2010). The association between individual time preferences and health maintenance habits. Medical Decision Making, 30(1), 99-112.
27. Briss, P. A., L. E. Rodewald, A. R. Hinman, A. M. Shefer, R. A. Strikas, R. R. Bernier, V. G. Carande-Kulis, H. R. Yusuf, S. M. Ndiaye, and S. M. Williams. 2000. "Reviews of Evidence Regarding Interventions to Improve Vaccination Coverage in Children, Adolescents, and Adults. The Task Force on Community Preventive Services." *American Journal of Preventive Medicine* 18 (1 Suppl): 97–140.
28. Bruine de Bruin, W., Lefevre, C. E., Taylor, A. L., Dessai, S., Fischhoff, B., & Kovats, S. (2016). Promoting protection against a threat that evokes positive affect: The case of heat waves in the United Kingdom. Journal of experimental psychology: applied, 22(3), 261.
29. Bryan, C.J., Mazar, N., Jamison, J.C., et al. (2017). Overcoming behavioral obstacles to escaping poverty. Behavioral Science & Policy, 3(1), 80-91.
30. Burke, L. E., Styn, M. A., Sereika, S. M., Conroy, M. B., Ye, L., Glanz, K., ... & Ewing, L. J. (2012). Using mHealth technology to enhance self-monitoring for weight loss: a randomized trial. American journal of preventive medicine, 43(1), 20-26.
31. Busso, M., Cristia, J., & Humpage, S. (2015). Did you get your shots? Experimental evidence on the role of reminders. Journal of health economics, 44, 226-237.
32. Camilloni L, Ferroni E, Cendales BJ, Pezzarossi A, Furnari G, Borgia P, et al. Methods to increase participation in organised screening programs: A systematic review. BMC Public Health. BioMed Central. 2013;13:1–16.
33. Castaño, P. M., Bynum, J. Y., Andrés, R., Lara, M.,& Westhoff, C. (2012). Effect of daily text messages on oral contraceptive continuation: a randomized controlled trial. Obstetrics & Gynecology, 119(1), 14-20.
34. Cawley, J., & Ruhm, C. J. (2011). The economics of risky health behaviors. In Handbook of health economics (Vol. 2, pp. 95-199). Elsevier.
35. Chang, L. L., DeVore, A. D., Granger, B. B., Eapen, Z. J., Ariely, D., & Hernandez, A. F. (2017). Leveraging behavioral economics to improve heart failure care and outcomes. Circulation, 136(8), 765-772.
36. Chauhan, Bhupendrasinh F., Maya Jeyaraman, Amrinder Singh Mann, Justin Lys, Becky Skidmore, Kathryn M. Sibley, Ahmed Abou-Setta, and Ryan Zarychanksi. 2017. "Behavior Change Interventions and Policies Influencing Primary Healthcare Professionals' Practice—an Overview of Reviews." *Implementation Science* 12 (1): 3.
37. Chokshi, N. P., Adusumalli, S., Small, D. S., Morris, A., Feingold, J., Ha, Y. P., ... & Patel, M. S. (2018). Loss-framed financial incentives and personalized goal-setting to increase physical activity among ischemic heart disease patients using wearable devices: the ACTIVE REWARD Randomized Trial. Journal of the American Heart Association, 7(12), e009173.
38. Chow, C. K., Teo, K. K., Rangarajan, S., Islam, S., Gupta, R., Avezum, A., ... & Yusuf, S. (2013). Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. Jama, 310(9), 959-968.
39. Cialdini, R. B. (2003). Crafting normative messages to protect the environment. Current directions in psychological science, 12(4), 105-109.
40. Cohen DA, Babey SH (2012). "Candy at the Register—A Risk Factor of Obesity and Chronic Disease."New England Journal of Medicine, vol. 367, pp. 1381-1383.
41. Cohen DA, Babey SH. (2012) "Contextual Influences on Eating Behaviours: Heuristic Processing and Dietary Choices." Obesity Reviews, vol. 13, pp. 766-779.
42. Cutler D. M, Everett (2010) W. Thinking outside the pillbox—Medication adherence as a priority for health care reform. N Engl J Med.; 362(17):1553-5.
43. Davis, D. A., M. A. Thomson, A. D. Oxman, and R. B. Haynes. (1995) "Changing Physician Performance. A Systematic Review of the Effect of Continuing Medical Education Strategies." *JAMA* 274 (9): 700–705.
44. Dawson, N. V., & Arkes, H. R. (1987). Systematic errors in medical decision making. Journal of General Internal Medicine, 2(3), 183-187.
45. De Los Monteros, K. E., & Gallo, L. C. (2011). The relevance of fatalism in the study of Latinas' cancer screening behavior: A systematic review of the literature. International journal of behavioral medicine, 18(4), 310-318.
46. de Walque D, Chukwuma A, Ayivi-Guedehoussou N, Koshka-karyan M. (2020) Invitations, incentives, and conditions: a randomized evaluation of demand-side interventions for health screenings in Armenia. Policy Research Working Paper. World Bank No.: 9346:1-32.
47. DeFulio, A., & Silverman, K. (2012). The use of incentives to reinforce medication adherence. Preventive medicine, 55, S86-S94.
48. Devassy, S. M., Benny, A. M., Scaria, L., Nannatt, A., Fendt-Newlin, M., Joubert, J., ... & Webber, M. (2020). Social factors associated with chronic non-communicable disease and comorbidity with mental health problems in India: a scoping review. *BMJ open*, *10*(6), e035590.
49. Devi, R., Kanitkar, K., Narendhar, R., Sehmi, K., & Subramaniam, K. (2020). A narrative review of the patient journey through the lens of non-communicable diseases in low-and middle-income countries. Advances in Therapy, 37(12), 4808-4830.
50. Dexheimer, Judith W., Thomas R. Talbot, David L. Sanders, S. Trent Rosenbloom, and Dominik Aronsky. (2008) "Prompting Clinicians about Preventive Care Measures: A Systematic Review of Randomized Controlled Trials." *Journal of the American Medical Informatics Association : JAMIA* 15 (3): 311–20.
51. Dieleman, M., Cuong, P. V., Anh, L. V., & Martineau, T. (2003). Identifying factors for job motivation of rural health workers in North Vietnam. *Human resources for health*, *1*(1), 1-10.
52. Doctor, J. N., Nguyen, A., Lev, R., Lucas, J., Knight, T., Zhao, H., & Menchine, M. (2018). Opioid prescribing decreases after learning of a patient's fatal overdose. Science, 361(6402), 588-590.
53. Dupas, P. (2011). Health behavior in developing countries. Annu. Rev. Econ., 3(1), 425-449.
54. East, K. A., Hitchman, S. C., McDermott, M., McNeill, A., Herbeć, A., Tountas, Y., ... & Vardavas, C. I. (2018). Social norms towards smoking and electronic cigarettes among adult smokers in seven European Countries: findings from the EUREST-PLUS ITC Europe Surveys.*Tobacco Induced Diseases*, *16*.
55. East, K. A., Hitchman, S. C., McNeill, A., Thrasher, J. F., & Hammond, D. (2019). Social norms towards smoking and vaping and associations with product use among youth in England, Canada, and the US.*Drug and Alcohol Dependence*,*205*, 107635.
56. East, K., McNeill, A., Thrasher, J. F., & Hitchman, S. C. (2021). Social norms as a predictor of smoking uptake among youth: a systematic review, meta-analysis and meta-regression of prospective cohort studies. *Addiction*, *116*(11), 2953-2967.
57. Elgar, F. J., Roberts, C., Parry-Langdon, N., & Boyce, W. (2005).

Income inequality and alcohol use: a multilevel analysis of drinking and drunkenness in adolescents in 34 countries. *The European Journal of Public Health*, *15*(3), 245-250.
58. Emanuel, E. J., Ubel, P. A., Kessler, J. B., Meyer, G., Muller, R. W., Navathe, A. S., ... & Volpp, K. G. (2016). Using behavioral economics to design physician incentives that deliver high-value care. Annals of internal medicine, 164(2), 114-119.
59. Evans-Lacko, S., Brohan, E., Mojtabai, R., & Thornicroft, G. (2012). Association between public views of mental illness and self-stigma among individuals with mental illness in 14 European countries. Psychological medicine, 42(8), 1741-1752.
60. Faries, M. D. (2016). Why we don't "just do it" understanding the intention-behavior gap in lifestyle medicine. American journal of lifestyle medicine, 10(5), 322-329.
61. Fingeret, M. C., Nipomnick, S., Guindani, M., Baumann, D., Hanasono, M., & Crosby, M. (2014). Body image screening for cancer patients undergoing reconstructive surgery. *Psycho-oncology*, *23*(8), 898-905.
62. Finkelstein EA, Haaland BA, Bilger M, Sahasranaman A, Sloan RA, Nang EEK, Evenson KR. (2016) Effectiveness of activity trackers with and without incentives to increase physical activity (TRIPPA): a randomised controlled trial. Lancet Diabetes Endocrinol.;4(12):983–95.
63. Finkelstein, E. A., K. W. Tham, B. A. Haaland and A. Sahasranaman (2017), 'Applying economic incentives to increase effectiveness of an outpatient weight loss program (TRIO) – A randomized controlled trial', Social Science & Medicine, 185(July): 63–70.
64. Finkelstein, E. A., L. A. Linnan, D. F. Tate and B. E. Birken (2007), 'A pilot study testing the effect of different levels of financial incentives on weight loss among overweight employees', Journal of Occupational and Environmental Medicine, 49(9): 981–989.
65. Fiscella, K., Franks, P., Zwanziger, J., Mooney, C., Sorbero, M., & Williams, G. C. (2000). Risk aversion and costs. Journal of Family Practice, 49(1), 12-12.
66. Fox, C. R., & Tversky, A. (1995). Ambiguity aversion and comparative ignorance. The quarterly journal of economics, 110(3), 585-603.
67. Fox, C. R., & Weber, M. (2002). Ambiguity aversion, comparative ignorance, and decision context. Organizational behavior and human decision processes, 88(1), 476-498.
68. Franks, P., Williams, G. C., Zwanziger, J., Mooney, C., & Sorbero, M. (2000). Why do physicians vary so widely in their referral rates?. Journal of general internal medicine, 15(3), 163-168.
69. Friedman, Emily. 1994. "Money Isn't Everything: Nonfinancial Barriers to Access." *JAMA* 271 (19): 1535–38.
70. Galizzi, M. M., Miraldo, M., Stavropoulou, C., & Van Der Pol, M. (2016). Doctor–patient differences in risk and time preferences: A field experiment. Journal of health economics, 50, 171-182.
71. Gao, G., Burke, N., Somkin, C. P., & Pasick, R. (2009). Considering culture in physician—patient communication during colorectal cancer screening. Qualitative health research, 19(6), 778-789.
72. Gilovich, T., Griffin, D., & Kahneman, D. (Eds.). (2002). Heuristics and biases: The psychology of intuitive judgment. Cambridge University Press.
73. Gong, E., Chukwuma, A., Ghazaryan, E., & de Walque, D. (2020). Invitations and incentives: a qualitative study of behavioral nudges for primary care screenings in Armenia. *BMC health services research*, *20*(1), 1-14.
74. Greene SJ, Butler J, Albert NM, DeVore AD, Sharma PP, Duffy CI, et al. Medical therapy for heart failure with reduced ejection fraction. J Am Coll Cardiol. 2018;72(4):351–66.
75. Haff N, Patel M. S., Lim R, et al. (2015) The role of behavioral economic incentive design and demographic characteristics in financial incentive-based approaches to changing health behaviors: a meta-analysis. Am J Health Promotion;29:314–23.
76. Halim, A., Hasking, P., & Allen, F. (2012). The role of social drinking motives in the relationship between social norms and alcohol consumption. *Addictive behaviors*, *37*(12), 1335-1341.
77. Hall, M. A., E. Dugan, B. Zheng, and A. K. Mishra. (2001). "Trust in Physicians and Medical Institutions: What Is It, Can It Be Measured, and Does It Matter?" The Milbank Quarterly 79 (4): 613–39.
78. Hallsworth M, Chadborn T, Sallis A, Sanders M, Berry D, Greaves F, et al. (2016) Provision of social norm feedback to high prescribers of antibiotics in general practice: a pragmatic national randomised controlled trial. The Lancet;387: 1743–1752.
79. Hansen, H., Bourgois, P., & Drucker, E. (2014). Pathologizing poverty: New forms of diagnosis, disability, and structural stigma under welfare reform. Social science & medicine, 103, 76-83.
80. Hardy, H., Kumar, V., Doros, G., Farmer, E., Drainoni, M. L., Rybin, D., ...& Skolnik, P. R. (2011). Randomized controlled trial of a personalized cellular phone reminder system to enhance adherence to antiretroviral therapy. AIDS patient care and STDs, *25*(3), 153-161.
81. Hart, J., Yadav, K., Szymanski, S., Summer, A., Tannenbaum, A., Zlatev, J., ... & Halpern, S. D. (2021). Choice architecture in physician–patient communication: a mixed-methods assessments of physicians' competency. BMJ quality & safety, 30(5), 362-371.
82. Harte, E., MacLure, C., Martin, A., Saunders, C. L., Meads, C., Walter, F. M., ... & Usher-Smith, J. A. (2018). Reasons why people do not attend NHS Health Checks: a systematic review and qualitative synthesis. British Journal of General Practice, 68(666), e28-e35.
83. Hatzenbuehler, M. L., & Link, B. G. (2014). Introduction to the special issue on structural stigma and health. Social Science & Medicine.
84. Heller, D. J., Kumar, A., Kishore, S. P., Horowitz, C. R., Joshi, R., & Vedanthan, R. (2019). Assessment of barriers and facilitators to the delivery of care for noncommunicable diseases by nonphysician health workers in low-and middle-income countries: a systematic review and qualitative analysis. *JAMA Network Open*, *2*(12), e1916545-e1916545.
85. Higgins, Stephen T., Sheila M. Alessi, and Robert L. Dantona. 2002. "Voucher-Based Incentives: A Substance Abuse Treatment Innovation." Addictive Behaviors, 27: 887- 910.
86. Hollands, G. J., Shemilt, I., Marteau, T. M., Jebb, S. A., Kelly, M. P., Nakamura, R., ... & Ogilvie, D. (2013). Altering micro-environments to change population health behaviour: towards an evidence base for choice architecture interventions. BMC public health, 13(1), 1-6.
87. Holtgrave, D. R., Lawler, F., & Spann, S. J. (1991). Physicians' risk attitudes, laboratory usage, and referral decisions: the case of an academic family practice center. Medical Decision Making, 11(2), 125-130.
88. Hou, M. Y., Hurwitz, S., Kavanagh, E., Fortin, J., & Goldberg, A. B. (2010). Using daily text-message reminders to improve adherence with oral contraceptives: a randomized controlled trial. Obstetrics & Gynecology, 116(3), 633-640.
89. Hunt, D. L., R. B. Haynes, S. E. Hanna, and K. Smith. 1998. "Effects of Computer-Based Clinical Decision Support Systems on Physician Performance and Patient Outcomes: A Systematic Review." *JAMA* 280 (15): 1339–46.
90. John, L. K., Loewenstein, G., Troxel, A. B., Norton, L., Fassbender, J. E., & Volpp, K. G. (2011). Financial incentives for extended weight loss: a randomized, controlled trial. Journal of general internal medicine, 26(6), 621-626.
91. Kahneman, D. (2011). Thinking, fast and slow. Macmillan.

92. Kahneman, D. & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. Econometrica, 47(2), 363-391.
93. Kamvura, T. T., Dambi, J. M., Chiriseri, E., Turner, J., Verhey, R., & Chibanda, D. (2022). Barriers to the provision of non-communicable disease care in Zimbabwe: a qualitative study of primary health care nurses. *BMC nursing*, *21*(1), 1-12.
94. Keenan, K., Saburova, L., Bobrova, N., Elbourne, D., Ashwin, S., & Leon, D. A. (2015). Social factors influencing Russian male alcohol use over the life course: a qualitative study investigating age based social norms, masculinity, and workplace context. *Plos one*, *10*(11), e0142993.
95. Kessler, J. B., & Zhang, C. Y. (2014). Behavioral Economics and Health. Paper for Oxford Textbook of Public Health.
96. Kilpela, L. S., Becker, C. B., Wesley, N., & Stewart, T. (2015). Body image in adult women: Moving beyond the younger years. *Advances in Eating Disorders: Theory, Research and Practice*, *3*(2), 144-164.
97. Kullgren, J. T., Troxel, A. B., Loewenstein, G., Asch, D. A., Norton, L. A., Wesby, L., ... & Volpp, K. G. (2013). Individual-versus group-based financial incentives for weight loss: a randomized, controlled trial. Annals of internal medicine, 158(7), 505-514.
98. Kuntsche, E., Kuntsche, S., Thrul, J., & Gmel, G. (2017). Binge drinking: Health impact, prevalence, correlates and interventions. *Psychology & health*, *32*(8), 976-1017.
99. LaBrie, J. W., Hummer, J. F., Huchting, K. K., & Neighbors, C. (2009). A brief live interactive normative group intervention using wireless keypads to reduce drinking and alcohol consequences in college student athletes. Drug and alcohol review, 28(1), 40-47.
100. Lagarde, M., Haines, A., & Palmer, N. (2007). Conditional cash transfers for improving uptake of health interventions in low- and middle-income countries: a systematic review. Jama, 298(16), 1900-1910.
101. Lee, C. S., & McCormick, P. A. (2003). Telephone reminders to reduce non-attendance rate for endoscopy. Journal of the Royal Society of Medicine, 96(11), 547-548.
102. Liebman, J., & Zeckhauser, R. (2008). *Simple humans, complex insurance, subtle subsidies* (No. w14330). National Bureau of Economic Research.
103. Linder JA, Meeker D, Fox CR, Friedberg MW, Persell SD, Goldstein NJ, et al. Effects of Behavioral Interventions on Inappropriate Antibiotic Prescribing in Primary Care 12 Months After Stopping Interventions. JAMA. 2017;318: 1391.
104. Lu, Y., & Goldman, D. (2010). The Effects of Relative Food Prices on Obesity--Evidence from China: 1991-2006 (No. w15720). National Bureau of Economic Research.
105. Luoto, J., & Carman, K. G. (2014). Behavioral economics guidelines with applications for health interventions. Washington DC: Inter-American Development Bank.
106. McCaffery, K., Waller, J., Nazroo, J., & Wardle, J. (2006). Social and psychological impact of HPV testing in cervical screening: a qualitative study. Sexually transmitted infections, 82(2), 169-174.
107. McCarthy CP, Murphy S, Cohen JA, et al. Underutilization of cardiac rehabilitation for type 2 myocardial infarction. J Am Coll Cardiol. 2019;25917:2005–7.
108. McGill B, O'Hara BJ, Bauman A, et al. Are financial incentives for lifestyle behavior change informed or inspired by behavioral economics? A mapping review. Am J Health Promot 2019;33.
109. McGuire, T. G. (2000). Physician agency. Handbook of health economics, 1, 461-536.
110. Meeker D, Knight TK, Friedberg MW, Linder JA, Goldstein NJ, Fox CR, et al. (2014) Nudging Guideline-Concordant Antibiotic Prescribing: A Randomized Clinical Trial. JAMA Intern Med.;174: 425.
111. Meeker D, Linder JA, Fox CR, Friedberg MW, Persell SD, Goldstein NJ, et al. (2016) Effect of Behavioral Interventions on Inappropriate Antibiotic Prescribing Among Primary Care Practices: A Randomized Clinical Trial. JAMA;315: 562.
112. Milkman, K. L., Beshears, J., Choi, J. J., Laibson, D., & Madrian, B. C. (2011). Using implementation intentions prompts to enhance influenza vaccination rates. Proceedings of the National Academy of Sciences, 108(26), 10415-10420.
113. Mitchell, M. S., Orstad, S. L., Biswas, A., Oh, P. I., Jay, M., Pakosh, M. T., & Faulkner, G. (2020). Financial incentives for physical activity in adults: systematic review and meta-analysis. British journal of sports medicine, 54(21), 1259-1268.
114. Möllenkamp, M., Zeppernick, M.,& Schreyögg, J. (2019). The effectiveness of nudges in improving the self-management of patients with chronic diseases: a systematic literature review. Health Policy, 123(12), 1199-1209.
115. Mugo, P. M., Wahome, E. W., Gichuru, E. N., Mwashigadi, G. M., Thiong'o, A. N., Prins, H. A., ... & Sanders, E. J. (2016). Effect of text message, phone call, and in-person appointment reminders on uptake of repeat HIV testing among outpatients screened for acute HIV infection in Kenya: a randomized controlled trial. PLoS One, 11(4), e0153612.
116. Mullainathan, S., & Shafir, E. (2013). Scarcity: Why having too little means so much. New York, NY: Times Books.
117. Murphy, S., Moore, G., Williams, A., & Moore, L. (2012). An exploratory cluster randomised trial of a university halls of residence based social norms intervention in Wales, UK. BMC public health, 12(1), 1-8.
118. O'Donoghue, T., & Rabin, M. (1999). Doing it now or later. American economic review, 89(1), 103-124.
119. Oettingen, G., Kappes, H. B., Guttenberg, K. B., and Gollwitzer, P. M. (2015). Self-regulation of time management: mental contrasting with implementation intentions. Eur. J. Soc. Psychol. 45, 218–229. doi: 10.1002/ejsp.2090.
120. Oettingen, G., Pak, H., and Schnetter, K. (2001). Self-regulation of goal setting: turning free fantasies about the future into binding goals. J. Personal. Soc. Psychol. 80, 736–753.
121. Patel, M. S., Asch, D. A., Rosin, R., Small, D. S., Bellamy, S. L., Eberbach, K., ... & Volpp, K. G. (2016a). Individual versus team-based financial incentives to increase physical activity: a randomized, controlled trial. Journal of general internal medicine, 31, 746-754.
122. Patel, M. S., Benjamin, E. J., Volpp, K. G., Fox, C. S., Small, D. S., Massaro, J. M., ... & Murabito, J. M. (2017). Effect of a game-based intervention designed to enhance social incentives to increase physical activity among families: the BE FIT randomized clinical trial. JAMA internal medicine, 177(11), 1586-1593.
123. Patel, M. S., Volpp, K. G., Rosin, R., Bellamy, S. L., Small, D. S., Fletcher, M. A., ... & Asch, D. A. (2016b). A randomized trial of social comparison feedback and financial incentives to increase physical activity. American Journal of Health Promotion, 30(6), 416-424.
124. Peek, M. E., Sayad, J. V., & Markwardt, R. (2008). Fear, fatalism and breast cancer screening in low-income African-American women: the role of clinicians and the health care system. Journal of general internal medicine, 23(11), 1847-1853.
125. Peel, N. M., McClure, R. J., & Bartlett, H. P. (2005). Behavioral determinants of healthy aging. American journal of preventive medicine, 28(3), 298-304.
126. Perron, N. J., Dao, M. D., Righini, N. C., Humair, J. P., Broers, B., Narring, F., ... & Gaspoz, J. M. (2013). Text-messaging versus telephone reminders to reduce missed appointments in an ac-

ademic primary care clinic: a randomized controlled trial. BMC health services research, 13(1), 1-7.
127. Persell SD, Doctor JN, Friedberg MW, Meeker D, Friesema E, Cooper A, et al. Behavioral interventions to reduce inappropriate antibiotic prescribing: a randomized pilot trial. BMC Infect Dis. 2016;16: 373.
128. Peters DH, Garg A, Bloom G, Walker DG, Brieger WR, et al. (2008) Poverty and access to health care in developing countries. Ann N Y Acad Sci 1136: 161–71.
129. Petry, N. M. (2011). Contingency management: what it is and why psychiatrists should want to use it. The psychiatrist, 35(5), 161-163.
130. Petty, N.M., and B. Martin. 2002. "Low-Cost Contingency Management for Treating Cocaineand Opiod-Abusing Metadone Patients." Journal of Consulting and Clinical Psychology, 70(2): 398-405.
131. Pop-Eleches, C., Thirumurthy, H., Habyarimana, J. P., Zivin, J. G., Goldstein, M. P., De Walque, D., ... & Bangsberg, D. R. (2011). Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of text message reminders. AIDS (London, England), 25(6), 825.
132. Prendergast, Michael, Deborah Podus, John Finney, Lisa Greenwell, and John Roll. 2006. "Contingency management for treatment of substance use disorders: a meta-analysis." Addiction, 101(11): 1546–1560.
133. Rai, S. S., Syurina, E. V., Peters, R. M., Putri, A. I., & Zweekhorst, M. B. (2020). Non-communicable diseases-related stigma: a mixed-methods systematic review. *International journal of environmental research and public health*, *17*(18), 6657.
134. Ridout, B., & Campbell, A. (2014). Using F acebook to deliver a social norm intervention to reduce problem drinking at university. Drug and alcohol review, 33(6), 667-673.
135. Riegel, B., Stephens-Shields, A., Jaskowiak-Barr, A., Daus, M., & Kimmel, S. E. (2020). A behavioral economics-based telehealth intervention to improve aspirin adherence following hospitalization for acute coronary syndrome. Pharmacoepidemiology and drug safety, 29(5), 513-517.
136. Ritchie, P. D., Jenkins, M., & Cameron, P. A. (2000). A telephone call reminder to improve outpatient attendance in patients referred from the emergency department: a randomised controlled trial. Australian and New Zealand journal of medicine, 30(5), 585-592.
137. Ritov, I., & Baron, J. (1992). Status-quo and omission biases. Journal of risk and uncertainty, 5(1), 49-61.
138. Ruhm, C. J. (2012). Understanding overeating and obesity. Journal of Health economics, 31(6), 781-796.
139. Sacarny A, Barnett ML, Le J, Tetkoski F, Yokum D, Agrawal S. Effect of Peer Comparison Letters for High-Volume Primary Care Prescribers of Quetiapine in Older and Disabled Adults: A Randomized Clinical Trial. JAMA Psychiatry. 2018;75: 1003.
140. Sacarny A, Yokum D, Finkelstein A, Agrawal S. Medicare Letters To Curb Overprescribing Of Controlled Substances Had No Detectable Effect On Providers. Health Affairs. 2016;35: 471–479.
141. Salami JA, Warraich H, Valero-Elizondo J, et al. National trends in statin use and expenditures in the US adult population from 2002 to 2013: insights from the medical expenditure panel survey. JAMA Cardiol. 2017;2(1):56–65.
142. Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. Journal of risk and uncertainty, 1(1), 7-59.
143. Saposnik, G., Redelmeier, D., Ruff, C. C., & Tobler, P. N. (2016). Cognitive biases associated with medical decisions: a systematic review. BMC medical informatics and decision making, 16(1), 1-14.
144. Schneider, P., Popkin, B., Shekar, M., Eberwein, J. D., Block, C., & Okamura, K. S. (2020). Health and economic impacts of overweight/obesity. *Health and Economic Consequences of an Impending Global Challenge*, 69.
145. Scott, I. A., Soon, J., Elshaug, A. G., & Lindner, R. (2017). Countering cognitive biases in minimising low value care. Medical Journal of Australia, 206(9), 407-411.
146. Sen, A., Huffman, D., Loewenstein, G., Asch, D. A., Kullgren, J. T., & Volpp, K. G. (2017). Do Financial Incentives Reduce Intrinsic Motivation for Weight Loss? Evidence from Two Tests of Crowding Out. Retrieved from http://repository.upenn.edu/hcmg_papers/8.
147. Serrano Fuentes, N., Rogers, A., & Portillo, M. C. (2019). Social network influences and the adoption of obesity-related behaviours in adults: a critical interpretative synthesis review. *BMC public health*, *19*(1), 1-20.
148. Skov, L. R., Lourenco, S., Hansen, G. L., Mikkelsen, B. E., & Schofield, C. (2013). Choice architecture as a means to change eating behaviour in self-service settings: a systematic review. Obesity Reviews, 14(3), 187-196.
149. Shiv, B., & Fedorikhin, A. (1999). Heart and mind in conflict: The interplay of affect and cognition in consumer decision making. *Journal of consumer Research*, 26(3), 278-292.
150. Stockwell, M. S., Kharbanda, E. O., Martinez, R. A., Vargas, C. Y., Vawdrey, D. K., & Camargo, S. (2012). Effect of a text messaging intervention on influenza vaccination in an urban, low-income pediatric and adolescent population: a randomized controlled trial. Jama, 307(16), 1702-1708.
151. Strulik, H., & Werner, K. (2021). Time-inconsistent health behavior and its impact on aging and longevity. Journal of Health Economics, 76, 102440.
152. Suri, G., Sheppes, G., Schwartz, C., & Gross, J. J. (2013). Patient inertia and the status quo bias: when an inferior option is preferred. Psychological science, 24(9), 1763-1769.
153. Taylor, Michael J., Ivo Vlaev, John Maltby, Gordon DA Brown, and Alex M. Wood. "Improving social norms interventions: Rank-framing increases excessive alcohol drinkers' information-seeking." Health psychology 34, no. 12 (2015): 1200.
154. Thaler, R. H., Sunstein, C. R., & Balz, J. P. (2013). Choice architecture. In E. Shafir (Ed.), The behavioral foundations of public policy (pp. 428-439). Princeton, NJ: Princeton University Press.
155. Thapa, J. R., & Lyford, C. P. (2014). Behavioral economics in the school lunchroom: can it affect food supplier decisions? A systematic review. International Food and Agribusiness Management Review, 17(1030-2016-82992), 187-208.
156. Toll BA & Ling PM. The Virginia Slims identity crisis: an inside look at tobacco industry marketing to women. Tob Control 2005;14:172–80.
157. Torrente, F., Bustin, J., Triskier, F., Ajzenman, N., Tomio, A., Mastai, R., & Boo, F. L. (2020). Effect of a Social Norm Email Feedback Program on the Unnecessary Prescription of Nimodipine in Ambulatory Care of Older Adults: A Randomized Clinical Trial. JAMA network open, 3(12), e2027082-e2027082.
158. Tversky, A; D. Kahneman, (1973). Availability: A heuristic for judging frequency and probability. Cognitive Psychology. 5, 207–232.
159. Tversky, A. and Kahneman, D., (1974). Judgment under Uncertainty: Heuristics and Biases: Biases in judgments reveal some heuristics of thinking under uncertainty. Science, 185(4157), pp.1124-1131.

160. van der Weijden, T. (2007). van SB, Stoffers HE, Timmermans DR, Grol R. Primary prevention of cardiovascular diseases in general practice: mismatch between cardiovascular risk and patients' risk perceptions. Med Decis Making, 27(6), 754-761.
161. Vervloet, M., Linn, A. J., van Weert, J. C., De Bakker, D. H., Bouvy, M. L., & Van Dijk, L. (2012). The effectiveness of interventions using electronic reminders to improve adherence to chronic medication: a systematic review of the literature. Journal of the American Medical Informatics Association, 19(5), 696-704.
162. Vlaev, I., King, D., Darzi, A. and Dolan, P., 2019. Changing health behaviors using financial incentives: a review from behavioral economics. BMC public health, 19(1), pp.1-9.
163. Volpp, K.G., Troxel, A.B., Pauly, M.V., Glick, H.A., Puig, A., Asch, D.A., Galvin, R., Zhu, J., Wan, F., DeGuzman, J. and Corbett, E., 2009. A randomized, controlled trial of financial incentives for smoking cessation. N Engl J Med, 360, pp.699-709.
164. Volpp KG, John LK, Troxel AB, Norton L, Fassbender J, Loewenstein G. (2008a). Financial incentive–based approaches for weight loss: a randomized trial. JAMA. 2008;300(22):2631–7.
165. Volpp, K.G., Loewenstein, G., Troxel, A.B., Doshi, J., Price, M., Laskin, M. and Kimmel, S.E., (2008b). A test of financial incentives to improve warfarin adherence. BMC health services research, 8(1), pp.1-6.
166. Von Wagner, C., Baio, G., Raine, R., Snowball, J., Morris, S., Atkin, W., ... & Wardle, J. (2011). Inequalities in participation in an organized national colorectal cancer screening programme: results from the first 2.6 million invitations in England. International journal of epidemiology, 40(3), 712-718.
167. Wang, S. Y., & Groene, O. (2020). The effectiveness of behavioral economics-informed interventions on physician behavioral change: A systematic literature review. PloS one, 15(6), e0234149.
168. Watkins et al. (2022). "NCD Countdown 2030: efficient pathways and strategic investments to accelerate progress towards the Sustainable Development Goal target 3.4 in low-income and middle-income countries." The Lancet 399, no. 10331: 1266-1278.
169. Weinstein, N. D. (1980). Unrealistic optimism about future life events. Journal of personality and social psychology, 39(5), 806.
170. Weller, D. P., Patnick, J., McIntosh, H. M., & Dietrich, A. J. (2009). Uptake in cancer screening programmes. The lancet oncology, 10(7), 693-699.
171. Wexler R, Elton T, Pleister A, Feldman D (2009) Barriers to blood pressure control as reported by african american patients. J Natl Med Assoc 101 (6) 597–603.
172. Witte, K., & Allen, M. (2000). A meta-analysis of fear appeals: Implications for effective public health campaigns. Health education & behavior, 27(5), 591-615.
173. Wittleder, S., Kappes, A., Oettingen, G., Gollwitzer, P. M., Jay, M., & Morgenstern, J. (2019). Mental contrasting with implementation intentions reduces drinking when drinking is hazardous: an online self-regulation intervention. Health Education & Behavior, 46(4), 666-676.

ANNEX 6.1

TABLE 6A.1 Summary of Behavioral Economics Concepts

Concept	Definition	Example
Present bias	Tendency to value instant gratification more than future benefits	Patient decides to consume an unhealthy but delicious meal now despite knowing that it contributes to poor health outcomes in the future
Time inconsistency	Tendency to be impatient when choosing between receiving benefits today and receiving them in the future, but patient when choosing between benefits at two different moments in the future	
Intention-action gap		Patient understands the importance of symptom monitoring but does not do it
Overconfidence	Overestimation of own performance and overplacement of own performance relative to others.	Patient understands that exercise is beneficial, but that knowledge fails to lead to increased physical activity
Over-optimism	Tendency to underestimate the probability of negative events and overestimate the probability of positive events.	
Availability heuristic	Tendency to judge the probability of a future event occurring based on the ease with which an occurrence of such an event comes to mind	Patient immediately following the death of an overweight friend from a heart attack may be more likely to eat healthier, but over time, as the recency and vividness fades, such habits dissipate.
Cognitive dissonance	Tendency to often hold contradictory opinions	People smoke even though they have read countless times that it is dangerous. This self-contradiction causes dissonance, so people need to develop cognitive tools to justify the contradiction. For example, by overly exaggerating how much pleasure they get out of smoking underestimating the future costs
Loss aversion	Loss causes distress that is greater than the happiness caused by a gain of the same size	
Endowment effect	The overvaluation of a good when we possess it	
Framing effects	Tendency to draw different conclusions depending on how the information is presented	Food options or incentives can be presented in a way that highlights the positive or negative aspects of a decision, leading an option to be perceived as more or less attractive
Anchoring	An initial exposure to a certain number or attribute serves as point of reference and impacts subsequent judgements	When faced with a decision under uncertainty, individuals attribute to much weight to the initial exposure, which, without further awareness, distorts estimates and judgements
Cognitive overload (choice and decision fatigue)	The cognitive load is the amount of mental effort and memory used at a given moment in time. Overload is when the volume of information or choices provided exceeds an individual's capacity to process it.	
Social norms	The unwritten rules governing behavior within a society	
Peer effects	The influence exerted by a peer group on its individual members to fit in with or conform to the group's norms and expectations	
Stigma	The negative social attitude attached to a characteristic of an individual that may be regarded as a mental, physical, or social deficiency and can lead unfairly to discrimination against and exclusion of the individual.	

Source: Original for this publication with input from Chang et al. (2017); Emanuel et al. (2016).

7

Taxation of harmful products, including tobacco, alcohol and sugar-sweetened beverages (SSBs), and related topics

Guillermo Paraje [a], *Prabhat Jha* [b], *William Savedoff* [c], *Alan Fuchs* [d]

[a] Escuela de Negocios, Universidad Adolfo Ibáñez
[b] Centre for Global Health Research, Unity Health Toronto, University of Toronto
[c] Social Insight
[d] Poverty and Equity, Middle East and North Africa, World Bank

INTRODUCTION

THE CONSUMPTION OF UNHEALTHY PRODUCTS AND THE HEALTHY LONGEVITY AGENDA

Even as human beings are living longer and generally healthier lives, consumption of tobacco, alcohol, and processed foods with high sugar content are causing substantial death and disease. In recent decades, the magnitude of these health effects has become increasingly apparent in terms of cancers, cardiovascular disorders, diabetes, and other illnesses which are obstacles to healthy aging.

Consumption of tobacco, alcohol, and sugar-sweetened beverages (SSBs) have negative consequences on health for people of all ages. However, these negative effects are especially evident at older ages. The main contributors to the disease burden in people 60 years of age and older at the global level are cardiovascular diseases (30.3 percent), cancer (15.1 percent), and chronic respiratory diseases (9.5 percent), all causes closely associated with the consumption of tobacco, alcohol, and SSBs (Prince et al. 2015).

In a rapidly aging world, it is crucial to improve the health of older adults. 23 percent of the total burden of disease is attributable to illness in adults ages 60 and older (Prince et al. 2015). Suffering chronic illnesses is strongly associated with functional dependence. In Latin America, for instance, 14 percent of the over-65 population are care dependent, while functional dependence is negatively associated with socioeconomic status (Aranco et al. 2022). A recent study found that labor income received by members of households with older adults needing chronic care was substantially lower than in those households where such care was not needed. Household consumption was also about 12 percent lower and catastrophic health care costs about 64 percent more likely in households where older adults needed care (Guerchet et al. 2018).

Unless countries reduce smoking, alcohol use, and SSB consumption, people reaching old age in the coming decades will increasingly experience preventable chronic illnesses, with the burden that this implies for health systems and caregivers, especially women. Improving the health status of older adults can produce social benefits in the form of an extended productive life span (comprehensive longevity boost) and a reduced fertility rate (Heijdra and Reijnders 2016). Action toward these goals must unfold across the life course. The years gained through increased life expectancy need to be as healthy as possible to avoid burdening already-strained pension systems, health systems, and family members providing informal care for older people in poor health (Bloom et al. 2015). Fiscal tools (e.g., taxes) like the ones discussed in this document can play a fundamental role in preventing chronic diseases and improving people's lives.

This chapter discusses taxation as a proven method to discourage consumption of harmful products, improve population health, and contribute to healthy aging. It discusses the economic rationale for taxing these products and documents their health effects and costs to society. It presents evidence on the effectiveness of taxation in raising prices and reducing consumption. Taking account of health benefits as well as indirect financial effects, it also shows how taxation disproportionately benefits poorer households. The chapter considers the role of industries in opposing taxation and concludes with a discussion of how this topic relates to the broader agenda of healthy longevity.

For the purpose of this review, tobacco products are defined as those that contain tobacco that can be smoked, inhaled, or chewed. So-called "electronic cigarettes" (electronic nicotine delivery systems, or electronic non-nicotine delivery systems) raise additional issues beyond the scope of this study. With respect to sugar, this review will focus on SSBs. Because SSBs are a significant source of added sugars in people's diets and lack other nutritional benefits, many governments have initiated efforts to restrict sugar intake by focusing on these beverages. Researchers have been able to generate evidence about reducing sugar consumption by studying such policies. SSBs are defined as all types of beverages containing free sugars. These include carbonated and non-carbonated soft drinks, fruit/vegetable juices and drinks, liquid and powder concentrates, flavored water, energy and sports drinks, ready-to-drink tea, ready-to-drink coffee, and flavored milk drinks (WHO 2017b).

THE CONSUMPTION OF HARMFUL PRODUCTS AND THEIR EFFECTS

Tobacco, alcohol, and sugar have been around a long time. However, current consumption patterns – driven by rising incomes, falling prices, and easier access – have led to higher levels and more widespread use of these products. The effects on population health and economic activity are increasingly well documented.

Consumption patterns

Consumption of tobacco, alcohol, and SSBs is associated with negative health consequences. Scientific evidence of these impacts is consistent, significant, and growing.

It is estimated that tobacco kills between 5 to 8 million people in the world each year, mostly in low- and middle-income countries (LICs and MICs), along with a more uncertain but high number of second-hand (passive) smokers (WHO 2021; Jha and Peto 2014). Highly toxic and addictive, tobacco has posed one of the main public health challenges of the second half of the 20th century and of the 21st. Although tobacco consumption remains very high, it is falling, marking a reversal of the rising trends seen before the late 1990s (Jha 1999). Relying on direct surveys for some countries and model-based estimates for most others, the World Health Organization (WHO) estimates that global smoking prevalence in people aged 15 years and older fell by a third between 2000 and 2020, from about 33.3 percent to 22.8 percent (WHO 2019b). Differences by gender are notable. Current-smoking prevalence for men fell by a quarter (50 percent to 37.5 percent), while for women, it dropped by half (16.7 percent to 8 percent). In some countries, such as China, India, and Indonesia, cigarette smoking is largely concentrated among men, but in others, including many Latin American countries, smoking among women is common. Adopting United Nations (UN) population projections (United Nations 2019), these figures imply that the absolute number of current smokers worldwide fell almost 7 percent between 2000 and 2020, with a decrease of 35 percent for women, but an increase of 2 percent for men. Decreases in both prevalence and number of smokers are projected for both sexes and for all age groups through 2025 (WHO 2019b). It is estimated that one smoking death occurs for every 0.8 to 1.1 million cigarettes smoked (Jha 2020). Thus, the 7.4 trillion cigarettes consumed in 2019 alone will lead, eventually, to at least 7 million premature deaths.

For alcohol, the situation is quite different. Though the share of current drinkers among people aged 15 years and older decreased between 2000 and 2016 (from 47.6 percent to 43 percent percent), the per capita volume of pure alcohol consumed has increased from 5.7 liters to 6.4 liters and is projected to grow further to 7 liters by 2025 (WHO 2018; Manthey et al. 2019). If only drinkers are considered, pure alcohol consumption per capita reached 15.1 liters in 2016 (up from 11.1 liters in 2000) – (WHO 2018). Considering global population growth in the period 2000-2016, the number of drinkers worldwide increased by 16 percent, and the amount of pure alcohol consumed globally increased by 58 percent (an average annual increase of 3.1 percent versus a 1.7 percent average annual increase in global constant dollar per capita GDP) – (United Nations 2019; World Bank 2023). Consumption of spirits contributed the most to increasing consumption of pure alcohol at the global level (44.8 percent). Beer and wine followed, with increases of 34.3 percent and 11.7 percent, respectively (WHO 2018).

Global alcohol consumption prevalence was about 70 percent higher among men ages 15 years and older than among women in the same age group in 2016 (53.6 percent versus 32.3 percent, respectively), while the consumption of pure alcohol among drinkers ages 15 years and older is 180 percent higher among men than among women (19.4 versus 7 liters) – (WHO 2018). However, the gender gap in alcohol consumption has decreased significantly over the last century, and there are strong indications that the gap will continue to narrow, due to faster growth in consumption among women (Slade et al. 2016).

Patterns of alcohol consumption have also changed, but with greater regional variation and far less reliable survey data available than for cigarettes. The prevalence of heavy episodic drinking (HED)[1] among drinkers 15 years and older declined by only about 1 percent per year from 2010 to 2016, from 41.9 percent, to 39.5 (WHO 2018). HED is more prevalent among men (50.2 percent versus 19.9 percent for women in 2016), though this gap declined sharply, from 3.8 times higher in 2010 to 1.5 times

1 HED is defined as 60 or more grams of pure alcohol on at least one single occasion at least monthly.

higher in 2016 (WHO 2018; WHO 2014).

In the case of SSBs, consumption has been increasing, though there are few estimates of the evolution of consumption at the global level. Global consumption for carbonated soft drinks, excluding bottled still or carbonated water, fruit or vegetable juices, coffee, tea, or sports drinks, increased from 36 liters per person per year in 1997 to 43.1 liters in 2010 (Basu et al. 2013). Another study estimated that per capita SSB and fruit juice consumption in the population aged 20 years and older was 1.22 liters per week in 2010 (Singh et al. 2015). This was 30 percent higher than the weekly consumption of milk. Consumption was similar for men and women but higher among younger people. For example, people who were 20-39 years old consumed 139 percent more of these drinks than those ages 60 years and older. Upper-middle-income countries (UMICs) had the highest per capita consumption for persons 20 years and older at 1.7 liters per person per week, while high-income countries (HICs) ranked second with 1.4 liters per week. Lower-middle-income countries (LMICs) and LICs had 1.3 and 0.7 liters per week, respectively. In the case of LICs, consumption of SSBs and fruit juices was 27 percent higher than consumption of milk. Recent estimates suggest that consumption of SSBs in HICs will stabilize (or decrease slightly) by 2022, albeit at a very high consumption level (about 120 liters per capita per year). Per capita SSB consumption will also stabilize for UMICs (at about 50 liters per capita per year) but increase strongly for LICs and LMICs (World Bank 2020).

Price and affordability

Many variables affect consumption, including income and income distribution; advertising and product promotion; changes in social activities, religious practices, and cultural norms; along with prices and affordability. Governments have had success in discouraging consumption of health-damaging products through a range of policies. These include advertisement and marketing regulations; sales restrictions (e.g., prohibiting sales to minors or in certain places/times); regulation of places for consumption (e.g., smoking bans in public spaces); and packaging requirements (e.g., graphic warnings, front-of-pack labeling). However, evidence shows that, for tobacco, alcohol, and SSBs, own-prices and consumers' incomes are among the main determinants of consumption (WHO 2017a). The relationship between product prices and consumers' incomes determines product affordability. If consumers' incomes increase faster than the prices of certain goods, then individuals would have to devote a lower proportion of their income to purchase these goods. Under most conditions (i.e., normal goods) this would lead to an increase in demand for these products.

Directly measuring the affordability of key health-damaging products is difficult and costly. One of the many measures of affordability often relied upon instead is the Relative Income Price (RIP). The RIP measures what proportion of per capita GDP would be required to buy 100 packs of cigarettes or 100 liters of beer or SSBs (Blecher and van Walbeek 2009; Blecher et al. 2017, 2018). Based on the RIP, the affordability of tobacco over the last three decades (1990-2006) has varied a great deal. In HICs, tobacco has generally become less affordable (though there are variations among these countries), while in LICs and MICs tobacco has generally become more affordable i.e., a smaller fraction of per capita GDP is needed to buy 100 packs of cigarettes (Blecher and van Walbeek 2009). Between 2008 and 2018, the RIP increased in 117 out of 168 countries, indicating that tobacco became less affordable in those countries. In 42 of those countries the tobacco RIP increased more than 50 percent, and in 26 countries it increased more than 100 percent (Paraje and Stoklosa 2017).

For alcohol, trends are clearer: alcohol has become significantly more affordable over the last few decades. Between 1990 and 2016, the RIP for beer fell in 30 out of 37 HICs, and in 42 out of 44 LICs and MICs (Blecher et al. 2018). In almost half of the countries, affordability increased both because of an increase in income and a decrease in beer prices. The same trend and pattern have been found for a sample of nine Latin American countries (Paraje and Pincheira 2018).

Affordability has also increased for SSBs in the 1990-2016 period. In 79 of 82 countries (40 of them HICs), the RIP significantly decreased (i.e., less income was needed to buy 100 liters of Coca-Cola, for example), mostly due to a higher rate of income growth, rather than a fall in the real prices of SSBs (Blecher et al. 2017). This evidence is consistent with findings in Latin America, where 7 of 12 countries studied showed an increase in the affordability of SSBs – in some countries by more than 6 percent per year – and a decline in affordability in only one country: Mexico (Paraje and Pincheira 2018).

Health impact of the consumption of tobacco, alcohol, and SSBs

Evidence on the health burden linked to the consumption of tobacco and alcohol is overwhelming, and it is solid and growing for SSBs. Direct epidemiological studies in several countries, paired with model-based estimates, have led the Global Burden of Disease (GBD) Project to estimate that, in 2020, tobacco smoking accounted for 7.7 million deaths globally, of which 87 percent were among current smokers and 80 percent among men (IHME 2020). In terms of disability-adjusted life years (DALYs), tobacco was responsible for 9 percent of DALYs at the global level in 2019 – more than 229 million DALYs (IHME 2020).

Alcohol caused an estimated 2.4 million deaths worldwide in 2019 or 4.3 percent of total risk-related deaths (IHME 2020). Almost 85 percent of those deaths were among men. DALYs due to alcohol represented 3.7 percent of total risk related DALYs. Alcohol was the main cause of death in the 10-24 year age group (22 percent of all risk-related deaths), and in some countries (e.g., the United States and Scotland) alcohol is identified as one of the leading causes of "deaths of despair"(Substance Abuse and Mental Health Services Administration (US) and Office of the Surgeon General (US) 2016; Case and Deaton 2021). Alcohol consumption is directly related to crime and domestic violence, which dramatically affect community life and well-being among minors and women.

Finally, diets high in SSBs were responsible for 242,000 deaths at the global level in 2019 (0.4 percent of total risk-related deaths) and for more than 6 million DALYs (0.25 percent of total risk-related DALYs) – (IHME 2020).

Tobacco consumption has been causally linked to "diseases of nearly all organs of the body, to diminished health status, and to harm to the fetus."(-Jha 2020; U.S. Department of Health and Human Services 2014). Main diseases caused by tobacco (especially manufactured cigarettes and bidis) are circulatory diseases (such as ischemic heart diseases and stroke); respiratory diseases (such as COPD and asthma); a wide array of cancers (lung, trachea, esophagus, bladder, colon, stomach, liver, kidney, and others); metabolic conditions (diabetes mellitus, impaired immune system, and others); infertility; and tuberculosis (Jha 2020; U.S. Department of Health and Human Services 2014). Tobacco is also the cause of permanent adverse consequences for brain development, if fetuses are exposed to nicotine, as well as other conditions with potentially serious lifelong health consequences, such as low birthweight. A recent meta-analysis finds that smoking is a significant contributor to hospitalization and death from COVID-19 infection (Reddy 2021). Though tobacco is one of the biggest killers among the elderly, at least half of tobacco deaths occur in middle age (30-69 years), leading to a loss of two or more decades of life. On average, smoking kills about half of regular smokers, with an average loss of life for these persons of about 20 years, or about 10 years for regular smokers overall (Jha and Peto 2014; Jha et al. 2013).

On the other hand, early cessation can reverse most of the harms of early tobacco use. It has been found that adults who quit smoking at 25 to 34, 35 to 44, or 45 to 54 years of age gained about 10, 9, and 6 years of life, respectively, as compared with those who continued to smoke until their (premature) death (Jha et al. 2013).

Alcohol consumption is associated with neuropsychiatric conditions; unintentional and intentional injuries; gastrointestinal diseases; several types of cancer; vascular diseases; maternal and perinatal conditions; and other negative health impacts (Rehm and Monteiro 2005; Rehm et al. 2009; Rehm et al. 2017; Griswald et al. 2018). Recent studies have shown that, contrary to what some earlier studies reported, there is no safe, "protective," or healthy consumption of alcohol (Griswald et al. 2018; Topiwala et al. 2021; Millwood et al. 2019).

Consumption of SSBs is also associated with negative health effects, especially because of the strong link between consumption of SSBs and overweight/obesity (Vartanian et al. 2007). Prominent experts in public health have signaled the consumption of SSBs in particular populations, most notably in the Americas, as "the single largest driver of the obesity epidemic"(Brownell and Frieden 2009). Evidence also shows a positive association between SSB consumption and cardiovascular diseases, type 2 diabetes mellitus, obesity-related cancer, dental caries, metabolic syndrome, and osteoporosis, among other diseases (Imamura et al. 2015; Wang et al. 2015; Yin et al. 2021; Narain et al. 2016; Hodge et al. 2018).

Overall, there is ample evidence that the consumption of tobacco, alcohol, and SSBs can severely affect health and wellbeing of people of all ages. Children and young adults exposed to these products can develop chronic illnesses and conditions that may permanently affect their future productive capabilities and increase the individual and social financial burden of treating those illnesses. Negative

health consequences from consuming these products are present at all ages, even if not immediately observed. When manifested at early stages of life, they have long-lasting consequences, while, emerging in middle or old age, they harm people's prospects for healthy longevity.

Economic costs

The consumption of products with significant negative health impacts has economic implications. These consequences can be broadly separated into two groups of costs: (i) direct costs attributable to the treatment of diseases; and (ii) indirect costs that can be attributed to premature mortality, loss of productivity due to absenteeism and presenteeism (i.e., people going to their jobs but being less productive), and opportunity costs for caregivers, as well as pain and suffering. In the case of alcohol, for instance, indirect costs also include violence, crime, destruction of property, costs of policing, prosecution, incarceration, domestic violence, and various forms of suffering experienced by drinkers and others. Present economic costs and health costs may also have an impact on future economic costs and wellbeing, as present illnesses may condition future incomes. In the case of tobacco, smokers' households also face economic costs reflecting factors that include but extend beyond the many annual deaths from second-hand smoke. These indirect costs are considered below.

It has been estimated that the economic cost of tobacco consumption at the global level was equivalent to 1.8 percent of world GDP in 2012 - about US$ PPP 1.8 trillion (Goodchild, Nargis, and Tursan d'Espaignet 2017). Of that amount, direct costs (related to health care expenditures) totaled USD PPP 467 billion (equivalent to 5.7 percent of global health expenditures). In LICs and MICs, direct costs can be large when compared to total health care costs. For instance, in Bangladesh and Malaysia, direct care costs linked to tobacco-attributable diseases have been estimated at 19.8 percent and 16.8 percent of all health spending, respectively (U.S. National Cancer Institute and World Health Organization 2016). Total - direct and indirect - costs can also be high, reaching as much as 7.2 percent of GDP in the Philippines, though in most cases the costs range from 0.1 percent to 2 percent of GDP (U.S. National Cancer Institute and World Health Organization 2016). A recent study conducted in 12 Latin American countries found that health care costs for smoking-attributable diseases represent about 6.9 percent of government health budgets in these countries. Uruguay and Bolivia were among the most affected, spending 16.7 percent and 11.8 percent of their government health budgets, respectively, on tobacco-related costs (Pichon-Riviere 2020).

In the case of alcohol, fewer studies are available, but those that have been conducted for several countries all show high economic costs. Pooled results for 29 locations (countries, states/regions, cities) found that the total cost of alcohol consumption amounted to US$ PPP 817 per adult, equivalent to 1.5 percent of GDP (of which 68 percent were indirect costs) - (Manthey et al. 2021). Comparable studies for HICs show that total per capita economic costs related to alcohol range from US$ PPP 384 in France to US$ PPP 837 in the United States, with a weighted average for four countries (France, the United States, Canada, and Scotland) of US$ PPP 725 (Rehm et al. 2009). On average, 72 percent of those costs are due to lost productivity, while 13 percent are health care costs. In two MICs (South Korea and Thailand), the weighted average of total per capita costs was US$ PPP 293, with 79 percent of that amount attributable to lost productivity and 5.6 percent to health care costs (Rehm et al. 2009). In another study of 14 HICs, the weighted average of alcohol-related social costs was equivalent to 1.6 percent of GDP, with individual country values ranging from 0.6 percent in Spain to 2 percent in New Zealand (Mohapatra et al. 2010). In these countries, indirect costs represented 72 percent of total social costs. The few studies available for other low- and middle-income countries are consistent with these findings. In Chile, the social costs of alcohol consumption were equivalent to 0.9 percent of GDP in 2014, of which 30 percent were health care-related costs (Margozzini et al. 2018). In South Africa, a study estimated alcohol-related costs to be equivalent to between 10 and 12 percent of GDP (Matzopoulos et al. 2013).

We are unaware of studies estimating economic costs specifically for the consumption of SSBs. However, several studies have estimated the economic costs of conditions and illnesses strongly associated with SSB consumption, such as obesity. At the global level, it has been estimated that obesity costs US$2 trillion per year, or the equivalent of 2.8 percent of global GDP (Dobbs et al. 2014). Estimates for 42 countries in Asia and the Pacific put the economic costs of overweight and obesity at 0.8 percent of the group's GDP (Helble and Francisco 2017). Direct costs can reach up to 37 percent of total health costs

(in Singapore), and indirect costs can reach up to 67 percent of total health costs (in Palau).

Apart from economic costs related to illnesses associated with consuming these products, other long-lasting economic effects have been demonstrated. In the case of tobacco, evidence from China (Wang et al. 2006), India (John 2008), Cambodia (John 2012), Zambia (Chelwa and van Walbeek 2014), Chile (Paraje and Araya 2017), Ghana (Masa-ud et al. 2020), and a study of 40 LICs and MICs (Do and Bautista 2015) shows that tobacco expenditures crowd out other items in household budgets, such as food, education, and medical care. In certain cases, a higher budget share devoted to tobacco is also associated with a higher budget share allocated to alcohol. Across six diverse LMICs, tobacco and alcohol use were associated with crowding-out spending on acute care and preventative health-related behaviors for children, including vaccination, and crowding-in of harmful behaviors (Wu et al. 2021). It has been argued that these effects on household spending patterns can harm the accumulation of human capital (especially through foregone education and lower health care expenditures) and, ultimately, households' future well-being and society's economic growth. Similar effects have been found in Jamaica in the case of SSBs (Paraje and Gomes 2021).

Of course, the costs incurred by society due to the consumption of tobacco, alcohol, and SSBs are not completely recovered if consumption of these products goes to zero. Reducing premature deaths and chronic illnesses related to consuming these products generates substantial savings. Some of these savings will be offset by an increase in spending on less preventable diseases that people will ultimately experience. However, helping people reduce harmful consumption postpones such spending and, fundamentally, ensures healthier longevity.

TAXATION: ECONOMIC RATIONALES AND EFFECTIVENESS

For persons concerned with public health, the social harms of tobacco, alcohol, and SSBs are an adequate justification for discouraging consumption of these products. Although diverse perspectives exist regarding the appropriateness of government intervention to influence individual consumption choices, there are important additional rationales that justify discouraging consumption of these products – especially by raising their prices. These rationales include economic concepts of externalities, internalities, optimal taxation, and cost-effectiveness.

Economic rationales for taxing tobacco, alcohol, and SSBs

The consumption of tobacco, alcohol, and SSBs is associated with negative externalities since such consumption negatively affects third parties' well-being. Externalities occur when one individual's action - consumption, production - affects the well-being of another individual. In the case of tobacco, for instance, second-hand smoke is related to several diseases (Dunbar et al. 2013; Banderali et al. 2015). In the case of alcohol, road accidents, domestic and street violence, arson, and other negative externalities are directly linked to alcohol consumption (Chaloupka et al. 2019). For all three types of harmful products considered here, the diseases associated with their consumption are treated in health systems that enjoy partial or total public funding, and these interventions crowd out the treatment of other diseases.

Diseases caused by the consumption of tobacco, alcohol, and SSBs often lead to premature mortality. In the case of tobacco, cardiovascular diseases and cancers of several organs are among the main resulting diseases with potentially fatal outcomes, though by no means, the only ones (Jha et al. 2015). Alcohol consumption causes liver diseases, cancers, cardiovascular diseases, traumatic injuries, and others (Gawryszewski and Monteiro 2014). In the case of SSBs, diabetes, cancers, and cardiovascular diseases are among the main diseases that may lead to premature mortality (Singh 2015). Premature deaths of productive adults, in whom society has previously invested through education, health care, welfare programs, and other channels, constitute a loss of valuable collective resources with a likely effect on economic development. At the household level, illnesses caused by the consumption of health-damaging products and the out-of-pocket expenditures associated with these ailments may lead to household impoverishment or financial hardship that can have long-lasting consequences and spur a vicious cycle of intergenerational impoverishment (Jha 1999; U.S. National Cancer Institute and World Health Organization 2016).

Not only are negative externalities present in the consumption of these products, but so are negative "internalities," which arise from individuals ignoring or not correctly considering harmful health effects to themselves (Allcott, Lockwood, and Taubinsky 2019). Internalities may be present when consumers have imperfect information on the negative effects on their own health of consuming these products and/or when consumers face problems of self-control and time-inconsistency i.e., underestimating their own future health care costs, relative to their future preferences regarding the significance of such costs (Allcott, Lockwood, and Taubinsky 2019). Educational campaigns, warning labels, restrictions on advertising and sponsorship, and similar measures correct for internalities, but they are not 100 percent effective. Thus, taxes still have a role to play (Allcott, Lockwood, and Taubinsky 2019).

The usual tool used to correct negative externalities are the so-called Pigouvian taxes that increase marginal (private) costs to the consumer by enough to offset the cost of present and future externalities. These externalities can be very large and often take a heavy toll on households where the consumption of tobacco, alcohol, and SSBs occur. They include, for example, lost household income and catastrophic health expenditure for the household (Jha 1999; U.S. National Cancer Institute and World Health Organization 2016). Taxes have been found to be the most cost-effective tool to curb consumption of tobacco and hence its externalities and internalities (Jha 1999; International Agency for Research on Cancer 2011); among the most cost-effective tools to decrease alcohol consumption; and cost-effective to reduce consumption of SSBs (WHO 2017a). Using taxes does not preclude or impede using other tools to decrease consumption of these products, such as marketing restrictions, prohibitions on selling to certain groups (minors, for instance), labeling of products with health warnings, and others.

A further economic rationale for taxing tobacco, alcohol, and SSBs is unrelated to their health effects. Rather, it focuses on identifying the best way to raise public revenues. Adam Smith discussed this point explicitly in *The Wealth of Nations*, when he identified tobacco, alcohol, and sugar as products which were better sources of government revenues than other goods or services. While this approach has received relatively little attention, one study explicitly explored the idea in relation to alcohol taxes (Parry et al. 2009). It found that a revenue-neutral policy of raising alcohol taxes to replace labor taxes would lead to substantial welfare gains. Adopting this revenue strategy would imply much higher rates of taxes on alcohol than those based purely on addressing externalities.

EFFECTIVENESS OF PRICE POLICIES

As noted earlier, affordability – the relationship between consumer income and product price – is the key variable affecting consumption of health-damaging products. Per capita incomes and product prices determine affordability – the first positively and the second negatively. Per capita incomes are obviously not a relevant policy instrument, but altering product prices can be. Taxation and/or minimum-price policies typically increase prices and, by doing so, decrease affordability and reduce consumption.

Studies have consistently shown that taxes on tobacco, alcohol, and SSBs do indeed raise prices and reduce consumption. This effectiveness is a consequence of how demand responds to increases in a product's price (own-price elasticity); to the availability of substitutes (cross-price elasticities); and to changes in income (income elasticity). Own-price elasticity measures the percentage by which consumption decreases when the product's price increases by 1 percent. High own-price elasticities imply that a small increase in price (e.g., due to a tax increase) produces a relatively large reduction in consumption. Cross-price elasticities measure the percentage change in consumption of a particular product when the price of an alternative product increases by 1 percent, thereby indicating whether these are substitute or complementary products; and income elasticities measure the percentage by which demand increases or decreases when income rises by 1 percent.

Own-price elasticities

There is a vast literature estimating the effect of tobacco prices on demand for entire populations and subgroups (e.g., youth, individuals with different income levels, genders). Less extensive, but still large, is a literature relating tobacco prices to smoking onset and cessation.

Studies have measured the own-price elasticities of tobacco and have centered around values of -0.4 for HICs and around -0.5 for LICs and MICs, though the difference may not be statistically significant (US National Cancer Institute and World Health Organization 2016; WHO 2011; Chaloupka and Powell 2019; Guidon et al. 2015). Overall, short-run elasticities are about half the absolute value of long-run elasticities (US National Cancer Institute and World Health Organization 2016; Becker et al 1994). About half of the own-price elasticity is due to a decrease in prevalence (i.e., due to people quitting), while the other half is due to a reduction in the number of cigarettes smoked by those who continue smoking (U.S. National Cancer Institute and World Health Organization 2016; Goodchild et al. 2016). Youth are substantially more price-responsive than adults in countries at all income levels (U.S. National Cancer Institute and World Health Organization 2016; Nikaj and Chaloupka 2013; Kostova et al. 2011), and young men are more price-responsive than young women (Chaloupka and Pacula 1999). In addition, higher prices delayed or even prevented the initiation of smoking in a variety of countries i.e., the own-price elasticity of smoking onset was negative and statistically significant (Guindon, Paraje and Chávez 2017; Guindon, Paraje and Chaloupka 2019; Kostova, Husain and Chaloupka 2017; Vellios and van Walbeek 2016; Shang et al. 2019). This is in large part because young people generally have lower discretionary incomes than they will when they are older. Finally, higher tobacco prices increase the likelihood of cessation, as demonstrated in both HICs and MICs (Gonzalez-Rozada and Montamat 2019; Forster and Jones 2001; DeCicca, Kenkel and Mathios 2008; Hyland et al. 2006; Shang, Chaloupka and Kostova 2013; Ross et al. 2013).

The evidence on own-price elasticity for alcohol is also compelling, with values of -0.5 for short-run elasticity and around -0.8 for long-run elasticity (Gallet 2007). However, not all types of alcoholic beverages show the same own-price elasticity. In general, beer demand is less price-responsive than wine and spirits (-0.3 vs. -0.6, respectively) – (Powell and Chaloupka 2019; Guindon et al. 2022). There is little evidence on gender differences in price-responsiveness (Gallet 2007). Studies show different results on own-price elasticities by age, finding no conclusive differences between young people and adults (Jackson et al. 2010; Stockings et al. 2016). In the United States, alcohol price elasticity among heavy drinkers is significantly negative (i.e., price increases decrease consumption) but lower (in absolute value) than for the entire population (-0.3 vs -0.5, respectively (Wagenaar, Salois and Komro 2009). Even binge drinkers are price-responsive (Burton et al. 2017) but tend to choose cheaper drinks in an effort to keep up their alcohol consumption. This implies that policies aimed at increasing the price of cheaper drinks (e.g., minimum unit price policies) can be effective at reducing binge and/or heavy drinking (Jackson et al. 2010; Booth et al. 2008; van Walbeek and Chelwa 2021). Finally, evidence on how prices affect alcohol initiation is scarce but suggests that higher prices delay and, to some extent, prevent initiation. This can have long-lasting effects on future drinking patterns; for example, individuals who initiate at older ages have a lower probability of having frequent heavy-drinking episodes (Sornpaisarn et al. 2015; Paraje, Guindon and Chaloupka 2020).

For SSBs, there is mounting evidence on relatively high (in absolute terms) and significantly negative own-price elasticities. The own-price elasticity for SSBs is around -1, i.e., a 1 percent increase in SSB prices decreases consumption by 1 percent (Teng et al. 2019). In some countries, higher price-responsiveness has been measured, for example in the United States (with an own-price elasticity of -1.2) (Powell et al. 2013); Mexico (-1.1 to -1.2) – (Powell et al. 2013); Chile (-1.3 to -1.4) – (Caro et al. 2018; Guerrero-López, Unar-Munguía and Colchero 2017); Ecuador (-1.2) – (Paraje 2016); Guatemala (-1.4) – (Chaon et al. 2018); and South Africa (-1.2) – (Stacey et al. 2017). A systematic review of studies in 164 countries found that price-responsiveness was higher in the lowest-income countries and for the youngest and oldest adults vis-à-vis middle-aged persons, probably reflecting life-cycle changes in incomes. The review found no differences in price-responsiveness between men and women (Muhammad et al. 2019).

Overall, there is vast and consistent evidence that people consume less tobacco, alcohol, and SSBs when faced with increases in prices. For tobacco and alcohol, raising prices decreases consumption less than proportionally, while in the case of SSBs the reductions in consumption tend to be proportional or more than proportional to the price change.

Cross-price and income elasticities

A rise in other products' prices can lead to increases in consumption if products are substitutes, or to consumption decreases if they are complements. The sign on the cross-price elasticity parameter in-

dicates whether they are substitutes (positive sign) or complements (negative sign).

In the case of tobacco, for instance, there is evidence of substitution among tobacco products, such as manufactured cigarettes, roll-your-own tobacco, bidis, and small cigars, as well as between brands within the same product e.g., cigarettes (Nargis et al. 2019; Chaloupka and Powell 2018; Jawad et al. 2018; Guindon et al. 2011). In addition, there is evidence of electronic cigarettes being substitutes with manufactured cigarettes (Stoklosa, Drope and Chaloupka 2013). Less clear is the relationship between tobacco and alcohol (Pacula 1998), as some studies have found that they are substitutes (Dee 1999; Chen et al. 2016), others have found that they are complements, and still other studies have reported mixed results (Markowtiz and Tauras 2009).

In the case of alcohol, there is no consistent evidence on substitution between different alcoholic beverages (possibly due to methodological problems, sample sizes, and other factors) (Ornstein 1980; Edwards 1994), while there is strong evidence on substitution within beverage groups e.g., beers (Rojas and Peterson 2008; Gruenewald et al. 2006; Meng et al. 2014; Srivastava et al. 2015; Ruhm et al. 2012). Finally, there is only suggestive evidence on cross-price elasticities between alcohol and illicit drugs (Burton et al. 2017).

SSBs clearly have substitutes among other beverages, such as milk, coffee, tea, bottled water, and diet carbonated beverages, with higher degrees of substitution for milk and bottled water (Guerrero-López, Unar-Munguía and Colchero 2017; Paraje 2016; Smith, Lin and Lee 2010; Finkelstein et al. 2013). Some studies have estimated SSB price-responsiveness in food demand systems, including not only beverages but solid sugar-rich foods, such as cookies, candies, deserts, and snacks. Findings from these investigations have been mixed. Some products are substitutes, others are complements, and others are not related (Colchero et al. 2015; Caro et al. 2018). Such a pattern would imply that higher SSB prices could lead to an increase in consumption of other unhealthy food products (salty snacks, candies, cookies, and others), partially offsetting the expected reduction in sugar intake. While this may happen, it has been found that the net effect of SSB price increases is still an overall decrease in sugar intake (Finkelstein et al. 2013; Pell et al. 2021; Leider et al. 2021).

There are considerably fewer studies on income elasticities. Still, the evidence is consistent in showing that the main tobacco products (e.g., cigarettes), alcoholic beverages, and SSBs are normal goods: that is, their income elasticity is positive, meaning that an increase in income increases demand for the product. For tobacco, income elasticity is estimated at between 0.3 and 0.4, such that a 10 percent increase in income would lead to a 3 to 4 percent increase in tobacco demand (Gallet and List 2003; Nargis et al. 2021). In the case of alcohol, a large systematic review found estimated income elasticities to be in the vicinity of 0.7 (Gallet 2007). Finally, for SSBs there is evidence that income elasticities are between 0.8 and 1, though the number of studies estimating this parameter is still low (Paraje et al. 2016; Chacon et al. 2018; Stacey et al. 2017). Results to date on income elasticities for these products—suggesting that they are normal goods—indicate that increases in affordability lead to higher demand for these products irrespective of what occurs with own or other products' prices. This corroborates our earlier discussion of affordability.

Pass-through to prices

Given the strong evidence that demand for tobacco, alcohol, and SSBs is price-responsive, taxes can decrease consumption only if they can increase prices. Though it is common to assume that a tax increase automatically raises prices, in fact, the degree and speed with which prices rise will depend, among other things, on the market structure, the structure of the excise tax system, and the availability of non-taxed or differentially taxed substitutes (which affects the own-price demand elasticity). In particular, prices will typically rise more in response to a tax increase when the market is concentrated, the taxes are charged at the retail level, and when a product has few or no close substitutes (and, hence, a low own-price demand elasticity). Taxes can be fully passed to prices (pass-through equal to 1), can be under-shifted (pass-through less than 1), or can be over-shifted (pass-through greater than 1).

There is evidence, for instance, that in less competitive markets, firms tend to fully pass taxes to prices or even over-shift them. For example, in the United States, the 1983 increase in the Federal Cigarette Excise Tax was over-shifted by oligopolistic firms exploiting their market power (Harris 1987). Similar behavior was found in Europe (Delipalla and O'Donnell. 2001). In the European case, ad-valorem taxes (i.e., a percentage of the price) tend to produce lower pass-through rates for tobacco when compared to specific taxes (i.e., a tax per unit sold). Tax

structure can also affect pass-through rates. In India (Jha et al. 2011) and Bangladesh (Nargis et al. 2020), a complex tiered tax system has given the tobacco industry room for passing taxes differentially according to price segments (i.e., taxes are under-shifted for cheaper cigarettes and over-shifted for premium cigarettes, thereby leading to downward substitution rather than reducing consumption). The same effect was also found in Mauritius (Berthet Valdois et al. 2019). The perspective of further regulations may also affect the pass-through rate, as producers facing a scenario of tightening restrictions in consumption, higher taxation, and other constraints may choose to maximize short-run profits by over-shifting taxes (Becker et al. 1994). There is evidence that the tobacco industry uses a number of strategies (e.g., stockpiling, that is, oversupplying the domestic market before a tax increase) to delay the change in prices after a tax increase, although prices eventually rise as a result of such an increase (Ross, Tesche and Vellios 2017; Marquez and Moreno-Dobson 2017).

For alcohol, taxes also seem to be fully passed or even over-shifted. A review found that taxes are generally over-shifted in the case of beer and fully shifted for wine and spirits (Nelson and Moran 2020). In the United States, state and federal alcohol taxes appear to be over-shifted, especially for beer and spirits. The price adjustment also seems to be quite rapid, within three months of the tax change (Young and Bielińska-Kwapisz 2002) Similar results were found in the case of beer in Alaska (Kenkel 2005). For the UK, the pass-through rate varies by price level of products. Producers of relatively cheaper alcohol beverages tend to under-shift taxes, while those of relatively more expensive beverages over-shift them (Ally et al. 2014). A similar finding was reported for the pass-through of alcohol taxes for 27 OECD countries (Shang, Ngo, and Chaloupka 2020). This study also reported under-shifting or fully shifting taxes in the case of wine and certain spirits (e.g., cognac) and over-shifting in the case of beer and Scotch whisky.

In the case of SSBs, the evidence is mixed. In Mexico, the SSB tax was mostly over-shifted for sodas and fully or mildly under-shifted for other SSBs (Grogger 2016; Colchero et al. 2015). In France, taxes were over-shifted for sodas and under-shifted for fruit juices and flavored waters (Berardi et al. 2016). In Denmark, three tax changes between 1998 and 2003 were either fully shifted or over-shifted (Bergman and Hansen 2019). However, in other cases, taxes have been under-shifted. This is the case of Barbados (Alvarado et al. 2017), Chile (Nakamur et al. 2018), and for some categories of SSBs in the UK e.g., those in the top tier of the tax (Scaborough et al. 2020). In the United States, studies of local taxes have found mixed results, depending on the location of the store – e,g., proximity to state borders led to under-shifting (Cawley et al. 2017), store types, and beverage types (Silver et al. 2017; Powell et al. 2020). A recent meta-analysis found that, on average, the pass-through was 70 percent of the tax, though with considerable variation across studies (Powell et al. 2021).

Evidence on price pass-throughs implies that large increases in specific taxes are a more effective strategy for reducing consumption than a series of smaller tax increases, particularly if they are ad-valorem taxes. A large specific excise tax is less easily manipulated by industry and, if applied uniformly to all products, it can narrow the differential between cheaper and more expensive brands. Incremental tax increases give the industry political room to blame the government for price increases they impose in order to maximize profits. A larger excise tax increase makes this "blame and pocket" strategy less feasible, as the public is more likely to be alerted to the larger expected tax increase (Marquez and Moreno-Dobson 2017). More importantly, behavioral research also find that people are more responsive to large salient changes in prices than to incremental ones because it changes the framing of their consumption decision and triggers a greater loss aversion response (Tversky and Kahneman 1981; Babor et al. 1978; Epstein et al. 2012; Kalyanaram and Winer 2022).

Minimum unit prices: cases, evidence, and implications

Minimum unit prices (MUP) are policies that raise the "floor" of prices without using taxes. MUPs raise average prices while reducing the possibility of down-trading (i.e., switching to cheaper brands). This measure has been used in the context of tobacco and alcohol control. Although it is effective when properly used, it has the disadvantage of not generating direct revenues (only indirect ones, via VAT for instance) and being more costly to enforce than, for instance, taxes at the producer level. In the case of tobacco, MUP policies might set a minimum price for 20-cigarette packages, while MUPs for alcohol have been based on alcohol content (e.g., Scotland's MUP is £0.50 per 8 grams of pure alcohol) or based on volume (e.g., £0.50 per liter of beer).

Some research suggests that, at least in countries with the institutional capacity to ensure en-

forcement, MUPs for alcohol may be even more effective than taxes for reducing consumption among certain groups. A study in Australia found that an MUP policy was more effective at reducing consumption among heavy drinkers of beer and wine than a volumetric excise tax i.e., a tax based on alcohol content (Shara et al. 2014). A systematic review found that modelling studies for England and Australia confirm that an MUP policy is highly effective at reducing consumption among heavy drinkers, though it would minimally affect moderate drinkers (Burton et al. 2017). The same effect was found in South Africa (van Walbeek and Chelwa 2021).

MUP policies are widely used for tobacco in the United States; at least 25 states have implemented them (Feighery et al. 2005). A study using data from 2007 to 2014 found that cigarette prices were significantly higher in states with MUP policies than those without, especially for cheaper products (Huang et al. 2016). Models predict that establishing a national MUP (at US$ 10) for cigarettes could significantly reduce sales of cigarettes and increase cessation (Doogan et al. 2018).

As MUP do not raise revenues (apart from those that can be generated from VAT) the political economy to implement them can be more complex. Ministries of Finance, for instance, may not have the incentives to push for MUP as they will not get any substantial extra revenues. High enforcement costs, especially important in poorer countries, can also be a deterrent to implement MUPs, as such costs may not be recovered with extra revenues.

RELATED TOPICS

Distribution of financial burden and averted health costs: extended cost-benefit analyses

The extended cost-benefit analysis (ECBA) methodology incorporates any short-term welfare losses from excise taxes into a framework that includes the medium- and long-term health benefits for those who quit consuming or who consume fewer harmful products. Among other aspects, ECBA accounts for differential behavioral responses across population groups—including different income groups—through the estimation of group-specific price elasticities. This kind of analysis tends to show that, because lower-income individuals tend to be more sensitive to cigarette, alcohol, and SSB pricing, they will benefit disproportionately from the resulting health improvements, health care expenditure reductions, and higher disposable income for purchasing non-toxic goods and services. Fiscal incidence analyses that do not consider behavioral responses and account only for the direct costs of taxing these products are partial or incomplete because they ignore these other effects. By accounting for both direct and indirect effects in the short and medium terms, ECBA provides a more complete picture of the costs and benefits that taxing tobacco, alcohol, and SSBs entails for household welfare. This contradicts industry claims that such taxes are hardest on the poor.

Tobacco, alcohol, and SSBs are unlike other taxable goods. Preventing health and economic harms associated with consumption of these products generates large benefits to current and potential consumers, governments, and societies. In general, most smokers are willing to quit but unable to do so. In the United States, for instance, about 68 percent of smokers were willing to quit, and 55 percent attempted to quit, but only about 7.5 percent of smokers successfully quit smoking (U.S. Department of Health and Human Services 2020). A US study that compares the value of statistical life for smokers with the costs of smoking found that "the economic value of the premature mortality due to smoking dwarfs the purchase price of cigarettes," reaching a private cost of US$ 222 per pack for men and US$ 94 per pack for women in 2006 dollars (Viscusi and Hersch 2008). A study in Spain reached similar conclusions (Cobacho et al. 2010).

The ECBA methodology has been applied widely, including in a 13-country study (Global Tobacco Economics Consortium 2018). At least 13 country studies using ECBA highlight that the medium- and long-term benefits of reducing smoking can outweigh the short-term spending on taxes, resulting in net gains, particularly among poorer households (Del Carmen, Fuchs and Genoni 2018; Fuchs, Matytsin, and Obukhova 2018; Fuchs and Meneses 2018, 2017a, 2017b; Fuchs and Del Carmen 2018; Fuchs and Del Carmen and Mukong 2018; Fuchs and Gonzalez 2019; Fuchs, Orlic, and Cancho 2019; Fuchs, Mandeville, and Alonso-Soria 2020). Similar findings are reached by Fuchs, Paz, and Gonzalez Icaza who simulate tax policy changes in eight low-, middle- and high-income countries

(Fuchs, Paz, and Gonzalez 2019). The distribution of elasticities and resultant health and economic benefits from reduced medical expenses and lower 'years of working-life lost' (YWLL) generally more than offset the short-term negative effects of tobacco taxes on household budgets. For sufficiently high price shocks and elasticity scenarios, the tax incidence is progressive. Half the population in these countries could benefit from net positive income gains in the medium to long term if cigarette prices rose by 50 percent. In a similar study, Postolovska et al. find that increasing Armenia's cigarette excise tax rate to 75 percent of the retail price could deliver large health and financial benefits to households, with pro-poor impacts (Postolovska et al. 2017).

The reduction in medical bills tends to be the most significant component driving the net benefits under the ECBA. All income groups benefit from the reduction in medical expenses when taxes discourage smoking, but these benefits are disproportionately larger for poor households. In Moldova, where tobacco-related diseases are the leading cause of premature adult deaths, just accounting for reductions in medical expenses is enough to offset the initial negative price effect on household expenditures, with a clear progressive pattern (Fuchs and Meneses 2018). In Chile, Ukraine, and Russia, reducing medical expenses constitutes the largest long-term benefit of the tobacco price increase under the ECBA (Fuchs and Matytsin 2018; Fuchs and Meneses 2017a, 2017b). Similarly, tobacco price increases yield positive welfare gains from being able to work longer. In Bangladesh, for instance, the main gains of taxing tobacco under the ECBA model arise from extending people's working lives i.e., lowering YWLLs (Del Carmen and Fuchs 2018).

Despite these ECBA results, those lobbying against tax increases continue to cite studies which look exclusively at the direct short-term distributional costs. One such study in Chile showed that, if cigarette prices increased by 25 percent, the poorest 20 percent of the population would reduce consumption of other goods by 0.35 percent in the absence of any adjustments in cigarette consumption, while the wealthiest 10 percent would face a smaller reduction of 0.09 percent (Fuchs and Meneses 2017). Without considering the health benefits, avoided health care costs, and productivity gains, these partial studies are biased regarding the distributional consequences of taxing harmful products.

Complete studies on the distributional consequences of taxing alcohol and SSBs are less common but growing in number. For example, a study of excise taxes on SSBs in Ukraine found that the net effect is progressive though small in magnitude: raising SSB prices by 20 percent increases disposable income of the poorest quintile of the population by 0.03 percent (Fuchs and Gonzalez 2021). In Kazakhstan, where the average price elasticity of SSBs is estimated to be -0.70, lower income deciles benefit more than higher income deciles from the simulated introduction of a 20 percent price increase on SSBs (Fuchs, Mandeville, and Alonso-Soria 2020). Finally, a recent ECBA in Brazil shows that price increases on alcohol, tobacco, and SSBs have positive and progressive effects, when incorporating the impact of health taxes on prices, medical expenditures, and productive lives (Coelho 2020).

No ECBAs are currently available specifically for alcohol taxation. However, a recent report analyzed the distributional effect of alcohol taxes in the UK (Bhattacharya 2020). It found that there is no evidence to support the idea that alcohol taxes are regressive. Furthermore, once the use of alcohol tax revenues by the Government is considered, results can be strongly progressive, if revenues are used to finance increased health spending or other pro-poor programs. Note that "soft" earmarking (i.e., in which the recommended use of the new revenues is not legally required) has been found to be helpful for overcoming political opposition to higher tobacco excise taxes (Marquez and Moreno-Dobson 2017).

In the case of alcohol, the relative financial burden may be affected not only by income but also, crucially, by the intensity of drinking. In Australia, alcohol taxes represent a higher burden to heavy drinkers irrespective of their incomes and, because of that, one study suggests that MUP policies or taxes that increase the cost of the cheapest alcohol can be more effective in reducing alcohol consumption, without having highly regressive effects (Vandenberg and Sharma 2016). However, this is a partial study which does not consider the distributional effects on revenues and health care cost savings.

COMBINATION OF TAXES AND NON-PRICE INTERVENTIONS

Price interventions through taxation (and/or MUPs) are not the only policies for reducing consumption of tobacco, alcohol, and SSBs, although they are generally among the most cost-effective. Other policies that are effective at reducing consumption include: (1) marketing controls (e.g., on advertising, package labelling, promotion, or sponsorship); (2) sales regulations (e.g., licensing, store opening times, age restrictions); (3) consumption regulations (e.g., restrictions on smoking or drinking in public places, work spaces, or other specified locations); (4) consumer education (e.g. mass media campaign, package labelling); and (5) cessation programs and interventions (especially for tobacco, but also for alcohol).

WHO has reviewed the evidence on the cost-effectiveness of some of these policies with regard to reducing tobacco and alcohol consumption (WHO 2017a). WHO's study defines "best-buys" as measures that cost at most US$ PPP 100 per DALY averted in low- and middle-income countries.

For tobacco, five "best-buys" were identified. Tobacco taxation leading to price increases was the most cost-effective. Two marketing control measures were jointly ranked second: (a) the implementation of plain/standardized packaging and/or large graphic health warnings on all tobacco packages; and (b) enacting and enforcing comprehensive bans on tobacco advertising, promotion, and sponsorship. Finally, cost-effectiveness was demonstrated for two additional measures: effective mass media campaigns that educate the public about the harms of smoking/tobacco use; and eliminating exposure to second-hand smoke in indoor spaces and public transportation.

Although tobacco taxation was the most cost-effective intervention, the measures noted above are complementary. Public awareness of the hazards of smoking and the benefits of quitting, achieved through mass media campaigns, graphic warnings on packs, and the other measures cited all encourage wider public support for tax hikes, in addition to discouraging consumption (Jha and Peto 2014). Similarly, bans on smoking in public places and bans on advertising restrict social cues that encourage smoking and reduce the tobacco industry's social and political influence, further enabling tax increases. Bans on smoking in public places, particularly workplaces, require smokers to take time from work and to go outside even in unpleasant weather, in effect raising the "cost" of smoking. It has been widely shown that bans on smoking in public places almost immediately affect health, reducing the incidence of strokes, myocardial infarctions, and certain respiratory diseases (Bartecchi et al. 2006; Juster et al. 2007; Naiman et al. 2010; Sargent et al. 2004; Ferrante et al. 2012).

For alcohol, the WHO "best buys" are: (1) increase excise taxes on alcoholic beverages; (2) enact and enforce bans on exposure to alcohol advertising; and (3) enact and enforce restrictions on the physical availability of retailed alcohol such as through reduced hours of sales (WHO 2017a).

Finally, WHO assessed the cost-effectiveness of measures to reduce unhealthy diets in general, not interventions focused specifically on SSBs. However, WHO's analysis did cite evidence that taxes on SSBs are cost-effective, even though they did not meet the threshold of US$ PPP 100 per DALY averted. For this reason, WHO has actively promoted and encouraged the use of SSB taxes as part of a policy package to tackle the overweight/obesity pandemic (WHO 2017b; PAHO 2021; WHO 2022).

CHALLENGES FROM THE INDUSTRY

The tobacco industry has a long and well-researched history of concealing evidence on the toxicity of its products, deceiving the public on the harmful effects of tobacco consumption, and interfering in public policy. As early as the 1950s, tobacco companies concealed evidence on the harmfulness of their products and the addictive properties of nicotine. In the 1970s and 1980s, they denied links between smoking and cancers and the harmfulness of second-hand smoking (WHO 2019a; Brownell and Warner 2009). More recently, despite robust scientific evidence, they misled the public regarding the relative safety of "light" or "low-tar" cigarettes (WHO 2019a).

The tactics of the tobacco industry have been exposed through successful efforts to make the industry's own documents public (Tobacco Control 2002). These documents have demonstrated the large discrepancies between what the industry knew and the ideas it promoted. For example, the industry has consistently portrayed smokers as well-informed, rational individuals who choose to smoke (Brownell and

Warner 2009; Kyriakoudes 2016; Risi and Proctor 2020), even when tobacco firms know that their own marketing is effective precisely because individuals are *not* well-informed and unfailingly rational.

Thus, to market cigarettes, firms use strategies that appeal to individuals' non-rational behaviors. These approaches include branding, associating cigarettes with desirable images, and increasing nicotine content to make smoking even more addictive. Such marketing strategies are used while intentionally repressing extensive evidence regarding smokers' ignorance and reluctance to internalize the health risks from smoking (due to time inconsistency) and the addictive nature of nicotine (which undermines rational choice). Also notable are the industry's efforts to market to youths, whose brain development is known to be incomplete, especially with regard to evaluating long-term consequences and risk (UN National Cancer Institute and World Health Organization 2016; Villanti et al. 2019). The one intervention major actors in the tobacco industry are willing to promote is public education campaigns, the least cost-effective intervention in the WHO study reported above (WHO 2017a). Public education is indeed important, but only as a complement to taxation and other policies, not as a substitute for them.

Apart from concealing and distorting evidence, the tobacco industry has used several arguments to deter, impede, or delay increases in tobacco taxes. A systematic review of the tobacco industry's tobacco tax opposition found that the most common and consistent arguments were that tobacco taxes are: (a) regressive; (b) do not affect consumption; (c) lead to more illicit trade and foster organized crime; and (d) reduce employment and harm businesses (Smith et al. 2013). The empirical evidence on regressivity and impact on consumption have been reviewed in preceding sections. Results show that the tobacco industry's arguments are unfounded with regard to these two issues. Evidence also refutes industry arguments about illicit trade and employment, as the next subsections will show.

In addition to disseminating these false arguments, the tobacco industry has developed a range of tactics to oppose, delay, or water down public health policies aimed at reducing smoking. The abovementioned review identifies 21 tactics, including: (a) using front groups and friendly "independent" experts to give their arguments credibility; (b) directly lobbying policy makers; (c) using media resources (including op-ed pieces and letters to newspapers) and other publicity campaigns to encourage public opposition to proposed taxes; (d) commissioning research that is biased toward supporting industry campaigns; (e) deliberately confusing debates about tobacco tax increases with broader tax debates; (f) undermining the credibility of tobacco control experts; and (g) stimulating and even participating in smuggling (see below) in the event of tax increases (Smith et al. 2013).

The tactics of the alcohol and SSB (or, more accurately, food) industries to oppose taxes and regulations are remarkably similar to those used by the tobacco industry. Alcohol, SSB, and food companies also shift blame for unhealthy eating or drinking away from themselves as purveyors of products and onto the individuals who are intentionally influenced by their marketing campaigns (Brownell and Warner 2009). The alcohol and processed-food industries have also linked regulations and taxes to the loss of personal freedoms and the notion that public health policies create "food police" or "food fascism." (Brownell and Warner 2009; Larrain 2016). Self-regulation is often proposed as an effective and more efficient alternative to state regulation, even when this has been shown to be ineffective. Like the tobacco industry, the producers of alcohol and SSBs lobby governments and the public by arguing that taxes do not reduce consumption; that they are regressive; and that they are "discriminatory" as they are levied on a specific group of products, or even unconstitutional (Hattersley et al. 2020).

Alcohol and SSB manufacturers promote two additional key ideas which are also common in tobacco industry strategies. They stress that: (a) the etiology of the problem is complex, and therefore no individual product can be blamed; and (b) population health measures (such as taxes) are too simple to address complex public health problems (Petticrew et al. 2017). Often, the solutions proposed by these industries are simplistic, disregarding their own diagnosis of complexity. Their recommended approaches largely focus on providing more information, consumer education, and relying on individual responsibility (Petticrew et al. 2017). The dismissal of independent scientific evidence contrary to their interests as "junk science" is also common.

In the case of alcohol, there is less evidence on the strategies used to influence alcohol taxes. Nevertheless, some authors have documented how the industry uses national and international front groups (for example, the International Centre for Alcohol Policy, ICAP, or the International Alliance for Responsible Drinking, IARD) to influence public poli-

cy (Collin and Hill 2019). These front groups engage in activities to distort evidence on taxation, claiming taxes are a "blunt tool" that do not reduce consumption, are regressive, increase illicit trade, and reduce government revenues. They also use strategies to meddle in political processes, by presenting alternative policies (not related to taxes) and lobbying policy makers and officials (Collin and Hill 2019). In the case of the SSB industry, the strategies and actions are similar, as the discussion of Mexico's SSB taxes has demonstrated (Pedroza-Tobias 2021).

Taxes and illicit trade

Once the tobacco industry lost its ability to deny the addictiveness and harmfulness of smoking, it sought other ways to confuse public policy debates, delay action, and stop or limit tax increases. One of the most common arguments the tobacco industry uses to challenge tobacco taxes is to claim that these policies will be ineffective and counterproductive because they will encourage illicit trade, an argument also used regularly by the alcohol industry. While the argument is plausible, it is empirically false. Indeed, investigations have found that the transnational tobacco industry is itself responsible for the production of about two-thirds of illicitly traded cigarettes (Gilmore et al. 2017). Quite often, tobacco companies are directly involved in smuggling, as shown by formal investigations and settlements, first with Canada (CBC News 2008) and later with the European Union, among others (NBC News 2004).

Evidence against the tobacco industry's claims on illicit trade is strong. First, illicit trade has not increased in the last decade, despite increasing tobacco taxes (Paraje and Stoklosa 2021; Joossens and Raw 2012; Goodchild 2020). In fact, illicit tobacco products, mostly cigarettes, constitute a stable share in a shrinking market. As mentioned above, affordability of cigarettes has decreased (as measured by the RIP) in 117 out of 168 countries between 2008 and 2018 (Paraje and Stoklosa 2021), and this decrease came mostly from higher tobacco taxes. Based on WHO data, the unweighted average of the total tax share (as proportion of final retail price) for the most-sold brand of cigarettes went from 46.6 percent in 2008 to 52.4 percent in 2018 (WHO 2019c). Out of 174 countries with complete data for this period, 118 increased the total tax share, with 48 countries raising it by more than 10 percentage points and 22 by more than 20 percentage points. There is no significant difference on this between the richest 40 and the poorest 40 countries, though the former had an initially higher total tax burden (66.5 percent versus 37.6 percent in 2008) (WHO 2019c). Out of 179 countries, 91 increased the tax burden of specific taxes, 58 raising this figure by more than 10 percentage points and 33 by more than 20 percentage points. A recent exercise in scoring changes in tobacco taxes found that, out of 170 countries, 51 increased tobacco taxes between 2014 and 2018 (Chaloupka et al. 2021b). The global situation of rising taxes and decreasing consumption does not fit the tobacco industry's narrative nor the evidence on illicit trade.

Second, the evidence cited by tobacco companies to link tobacco tax increases with illicit trade is weak and generally based on studies financed by the tobacco industry itself. These studies rarely make their methods and data publicly available for peer review and scrutiny. By contrast, independent studies have used cross-country evidence to show that countries with higher taxes have a lower penetration of illicit trade than those with lower taxes (US National Cancer Institute and World Health Organization 2016; Joossens et al. 2010). The recent cases of the UK, the Philippines, and Botswana provide an example (Blecher 2020; Diosana and Sta. Ana 2020; World Bank 2019). It is likely that illicit trade is driven less by price increases on tobacco than by the general capacity of tax administration authorities to enforce taxation – and this is true not only for tobacco (US National Cancer Institute and World Health Organization 2016). Lack of controls, corruption, and weak administrative capacities may foster illicit trade, though countries with middling administrative capacities, such as the Philippines and Botswana (among others), have succeeded in restraining illicit trade. Strengthening excise tax laws (e.g., through harsher penalties, strong governance and control processes, and other measures) helps to curb illicit tobacco trade (as illicit trade in any other product).

Furthermore, small-scale smuggling cannot have a significant effect on sales or smoking. Widespread smuggling requires active or tacit support from the tobacco industry. A comparison of France and Canada is informative. Both countries markedly raised taxes, tripling them from the 1990s to 2004. During these years, however, the tobacco industry in Canada led a well-orchestrated scheme to export tax-free Canadian brand cigarettes into the United States and then smuggle them back into Canada. The industry then used the evidence of smuggling (without admitting its own role) to lobby the Canadian government to lower taxes and to

argue against higher taxes in other countries. The excess consumption that resulted from the reduced excises spurred by this scheme, as well as directly from the smuggled (and cheaper) cigarettes, was approximately 30-40 billion sticks in the early 1990s. Hence, the failed Canadian response to smuggling would eventually cause some 30,000 to 40,000 tobacco-attributed deaths due to the tobacco industry's orchestration of smuggling during the 1990s (CBC News 2008; Jha et al. 2020).

Third, profit-maximizing smugglers increase illicit cigarette prices along with the increases in licit cigarette prices (Joossens and Raw 2012). This implies that, even when increased taxes divert some demand to the illicit market, they also push prices up in the illicit market, discouraging consumption (Goodchild et al. 2020). Recent evidence shows that illicit cigarette prices generally follow the prices of legal cigarettes (correlation coefficient: 0.87) (Paraje and Stoklosa 2021; Drope et al. 2021).

In the case of alcohol, there is less evidence on the relationship between taxation and illicit, unrecorded alcohol consumption. Alcohol is less susceptible to smuggling than tobacco, because it is heavier and more difficult to transport relative to its value. On the other hand, opportunities for artisanal, informal production are more widespread (Reuter et al. 2015). The same can be said for SSB illicit trade, where there is no evidence relating higher SSB taxes to increased illicit trade in SSBs (Hattersley et al. 2020). SSBs' low price relative to volume is, probably, a "natural" hurdle for illicit trading.

WHO estimates show that the global share of unrecorded alcohol consumption fell from 28.6 percent for 2005 to 25.5 percent for 2016 (WHO 2011; WHO 2018). Estimates of such a share for LICs and LMICs are around 43 percent for 2016, while for UMICs and HICs, they are around 17.5 percent (WHO 2018). Large variations also exist by region.

Taxes, economic activity, and employment

The tobacco, alcohol, and SSB industries routinely assert that excise taxes on these products reduce economic activity and employment as people purchase less of the taxed goods. This argument, which contradicts their claims that taxes do not have an impact on consumption (Petticrew et al. 2017) is also simplistic and untrue. When taxes reduce consumption of these products, it can affect sales and employment in those sectors. However, consumer spending on other products will increase and raise sales and employment in those other sectors (Chaloupka and Powell 2018). Furthermore, when governments spend the excise tax revenues, they also generate employment. Studies have found that shifting demand from the tobacco industry, which is relatively capital-intensive, to industries which are more labor-intensive can actually increase employment (Marquez and Moreno-Dobson 2017).

A relatively large body of evidence exists on this for SSB taxes (Hattersley et al. 2020). Though the SSB industry fought against a tax increase in Mexico in 2014 by claiming that it would reduce employment, subsequent evidence showed that the policy did not have any impact in terms of employment in the manufacturing sectors affected by the tax (Guerrero-López et al. 2017). Employment in the retail sector was also unaffected (it even showed a moderate increase). The same is shown for several cities in the United States that have implemented such a tax. In the case of San Francisco, a recent study shows that, two years after the implementation of the SSB tax, there was no discernible effect on employment for the overall economy, private sector, supermarkets and other grocery stores, convenience stores, limited-service restaurants, and beverage manufacturing, when compared to a suitable synthetic group (Marinello et al. 2021). Similar results are obtained in studies simulating the impact of a statewide SSB tax in California and Illinois (Powell et al. 2014)

In the case of alcohol, a study simulated the effect on employment of an alcohol tax increase in six US states and found that such a tax would have a positive impact on employment, mostly because the resulting fiscal expenditures would spur greater economic activity (Wada et al. 2017).

Finally, in the case of tobacco, there is ample evidence that tax and non-tax policies (such as smoke-free policies) do not have a discernible effect on aggregate employment. Studies on this topic have been conducted for Scotland, the UK, the United States and some of its individual states (Michigan, Indiana), Canada, South Africa, Zimbabwe, Bangladesh, Bulgaria, Egypt, and Indonesia (US National Cancer Institute and WHO 2016). In most cases, studies found a net gain of jobs under normal circumstances after a tobacco tax increase.

Though aggregate employment is not affected by tobacco taxes, members of some specific groups (e.g., small-scale tobacco farmers) may lose income or even go out of business. In most cases, farmers have long-established practices of shifting among

crops in response to demand and market prices (Marquez and Moreno-Dobson 2017). In other cases, crop substitution programs can be implemented. Alternatives to tobacco farming are present in countries as diverse as Indonesia, Malawi, Kenya, Brazil, Canada (US National Cancer Institute and World Health Organization 2016) and China (Li and Tang 2018). Compensatory programs can also be financed with the tax revenues. For example, the Philippines earmarked a significant proportion (15 percent) of incremental revenues from tobacco taxes to help tobacco farmers shift to other crops (Chavez et al. 2016). The benefits of reducing illnesses and deaths associated with tobacco consumption, and sparing the environmental costs associated with tobacco growing, are substantially higher than the costs of implementing these crop substitution programs (Lencucha et al. 2022; Lecours et al. 2012).

Non-tax measures, such as smoke-free policies, have also been cited as hurting businesses (e.g., bars, restaurants, pubs). However, studies conducted in several countries have shown little effect on sales, employment, number of establishments, business value, or gaming revenue (US National Cancer Institute and WHO 2016; Guerrero López 2011).

CONCLUSIONS

In 1776, Adam Smith stated that "sugar, rum, and tobacco are commodities which are nowhere necessaries of life, which have become objects of almost universal consumption, and which are therefore extremely proper subjects of taxation" (Smith 1776). Much time has passed since then, and evidence on the negative effects of the consumption of tobacco, alcohol, and SSBs is overwhelming (something unknown when Smith wrote). In addition, economic theory has demonstrated that taxing products that generate negative externalities not only raises revenues but increases economic efficiency.

Evidence collected over the past decades shows that tobacco taxation is the single most effective intervention to curb tobacco use (Jha 1999; International Agency for Research on Cancer 2011). Recently, WHO has included tobacco taxes as a "best buy" (interventions with the highest cost-effectiveness) to reduce consumption and the burden of diseases associated with tobacco use (WHO 2017a). Similar arguments can be made for alcohol taxation. In the case of SSB taxes, though they have not been included in the "best buy" list, they have been singled out as a cost-effective intervention for reducing SSB consumption.

Reducing consumption of alcohol, tobacco, and SSBs and the burden of disease associated with these products is not only about reducing health care costs, which can be significant and put substantial pressure on health systems, it is also about increasing the social return on human capital. Chronic illnesses and conditions associated with the consumption of these products hinder individuals' productive performance due to absenteeism and presenteeism (the reduction of productivity at work due to illness). Meanwhile, in addition to the personal tragedy of lives lost, premature mortality linked to these products implies that the social resources devoted to education and health care for the deceased individuals are also prematurely lost and do not deliver their full yields. Recall that, in the case of tobacco, smokers lose on average a decade of life when compared to non-smokers (Jha 2020). Loss of income due to illness and mortality may affect households' present and future wellbeing, creating a vicious cycle of lower human capital investment and poverty.

Contrary to the simplistic arguments advanced by affected industries, higher taxes on these harmful products are highly progressive (i.e., pro-poor). Because poorer individuals are more price-responsive, they have a higher propensity to reduce consumption or quit altogether when taxes increase. Consequently, they benefit disproportionately from longer and healthier lives, reduced spending on health care, fewer lost days of work, and longer working lives (Verguet et al. 2015). Evidence on this for countries at different income levels is significant and consistent.

There is also evidence, especially for tobacco and alcohol, that the best tax structure to decrease consumption relies on enacting high specific excise taxes and raising them to keep pace with inflation. In the case of tobacco, specific excises on cigarette "sticks" or grams of other tobacco are preferrable, as they discourage substitution to cheaper products, which are just as harmful as more expensive ones. In addition, specific taxes limit the industry's capacity to manipulate the pass-through to prices in ways that undermine the tax's effect on consumption and profits (International Agency for Research on Can-

cer 2011). In the case of alcohol, specific excises on alcohol content are also recommended as the best tool to decrease consumption and associated costs (WHO 2020). In the case of SSBs, specific taxes on sugar content have also been recommended as the best way to achieve the public health goal of reducing consumption of sugars (Popkin and Ng 2021).

Taxes are an important element of broader efforts to reduce consumption of tobacco, alcohol, and SSBs. They are not a cure-all, however. They should be used along with other cost-effective measures. These other measures include mass media education campaigns; prominent product labelling showing adverse health effects (especially for tobacco and alcohol); restrictions on opening times (particularly for establishments selling alcohol); restrictions on smoking and drinking alcoholic beverages in public spaces; labelling of products with health warnings (for tobacco, alcohol, and SSBs); and others. There is enough evidence on the effectiveness of these measures to amply justify their implementation, with adaptation and prioritization depending on individual country circumstances. Combinations of price and non-price measures have been highly effective at reducing consumption, as recent assessments of the WHO Framework Convention on Tobacco Control have shown (Muñoz 2021).

Unfortunately, in too many countries the use of these taxes is still far from optimal. Most governments have only enacted modest tax increases instead of the large excise hikes paired with non-price strategies which will be most effective in reducing consumption. A global assessment of tobacco taxes documented significant progress but noted that it has been slow and remains inadequate (Chaloupka et al. 2021a).

A key factor for successfully designing and adopting measures to reduce consumption of tobacco, alcohol, and SSBs is to exclude the targeted industries from all stages of decision making (technical and political). The industries involved, especially the tobacco industry, have a well-documented record of concealing evidence, misleading policymakers and the public, and interfering in public policy to oppose, delay, or undermine public health measures.

Without reducing the consumption of these harmful products, society will not be able to promote healthy longevity. Chronic conditions such as hypertension and diabetes are already major sources of ill health among today's older adults. These conditions are often correlated with functional dependence and with other illnesses in such a way that people cannot enjoy a healthy old age. Reducing consumption of these products at any age improves the chances of healthier living in the future. For this reason, taxing harmful products is one of the most cost-effective ways to reach a future with healthy longevity.

REFERENCES

1. Allcott, Hunt, Benjamin B. Lockwood, and Dmitry Taubinsky. 2019. "Should We Tax Sugar-Sweetened Beverages? An Overview of Theory and Evidence." *Journal of Economic Perspectives* 33 (3): 202–27. https://doi.org/10.1257/jep.33.3.202.
2. Ally, Abdallah K., Yang Meng, Ratula Chakraborty, Paul W. Dobson, Jonathan S. Seaton, John Holmes, Colin Angus, et al. 2014. "Alcohol Tax Pass-through across the Product and Price Range: Do Retailers Treat Cheap Alcohol Differently?" *Addiction* 109 (12): 1994–2002. https://doi.org/10.1111/add.12590.
3. Alvarado, Miriam, Deliana Kostova, Marc Suhrcke, Ian Hambleton, Trevor Hassell, T. Alafia Samuels, Jean Adams, and Nigel Unwin. 2017. "Trends in Beverage Prices Following the Introduction of a Tax on Sugar-Sweetened Beverages in Barbados." *Preventive Medicine* 105 (December): S23–25. https://doi.org/10.1016/j.ypmed.2017.07.013.
4. Aranco, Natalia, Mariano Bosch, Marco Stampini, Oliver Azuara Herrera, Laura Goyeneche, Pablo Ibarrarán, Déborah Oliveira, Maria Reyes Retana Torre, William D. Savedoff, and Eric Torres Ramirez. 2022. "Aging in Latin America and the Caribbean: Social Protection and Quality of Life of Older Persons." Inter-American Development Bank. https://doi.org/10.18235/0004287.
5. Babor, Thomas F., Jack H. Mendelson, Isaac Greenberg, and John Kuehnle. 1978. "Experimental Analysis of the 'Happy Hour': Effects of Purchase Price on Alcohol Consumption." *Psychopharmacology* 58 (1): 35–41. https://doi.org/10.1007/bf00426787.
6. Banderali, G., A. Martelli, M. Landi, F. Moretti, F. Betti, G. Radaelli, C. Lassandro, and E. Verduci. 2015. "Short and Long Term Health Effects of Parental Tobacco Smoking during Pregnancy and Lactation: A Descriptive Review." *Journal of Translational Medicine* 13 (1). https://doi.org/10.1186/s12967-015-0690-y.
7. Bartecchi, Carl, Robert N. Alsever, Christine Nevin-Woods, William M. Thomas, Raymond O. Estacio, Becki Bucher Bartelson, and Mori J. Krantz. 2006. "Reduction in the Incidence of Acute Myocardial Infarction Associated with a Citywide Smoking Ordinance." *Circulation* 114 (14): 1490–96. https://doi.org/10.1161/circulationaha.106.615245.
8. Basu, Sanjay, Martin McKee, Gauden Galea, and David Stuckler.

2013. "Relationship of Soft Drink Consumption to Global Overweight, Obesity, and Diabetes: A Cross-National Analysis of 75 Countries." *American Journal of Public Health* 103 (11): 2071–77. https://doi.org/10.2105/ajph.2012.300974.

9. Becker, Gary S., Michael Grossman, and Kevin M. Murphy. 1994. "An Empirical Analysis of Cigarette Addiction." *The American Economic Review* 84 (3): 396–418. https://www.jstor.org/stable/2118059.
10. Berardi, Nicoletta, Patrick Sevestre, Marine Tepaut, and Alexandre Vigneron. 2012. "The Impact of a `Soda Tax' on Prices. Evidence from French Micro Data." *Applied Economics* 48 (41): 3976–94. https://econpapers.repec.org/paper/bfrbanfra/415.htm.
11. Bergman, U. Michael, and Niels Lynggård Hansen. 2019. "Are Excise Taxes on Beverages Fully Passed through to Prices? The Danish Evidence." *FinanzArchiv* 75 (4): 323. https://doi.org/10.1628/fa-2019-0010.
12. Berthet Valdois, Julie, Cornelis Van Walbeek, Hana Ross, Hema Soondram, Bhavish Jugurnath, Marie Chan Sun, and Deowan Mohee. 2019. "Tobacco Industry Tactics in Response to Cigarette Excise Tax Increases in Mauritius." *Tobacco Control* 29 (e1): tobaccocontrol-2019-055196. https://doi.org/10.1136/tobaccocontrol-2019-055196.
13. Bhattacharya, Aveek. 2020. "Who Pays the Tab? The Distributional Effects of UK Alcohol Taxes." London, UK: Institute of Alcohol Studies. https://www.ias.org.uk/uploads/pdf/IAS%20reports/rp40022020.pdf.
14. Blecher, Evan, Alex Liber, Jeffrey Drope, Binh Nguyen, and Michal Stoklosa. 2017. "Global Trends in the Affordability of Sugar-Sweetened Beverages, 1990–2016." *Preventing Chronic Disease* 14 (May). https://doi.org/10.5888/pcd14.160406.
15. Blecher, Evan, Alex Liber, Corné Van Walbeek, and Laura Rossouw. 2018. "An International Analysis of the Price and Affordability of Beer." Edited by Isabel Novo-Cortí. *PLOS ONE* 13 (12): e0208831. https://doi.org/10.1371/journal.pone.0208831.
16. Blecher, Evan, and Corné van Walbeek. 2009. "Cigarette Affordability Trends: An Update and Some Methodological Comments." *Tobacco Control* 18 (3): 167–75. https://doi.org/10.1136/tc.2008.026682.
17. Bloom, David E, Somnath Chatterji, Paul Kowal, Peter Lloyd-Sherlock, Martin McKee, Bernd Rechel, Larry Rosenberg, and James P Smith. 2015. "Macroeconomic Implications of Population Ageing and Selected Policy Responses." *The Lancet* 385 (9968): 649–57. https://doi.org/10.1016/s0140-6736(14)61464-1.
18. BMJ. 2002. "How to Access Tobacco Industry Documents." *Tobacco Control* 11 (Supplement 1): i39–39. https://doi.org/10.1136/tc.11.suppl_1.i39.
19. Booth, Andrew, Petra Meier,Tim Stockwell, Anthea Sutton, Anna Wilkinson, Ruth Wong et al. 2008. "IndependentReview of the Effects of Alcohol Pricing and Promotion. Part A: SystematicReviews." Sheffield, UK: University of Sheffield.
20. Brownell, Kelly D., and Thomas R. Frieden. 2009. "Ounces of Prevention — the Public Policy Case for Taxes on Sugared Beverages." *New England Journal of Medicine* 360 (18): 1805–8. https://doi.org/10.1056/nejmp0902392.
21. Brownell, Kelly D., and Kenneth E. Warner. 2009. "The Perils of Ignoring History: Big Tobacco Played Dirty and Millions Died. How Similar Is Big Food?" *Milbank Quarterly* 87 (1): 259–94. https://doi.org/10.1111/j.1468-0009.2009.00555.x.
22. Burton, Robyn, Clive Henn, Don Lavoie, Rosanna O'Connor, Clare Perkins, Kate Sweeney, Felix Greaves, et al. 2017. "A Rapid Evidence Review of the Effectiveness and Cost-Effectiveness of Alcohol Control Policies: An English Perspective." *The Lancet* 389 (10078): 1558–80. https://doi.org/10.1016/s0140-6736(16)32420-5.
23. Caro, Juan Carlos, Camila Corvalán, Marcela Reyes, Andres Silva, Barry Popkin, and Lindsey Smith Taillie. 2018. "Chile's 2014 Sugar-Sweetened Beverage Tax and Changes in Prices and Purchases of Sugar-Sweetened Beverages: An Observational Study in an Urban Environment." Edited by Claudia Langenberg. *PLOS Medicine* 15 (7): e1002597. https://doi.org/10.1371/journal.pmed.1002597.
24. Case, Anne, and Angus Deaton. 2021. *Deaths of Despair and the Future of Capitalism*. NED - New edition. Princeton University Press. https://www.jstor.org/stable/j.ctv161f3f8.
25. Cawley, John, and David E. Frisvold. 2016. "The Pass-through of Taxes on Sugar-Sweetened Beverages to Retail Prices: The Case of Berkeley, California." *Journal of Policy Analysis and Management* 36 (2): 303–26. https://doi.org/10.1002/pam.21960.
26. CBC News. 2008. "Tobacco Giants to Pay up to $1.15B over Contraband Sales." *CBC News*, July 31, 2008. https://www.cbc.ca/news/canada/tobacco-giants-to-pay-up-to-1-15b-over-contraband-sales-1.701089.
27. Chacon, Violeta, Guillermo Paraje, Joaquin Barnoya, and Frank J. Chaloupka. 2018. "Own-Price, Cross-Price, and Expenditure Elasticities on Sugar-Sweetened Beverages in Guatemala." Edited by Rachel A. Nugent. *PLOS ONE* 13 (10): e0205931. https://doi.org/10.1371/journal.pone.0205931.
28. Chaloupka, Frank, Jeff Drope, Erika Siu, Violeta Vulovic, Maryam Mirza, Germán Rodriguez-Iglesias, Anh Ngo, et al. 2021a. Tobacconomics: Cigarette Tax Scorecard . 2nd ed. Chicago, IL: Health Policy Center, Institute for Health Research and Policy, University of Illinois Chicago. www.tobacconomics.org.
29. Chaloupka, Frank, and Rosalie L. Pacula. 1999. "Sex and Race Differences in Young People's Responsiveness to Price and Tobacco Control Policies." *Tobacco Control* 8 (4): 373–77. https://doi.org/10.1136/tc.8.4.373.
30. Chaloupka, Frank, and Lisa Powell. 2018. "Using Fiscal Policy to Promote Health: Taxing Tobacco, Alcohol, and Sugary Beverages." Background Paper Prepared for the Task Force on Fiscal Policy for Health. New York: Bloomberg Philanthropies.
31. Chaloupka, Frank J., Lisa M. Powell, and Kenneth E. Warner. 2019. "The Use of Excise Taxes to Reduce Tobacco, Alcohol, and Sugary Beverage Consumption." *Annual Review of*

Public Health 40 (1): 187–201. https://doi.org/10.1146/annurev-publhealth-040218-043816.

32. Chaloupka, Frank, Jeff Drope, Erika Siu, Violeta Vulovic, Michal Stoklosa, Maryam Mirza, Germán Rodriguez-Iglesias, and Hye Myung Lee. 2021b. "Tobacconomics Cigarette Tax Scorecard: Scoring Component Policy Note – Cigarette Price." Chicago, IL: Health Policy Center, Institute for Health Research and Policy, University of Illinois Chicago. https://tobacconomics.org/files/research/695/uic-tobacco-scorecard-component-policy-note-cigarette-price-v4.0.pdf.
33. Chaloupke, Frank, and Lisa Powell. 2019. "Health Taxes to Save Lives - Background Materials: Case Studies." *Bloomberg Philanthropies Task Force on Fiscal Policy for Health*. Chicago, IL: Tobaconomics. https://tobacconomics.org/research/health-taxes-to-save-lives-background-materials-case-studies/.
34. Chavez, Jenina J, Jeff Drope, Qing Li, and Madeiline J Aloria. 2016. "The Economics of Tobacco Farming in the Philippines." Quezon City: Action for Economic Reforms and Atlanta: American Cancer Society. https://www.cancer.org/content/dam/cancer-org/research/economic-and-healthy-policy/the-economics-of-tobacco-farming-in-the-philippines.pdf.
35. Chelwa, Grieve, and Cornelis van Walbeek. 2014. "Assessing the Causal Impact of Tobacco Expenditure on Household Spending Patterns in Zambia." *ERSA Working Paper 453*. Cape Town, South Africa: Economic Research Southern Africa. https://econrsa.org/wp-content/uploads/2022/06/working_paper_453.pdf.
36. Chen, Danhong, David Abler, De Zhou, Xiaohua Yu, and Wyatt Thompson. 2015. "A Meta-Analysis of Food Demand Elasticities for China." *Applied Economic Perspectives and Policy* 38 (1): 50–72. https://doi.org/10.1093/aepp/ppv006.
37. Cobacho Tornel, Mª Belén, Ángel López Nicolás, and José María Ramos Parreño. 2010. "El Coste de Mortalidad Asociado al Consumo de Tabaco En España" [The cost of mortality associated with tobacco consumption in Spain]. *Revista Española de Salud Pública* 84 (3): 271–80. https://scielo.isciii.es/scielo.php?pid=S1135-57272010000300005&script=sci_abstract.
38. Coelho, Daniel. 2020. "Distributive Impactof Health Taxes in Brazil." Unpublishedreport, World Bank, Washington, DC.
39. Colchero, M. Arantxa, Juan Carlos Salgado, Mishel Unar-Munguía, Mauricio Hernández-Ávila, and Juan Angel Rivera-Dommarco. 2015. "Price Elasticity of the Demand for Sugar Sweetened Beverages and Soft Drinks in Mexico." *Economics & Human Biology* 19 (December): 129–37. https://doi.org/10.1016/j.ehb.2015.08.007.
40. Colchero, M. Arantxa, Juan Carlos Salgado, Mishel Unar-Munguía, Mariana Molina, Shuwen Ng, and Juan Angel Rivera-Dommarco. 2015. "Changes in Prices after an Excise Tax to Sweetened Sugar Beverages Was Implemented in Mexico: Evidence from Urban Areas." Edited by Rachel A. Nugent. *PLOS ONE* 10 (12): e0144408. https://doi.org/10.1371/journal.pone.0144408.
41. Collin, Jeff, and Sarah Hill. 2019. "Structure and Tactics of the Tobacco, Alcohol, and Sugary Beverage Industries." *Background Paper for the Task Force on Fiscal Policy for Health*. University of Edinburgh. https://data.bloomberglp.com/dotorg/sites/2/2019/04/Structure-and-Tactics-of-the-Tobacco-Alcohol-and-Sugary-Beverage-Industries.pdf.
42. DeCicca, Philip, Don Kenkel, and Alan Mathios. 2008. "Cigarette Taxes and the Transition from Youth to Adult Smoking: Smoking Initiation, Cessation, and Participation." *Journal of Health Economics* 27 (4): 904–17. https://doi.org/10.1016/j.jhealeco.2008.02.008.
43. Dee, Thomas S. 1999. "The Complementarity of Teen Smoking and Drinking." *Journal of Health Economics* 18 (6): 769–93. https://doi.org/10.1016/s0167-6296(99)00018-1.
44. Del Carmen, Giselle, Alan Fuchs, and Maria Eugenia Genoni. 2018. "The Distributional Impacts of Cigarette Taxation in Bangladesh." *Policy Research Working Paper No. 8580*. Washington, D.C.: World Bank. https://doi.org/10.1596/1813-9450-8580.
45. Delipalla, Sophia, and Owen O'Donnell. 2001. "Estimating Tax Incidence, Market Power and Market Conduct: The European Cigarette Industry." *International Journal of Industrial Organization* 19 (6): 885–908. https://econpapers.repec.org/article/eeeindorg/v_3a19_3ay_3a2001_3ai_3a6_3ap_3a885-908.htm.
46. Diosana, Jo-Ann L., and Filomeno S. Sta. Ana III. 2020. "Case Studies in Illicit Tobacco Trade: The Philippines." Tobacconomics, Health Policy Center, Institute for Health Research and Policy, University of Illinois, Chicago. https://portal-uat.who.int/fctcapps/sites/default/files/kh-media/e-library-doc/2020/07/case-studies-in-illicit-tobacco-trade-the-Philippines.pdf.
47. Do, Young Kyung, and Mary Ann Bautista. 2015. "Tobacco Use and Household Expenditures on Food, Education, and Healthcare in Low- and Middle-Income Countries: A Multilevel Analysis." *BMC Public Health* 15 (1). https://doi.org/10.1186/s12889-015-2423-9.
48. Dobbs, Richard, Corrine Sawers, Fraser Thompson, James Manyika, Jonathan Woetzel, Peter Child, Sorcha McKenna, and Angela Spatharou. 2014. "Overcoming Obesity: An Initial Economic Analysis." *Discussion Paper*. McKinsey Global Institute.
49. Doogan, Nathan J, Mary Ellen Wewers, and Micah Berman. 2017. "The Impact of a Federal Cigarette Minimum Pack Price Policy on Cigarette Use in the USA." *Tobacco Control* 27 (2): 203–8. https://doi.org/10.1136/tobaccocontrol-2016-053457.
50. Drope, Jeffrey, Roberto Iglesias, Valeska Carvalho Figueiredo, SzkloAndré Salem, Paulo Borges, Michal Stoklosa, Kevin Welding, Hannah Nascimento, and Caroline Cortes. 2022. "Consumo de Cigarros Ilegais Em Cinco Cidades Brasileiras." Centro de Estudos sobre Tabaco e Saúde (Cetab). Escola Nacional de Saúde Pública Sérgio Arouca, Fiocruz. Rio de Janeiro: Outras Letras.
51. Dunbar, Andrew, William Gotsis, and William Frishman. 2013. "Second-Hand Tobacco Smoke and Cardiovascular Disease Risk." *Cardiology in Review* 21 (2): 94–100. https://doi.org/10.1097/crd.0b013e31827362e4.
52. Edwards, Griffith. 1997. "Alcohol Policy and the Public Good."

Addiction (Abingdon, England) 92 Suppl 1 (March): S73-79. https://pubmed.ncbi.nlm.nih.gov/9167291/.

53. Epstein, Leonard H, Noelle Jankowiak, Chantal Nederkoorn, Hollie A Raynor, Simone A French, and Eric Finkelstein. 2012. "Experimental Research on the Relation between Food Price Changes and Food-Purchasing Patterns: A Targeted Review." *The American Journal of Clinical Nutrition* 95 (4): 789–809. https://doi.org/10.3945/ajcn.111.024380.
54. Feighery, Ellen, Kurt Ribisl, NC Schleicher, Leslie Zellers, and N Wellington. 2005. "How Do Minimum Cigarette Price Laws Affect Cigarette Prices at the Retail Level?" *Tobacco Control* 14 (2): 80–85. https://www.jstor.org/stable/20747779.
55. Ferrante, Daniel, Bruno Linetzky, Mario Virgolini, Veronica Schoj, and B Apelberg. 2011. "Reduction in Hospital Admissions for Acute Coronary Syndrome after the Successful Implementation of 100% Smoke-Free Legislation in Argentina: A Comparison with Partial Smoking Restrictions." *Tobacco Control* 21 (4): 402–6. https://doi.org/10.1136/tc.2010.042325.
56. Finkelstein, Eric A., Chen Zhen, Marcel Bilger, James Nonnemaker, Assad M. Farooqui, and Jessica E. Todd. 2013. "Implications of a Sugar-Sweetened Beverage (SSB) Tax When Substitutions to Non-Beverage Items Are Considered." *Journal of Health Economics* 32 (1): 219–39. https://doi.org/10.1016/j.jhealeco.2012.10.005.
57. Forster, Martin, and Andrew M. Jones. 2001. "The Role of Tobacco Taxes in Starting and Quitting Smoking: Duration Analysis of British Data." *Journal of the Royal Statistical Society: Series a (Statistics in Society)* 164 (3): 517–47. https://doi.org/10.1111/1467-985x.00217.
58. Fuchs, Alan, and María FernandaGonzález Icaza. 2021. "The Welfareand Distributional Effects of TaxingSSB to Reduce the Risks of Obesity inUkraine." Unpublished report, World Bank,Washington, DC.
59. Fuchs Tarlovsky, Alan, and Fernanda Gonzalez Icaza. 2019. "The Welfare and Distributional Effects of Increasing Taxes on Tobacco in Viet Nam." Washington, D.C.: World Bank. https://doi. org/10.1596/32062.
60. Fuchs, Alan, and Giselle Del Carmen. 2018. "The Distributional Effects of Tobacco Taxation: The Evidence of White and Clove Cigarettes in Indonesia." *Policy Research Working Paper No. 8558*. Washington, D.C.: World Bank. https://doi.org/10.1596/1813-9450-8558.
61. Fuchs, Alan, Giselle Del Carmen, and Alfred Kechia Mukong. 2018. "Long-Run Impacts of Increasing Tobacco Taxes." *Policy Research Working Paper No. 8369*. Washington, D.C.: World Bank. https://doi.org/10.1596/1813-9450-8369.
62. Fuchs, Alan, Fernanda Gonzalez Icaza, and Daniela Paula Paz. 2019. "Distributional Effects of Tobacco Taxation: A Comparative Analysis." *Policy Research Working Paper No. 8805*. Washington, D.C.: World Bank. https://doi.org/10.1596/1813-9450-8805.
63. Fuchs, Alan, Kate Mandeville, and Ana Cristina Alonso-Soria. 2020. "Health and Distributional Effects Taxing Sugar-Sweetened Beverages: The Case of Kazakhstan." *Poverty and Equity Notes No. 24*. Washington, D.C.: World Bank. https://doi.org/10.1596/33859.
64. Fuchs, Alan, Mikhail Matytsin, and Olga Obukhova. 2018. "Tobacco Taxation Incidence: Evidence from the Russian Federation." *Policy Research Working Paper No. 8626*. Washington, D.C.: World Bank. https://doi.org/10.1596/1813-9450-8626.
65. Fuchs, Alan, and Francisco Meneses. 2017a. "Regressive or Progressive ? The Effect of Tobacco Taxes in Ukraine." *Policy Research Working Paper No. 8227*. Washington, D.C.: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/934621509107306525/regressive-or-progressive-the-effect-of-tobacco-taxes-in-ukraine.
66. Jha P, Guindon E, Joseph RA,Nandi A, John R, Rao K, et al. A rational taxation system of bidis andcigarettes to reduce smoking deaths in India. Economic and Political Weekly.2011;46:44-51.
67. Muñoz M. 2021. "Relación entre Consumo de Tabaco y el FrameworkConvention on Tobacco Control: Un Análisis Before-After" [Relationship between Tobacco Consumption and the Framework Convention on Tobacco Control: A Before-After Analysis]. Santiago, Chile: Universidad Adolfo Ibáñez.
68. ———. 2017b. "Are Tobacco Taxes Really Regressive?: Evidence from Chile." Washington, D.C.: World Bank. https://doi.org/10.1596/25969.
69. ———. 2018. "Tobacco Price Elasticity and Tax Progressivity in Moldova." *Policy Research Working Paper No. 8327*. Washington, D.C.: World Bank. https://doi.org/10.1596/1813-9450-8327.
70. Fuchs, Alan, Edvard Orlic, and Cesar Cancho. 2019. "Time to Quit: The Tobacco Tax Increase and Household Welfare in Bosnia and Herzegovina." Washington, D.C.: World Bank. https://doi.org/10.1596/31249.
71. Gallet, Craig A. 2007. "The Demand for Alcohol: A Meta-Analysis of Elasticities." *The Australian Journal of Agricultural and Resource Economics* 51 (2): 121–35. https://doi.org/10.1111/j.1467-8489.2007.00365.x.
72. Gallet, Craig A., and John A. List. 2003. "Cigarette Demand: A Meta-Analysis of Elasticities." *Health Economics* 12 (10): 821–35. https://doi.org/10.1002/hec.765.
73. Gawryszewski, Vilma Pinheiro, and Maristela G. Monteiro. 2014. "Mortality from Diseases, Conditions and Injuries Where Alcohol Is a Necessary Cause in the Americas, 2007-09." *Addiction* 109 (4): 570–77. https://doi.org/10.1111/add.12418.
74. Gilmore, Anna B, Allen W A Gallagher, and Andy Rowell. 2018. "Tobacco Industry's Elaborate Attempts to Control a Global Track and Trace System and Fundamentally Undermine the Illicit Trade Protocol." *Tobacco Control* 28 (2): 127–40. https://doi.org/10.1136/tobaccocontrol-2017-054191.
75. Global Tobacco Economic Consortium. 2018. "The Health, Poverty, and Financial Consequences of a Cigarette Price Increase among 500 Million Male Smokers in 13 Middle Income Countries: Compartmental Model Study." *BMJ* 361 (April): k1162. https://doi.org/10.1136/bmj.k1162.

76. Gonzalez-Rozada, Martin, and Giselle Montamat. 2019. "How Raising Tobacco Prices Affects the Decision to Start and Quit Smoking: Evidence from Argentina." *International Journal of Environmental Research and Public Health* 16 (19): 3622. https://doi.org/10.3390/ijerph16193622.
77. Goodchild, Mark, Nigar Nargis, and Edouard Tursan d'Espaignet. 2017. "Global Economic Cost of Smoking-Attributable Diseases." *Tobacco Control* 27 (1): 58–64. https://doi.org/10.1136/tobaccocontrol-2016-053305.
78. Goodchild, Mark, Jeremias Paul, Roberto Iglesias, Annerie Bouw, and Anne-Marie Perucic. 2020. "Potential Impact of Eliminating Illicit Trade in Cigarettes: A Demand-Side Perspective." *Tobacco Control* Published Online First: (November 3, 2020). https://doi.org/10.1136/tobaccocontrol-2020-055980.
79. Goodchild, Mark, Anne-Marie Perucic, and Nigar Nargis. 2016. "Modelling the Impact of Raising Tobacco Taxes on Public Health and Finance." *Bulletin of the World Health Organization* 94 (4): 250–57. https://doi.org/10.2471/blt.15.164707.
80. Griswold, Max G, Nancy Fullman, Caitlin Hawley, Nicholas Arian, Stephanie R M Zimsen, Hayley D Tymeson, Vidhya Venkateswaran, et al. 2018. "Alcohol Use and Burden for 195 Countries and Territories, 1990–2016: A Systematic Analysis for the Global Burden of Disease Study 2016." *The Lancet* 392 (10152): 1015–35. https://doi.org/10.1016/s0140-6736(18)31310-2.
81. Grogger, Jeffrey T. 2016. "Soda Taxes and the Prices of Sodas and Other Drinks: Evidence from Mexico." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2725043.
82. Gruenewald, Paul J., William R. Ponicki, Harold D. Holder, and Anders Romelsjo. 2006. "Alcohol Prices, Beverage Quality, and the Demand for Alcohol: Quality Substitutions and Price Elasticities." *Alcoholism: Clinical and Experimental Research* 30 (1): 96–105. https://doi.org/10.1111/j.1530-0277.2006.00011.x.
83. Guerchet, Maëlenn M., Mariella Guerra, Yueqin Huang, Peter Lloyd-Sherlock, Ana Luisa Sosa, Richard Uwakwe, Isaac Acosta, et al. 2018. "A Cohort Study of the Effects of Older Adult Care Dependence upon Household Economic Functioning, in Peru, Mexico and China." Edited by Stefano Federici. *PLOS ONE* 13 (4): e0195567. https://doi.org/10.1371/journal.pone.0195567.
84. Guerrero Lopez, C. M., J. A. Jimenez Ruiz, L. M. Reynales Shigematsu, and H. R. Waters. 2011. "The Economic Impact of Mexico City's Smoke-Free Law." *Tobacco Control* 20 (4): 273–78. https://doi.org/10.1136/tc.2010.036467.
85. Guerrero-López, Carlos M., Mariana Molina, and M. Arantxa Colchero. 2017. "Employment Changes Associated with the Introduction of Taxes on Sugar-Sweetened Beverages and Nonessential Energy-Dense Food in Mexico." *Preventive Medicine* 105 (December): S43–49. https://doi.org/10.1016/j.ypmed.2017.09.001.
86. Guerrero-López, Carlos M., Mishel Unar-Munguía, and M. Arantxa Colchero. 2017. "Price Elasticity of the Demand for Soft Drinks, Other Sugar-Sweetened Beverages and Energy Dense Food in Chile." *BMC Public Health* 17 (1). https://doi.org/10.1186/s12889-017-4098-x.
87. Guindon, G. Emmanuel, Arindam Nandi, Frank J. Chaloupka, and Prabhat Jha. 2011. "Socioeconomic Differences in the Impact of Smoking Tobacco and Alcohol Prices on Smoking in India." Social Science Research Network. Rochester, NY. November 1, 2011. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1954506.
88. Guindon, G. Emmanuel, Guillermo R. Paraje, and Frank J. Chaloupka. 2018. "The Impact of Prices and Taxes on the Use of Tobacco Products in Latin America and the Caribbean." *American Journal of Public Health* 108 (S6): S492–502. https://doi.org/10.2105/ajph.2014.302396r.
89. ———. 2019. "Association of Tobacco Control Policies with Youth Smoking Onset in Chile." *JAMA Pediatrics* 173 (8): 754. https://doi.org/10.1001/jamapediatrics.2019.1500.
90. Guindon, G. Emmanuel, Guillermo R. Paraje, and Ricardo Chávez. 2017. "Prices, Inflation, and Smoking Onset: The Case of Argentina." *Economic Inquiry* 56 (1): 424–45. https://doi.org/10.1111/ecin.12490.
91. Guindon, G. Emmanuel, Kevin Zhao, Tooba Fatima, Sophiya Garasia, Nicholas Quinn, N. Bruce Baskerville, and Guillermo Paraje. 2022. "Prices, Taxes and Alcohol Use: A Systematic Umbrella Review." *Addiction* 117 (12): 3004–23. https://doi.org/10.1111/add.15966.
92. Harris, Jeffrey E. 1987. "The 1983 Increase in the Federal Cigarette Excise Tax." *Tax Policy and the Economy* 1 (January): 87–111. https://doi.org/10.1086/tpe.1.20061764.
93. Hattersley , Libby, Alan Fuchs, Alberto Gonima , Lynn Silver, and Kate Mandeville . 2020. "Evidence Summary: Business, Employment, and Productivity Impacts of Sugar-Sweetened Beverages Taxes 1." Washington, D.C.: World Bank. https://documents1.worldbank.org/curated/zh/972421592559284445/pdf/Business-Employment-and-Productivity-Impacts-of-Sugar-Sweetened-Beverages-Taxes-Evidence-Summary.pdf.
94. Hattersley, Libby, Alessia Thiebaud, Lynn Silver, and Kate Mandeville. 2020. "Countering Common Arguments against Taxes on Sugary Drinks." *Health, Nutrition and Population Knowledge Brief*. Washington, D.C.: World Bank. https://openknowledge.worldbank.org/handle/10986/34361.
95. Heijdra, Ben J., and Laurie S. M. Reijnders. 2016. "Human Capital Accumulation and the Macroeconomy in an Ageing Society." *De Economist* 164 (3): 297–334. https://doi.org/10.1007/s10645-016-9283-2.
96. Helble, Matthias, and Kris Francisco. 2017. "The Imminent Obesity Crisis in Asia and the Pacific: First Cost Estimates." *Working Paper No. 743*. Manilla, The Philippines: Asian Development Bank. https://www.adb.org/publications/imminent-obesity-crisis-asia-and-pacific-first-cost-estimates.
97. Hodge, Allison M, Julie K Bassett, Roger L Milne, Dallas R English, and Graham G Giles. 2018. "Consumption of Sugar-Sweetened and Artificially Sweetened Soft Drinks and Risk of Obesity-Related Cancers." *Public Health Nutrition* 21 (9): 1618–26. https://

doi.org/10.1017/s1368980017002555.

98. Huang, Jidong, Jamie F Chriqui, Hillary DeLong, Maryam Mirza, Megan C Diaz, and Frank J Chaloupka. 2016. "Do State Minimum Markup/Price Laws Work? Evidence from Retail Scanner Data and TUS-CPS." *Tobacco Control* 25 (Suppl 1): i52–59. https://doi.org/10.1136/tobaccocontrol-2016-053093.
99. Hyland, A, FL Laux, C Higbee, G Hastings, H Ross, FJ Chaloupka, GT Fong, and KM Cummings. 2006. "Cigarette Purchase Patterns in Four Countries and the Relationship with Cessation: Findings from the International Tobacco Control (ITC) Four Country Survey." *Tobacco Control* 15 (suppl_3): iii59–64. https://doi.org/10.1136/tc.2005.012203.
100. Imamura, Fumiaki, Laura O'Connor, Zheng Ye, Jaakko Mursu, Yasuaki Hayashino, Shilpa N Bhupathiraju, and Nita G Forouhi. 2015. "Consumption of Sugar Sweetened Beverages, Artificially Sweetened Beverages, and Fruit Juice and Incidence of Type 2 Diabetes: Systematic Review, Meta-Analysis, and Estimation of Population Attributable Fraction." *BMJ* 351 (July): h3576. https://doi.org/10.1136/bmj.h3576.
101. Institute of Health Metrics and Evaluation (IHME). 2020. "Global Burden of Disease Study 2019 (GBD 2019) Results." Institute for Health Metrics and Evaluation (IHME). Seattle, United States. 2020. http://ghdx.healthdata.org/gbd-results-tool.
102. International Agency for Research on Cancer (IARC). 2011. "Effectiveness of Tax and Price Policies for Tobacco Control." *IARC Handbooks of Cancer Prevention Volume 14*. Lyon, France: International Agency for Research on Cancer. https://publications.iarc.fr/Book-And-Report-Series/Iarc-Handbooks-Of-Cancer-Prevention/Effectiveness-Of-Tax-And-Price-Policies-For-Tobacco-Control-2011.
103. Jackson, Rachel, Maxine Jackson, Fiona Campbell, Josie Messina, Louise Guillaume, Petra Meier, Elizabeth Goyder, Jim Chilcott, and Nick Payne. 2010. "Interventions on Control of Alcohol Price, Promotion and Availability for Prevention of Alcohol Use Disorders in Adults and Young People." ScHARR Public Health Collaborating Centre, University of Sheffield. https://www.nice.org.uk/guidance/ph24/evidence/interventions-on-control-of-alcohol-price-promotion-and-availability-for-prevention-of-alcohol-use-disorders-371568349.
104. Jawad, Mohammed, John Tayu Lee, Stanton Glantz, and Christopher Millett. 2018. "Price Elasticity of Demand of Non-Cigarette Tobacco Products: A Systematic Review and Meta-Analysis." *Tobacco Control* 27 (6): 689–95. https://doi.org/10.1136/tobaccocontrol-2017-054056.
105. Jha, Prabhat. 2020. "The Hazards of Smoking and the Benefits of Cessation: A Critical Summation of the Epidemiological Evidence in High-Income Countries." *ELife* 9 (1). https://doi.org/10.7554/elife.49979.
106. Jha, Prabhat, Emmanuel Guindon, Renu Joseph, Arindam Nandi, Rijo John, Kavita Rao, Frank Chaloupka, Jagdish Kaur, Prakash C Gupta, and M Govinda Rao. 2011. "A Rational Taxation System of Bidis and Cigarettes to Reduce Smoking Deaths in India." *Economic and Political Weekly* XLVI (42). https://www.tobacconomics.org/files/research/73/A-rational-taxation-system-of-bidis-and-cigarettes-to-reduce...India-2011.pdf.
107. Jha, Prabhat, Catherine Hill, Daphne C N Wu, and Richard Peto. 2020. "Cigarette Prices, Smuggling, and Deaths in France and Canada." *The Lancet* 395 (10217): 27–28. https://doi.org/10.1016/s0140-6736(19)31291-7.
108. Jha, Prabhat, Mary MacLennan, Frank. J. Chaloupka, Ayda Yurekli, Chintanie Ramasundarahettige, Krishna Palipudi, Witold Zatonksi, Samira Asma, and Prakash C. Gupta. 2015. "Global Hazards of Tobacco and the Benefits of Smoking Cessation and Tobacco Taxes." *Disease Control Priorities, Third Edition (Volume 3): Cancer*. https://doi.org/10.1596/978-1-4648-0349-9_ch10.
109. Jha, Prabhat, and Richard Peto. 2014. "Global Effects of Smoking, of Quitting, and of Taxing Tobacco." *New England Journal of Medicine* 370 (1): 60–68. https://doi.org/10.1056/nejmra1308383.
110. Jha, Prabhat, Chinthanie Ramasundarahettige, Victoria Landsman, Brian Rostron, Michael Thun, Robert N Anderson, Tim McAfee, and Richard Peto. 2013. "21st-Century Hazards of Smoking and Benefits of Cessation in the United States." *The New England Journal of Medicine* 368 (4): 341–50. https://doi.org/10.1056/NEJMsa1211128.
111. Jha, Prahbat, and Frank J Chaloupka. 1999. "Curbing the Epidemic: Governments and the Economics of Tobacco Control." Washington, D.C.: World Bank. https://documents1.worldbank.org/curated/en/914041468176678949/pdf/multi-page.pdf.
112. John, Rijo M, Hana Ross, and Evan Blecher. 2011. "Tobacco Expenditure and Its Implications for Household Resource Allocation in Cambodia." *Tobacco Control* 21 (3): 341–46. https://doi.org/10.1136/tc.2010.042598.
113. John, Rijo M. 2008. "Crowding out Effect of Tobacco Expenditure and Its Implications on Household Resource Allocation in India." *Social Science & Medicine* 66 (6): 1356–67. https://doi.org/10.1016/j.socscimed.2007.11.020.
114. Joossens, Luk, David Merriman, Hana Ross, and Martin Raw. 2010. "The Impact of Eliminating the Global Illicit Cigarette Trade on Health and Revenue." *Addiction* 105 (9): 1640–49. https://doi.org/10.1111/j.1360-0443.2010.03018.x.
115. Joossens, Luk, and Martin Raw. 2012. "From Cigarette Smuggling to Illicit Tobacco Trade." *Tobacco Control* 21 (2): 230–34. https://doi.org/10.1136/tobaccocontrol-2011-050205.
116. Juster, Harlan R., Brett R. Loomis, Theresa M. Hinman, Matthew C. Farrelly, Andrew Hyland, Ursula E. Bauer, and Guthrie S. Birkhead. 2007. "Declines in Hospital Admissions for Acute Myocardial Infarction in New York State after Implementation of a Comprehensive Smoking Ban." *American Journal of Public Health* 97 (11): 2035–39. https://doi.org/10.2105/ajph.2006.099994.
117. Kalyanaram, Gurumurthy, and Russell S. Winer. 2022. "Behavioral Response to Price: Data-Based Insights and Future Research for Retailing." *Journal of Retailing* 98 (1): 46–70. https://ideas.

repec.org/a/eee/jouret/v98y2022i1p46-70.html.

118. Kenkel, Donald S. 2005. "Are Alcohol Tax Hikes Fully Passed through to Prices? Evidence from Alaska." *American Economic Review* 95 (2): 273–77. https://doi.org/10.1257/000282805774670284.
119. Kostova, Deliana, Muhammad J Husain, and Frank J Chaloupka. 2016. "Effect of Cigarette Prices on Smoking Initiation and Cessation in China: A Duration Analysis." *Tobacco Control* 26 (5): 569–74. https://doi.org/10.1136/tobaccocontrol-2016-053338.
120. Kostova, Delliana, Hana Ross, Evan Blecher, and Sara Markowitz. 2011. "Is Youth Smoking Responsive to Cigarette Prices? Evidence from Low- and Middle-Income Countries." *Tobacco Control* 20 (6): 419–24. https://doi.org/10.1136/tc.2010.038786.
121. Kyriakoudes, Louis M. 2016. "The Tobacco Industry's Deadly Distortions of History." *Tobacco Control* 25 (5): 491–91. https://doi.org/10.1136/tobaccocontrol-2015-052712.
122. Larrain, Luis. 2017. "Fascismo, Alimentos Y Libertad de Expresión [Facism, Food, and Freedom of Expression]." *Libertad Y Desarrollo*, January 5, 2017. https://lyd.org/opinion/2017/01/columna-luis-larrain-diario-financiero-fascismo-alimentos-libertad-expresion/.
123. Lecours, Natacha, Guilherme E G Almeida, Jumanne M Abdallah, and Thomas E Novotny. 2012. "Environmental Health Impacts of Tobacco Farming: A Review of the Literature: Table 1." *Tobacco Control* 21 (2): 191–96. https://doi.org/10.1136/tobaccocontrol-2011-050318.
124. Leider, Julien, Vanessa Oddo, and Lisa Powell. 2021. "A Review of the Effects of U.S. Local Sugar- Sweetened Beverage Taxes on Substitution to Untaxed Beverages and Food Items." *P3RC Research Brief No. 123*. Chicago, IL: Policy, Practice, and Prevention Research Center (P3RC), University of Illinois, Chicago. https://p3rc.uic.edu/wp-content/uploads/sites/561/2021/12/Rvw-Effcts-US-SSB-Taxes-Sbsttn-to-Untxd-Bev-Foods_Rsrch-Brf-No.-123_Nov-2021.pdf.
125. Lencucha, Raphael, Jeffrey Drope, Peter Magati, and Gumilang Aryo Sahadewo. 2022. "Tobacco Farming: Overcoming an Understated Impediment to Comprehensive Tobacco Control." *Tobacco Control* 31 (2): 308–12. https://doi.org/10.1136/tobaccocontrol-2021-056564.
126. Li, Virginia C., and Songyuan Tang. 2018. "China's New Road for Tobacco Control: Tobacco Crop Substitution." *American Journal of Public Health* 108 (10): 1316–17. https://doi.org/10.2105/ajph.2018.304620.
127. Manthey, Jakob, Syed Ahmed Hassan, Sinclair Carr, Carolin Kilian, Sören Kuitunen-Paul, and Jürgen Rehm. 2021. "What Are the Economic Costs to Society Attributable to Alcohol Use? A Systematic Review and Modelling Study." *PharmacoEconomics* 39 (7): 809–22. https://doi.org/10.1007/s40273-021-01031-8.
128. Manthey, Jakob, Kevin D Shield, Margaret Rylett, Omer S M Hasan, Charlotte Probst, and Jürgen Rehm. 2019. "Global Alcohol Exposure between 1990 and 2017 and Forecasts until 2030: A Modelling Study." *The Lancet* 393 (10190): 2493–2502. https://doi.org/10.1016/s0140-6736(18)32744-2.
129. Margozzini, Paula, Guillermo Paraje, Pedro Zitko, Manuel Espinoza, Rubén Rojas, Carlos Balmaceda, Tomas Abbot, Paula Bedregal, and Patricia Berrios. 2017. "Estudio Del Costo Económico Y Social Del Consumo de Alcohol En Chile [Study on the Economic and Social Cost of Consuming Alcohol in Chile]." Santiago, Chile: Departamento de Salud Pública, Facultad de Medicina, Pontificia Universidad Católica de Chile. https://medicina.uc.cl/wp-content/uploads/2019/03/COSTO-ALCOHOL_Actualizacio%CC%81n-2018_Informe.pdf.
130. Marinello, Samantha, Julien Leider, and Lisa M. Powell. 2021. "Employment Impacts of the San Francisco Sugar-Sweetened Beverage Tax 2 Years after Implementation." Edited by Guillermo Paraje. *PLOS ONE* 16 (6): e0252094. https://doi.org/10.1371/journal.pone.0252094.
131. Marquez, Patricio V., and Blanca Moreno-Dodson. 2017. "Tobacco Tax Reform at the Crossroads of Health and Development: A Multisectoral Perspective ." Washington, D.C.: World Bank. https://doi.org/10.1596/28494.
132. Masa-ud, Abdul Gafar, Grieve Chelwa, and Corné van Walbeek. 2020. "Does Tobacco Expenditure Influence Household Spending Patterns in Ghana?: Evidence from the Ghana 2012/2013 Living Standards Survey." *Tobacco Induced Diseases* 18 (June). https://doi.org/10.18332/tid/120936.
133. Matzopoulos, Richard G, Sarah Truen, Brett Bowman, and Joanne Corrigall. 2014. "The Cost of Harmful Alcohol Use in South Africa." *South African Medical Journal* 104 (2): 127–32. https://doi.org/10.7196/samj.7644.
134. Matzopoulos, Richard Gregory, Sarah Truen, Brett Bowman, and Joanne Corrigall. 2013. "The Cost of Harmful Alcohol Use in South Africa." *South African Medical Journal* 104 (2): 127. https://doi.org/10.7196/samj.7644.
135. Meng, Yang, Alan Brennan, Robin Purshouse, Daniel Hill-McManus, Colin Angus, John Holmes, and Petra Sylvia Meier. 2014. "Estimation of Own and Cross Price Elasticities of Alcohol Demand in the UK—a Pseudo-Panel Approach Using the Living Costs and Food Survey 2001–2009." *Journal of Health Economics* 34 (March): 96–103. https://doi.org/10.1016/j.jhealeco.2013.12.006.
136. Millwood, Iona Y., Robin G. Walters, Xue W. Mei, Yu Guo, Ling Yang, Zheng Bian, Derrick A. Bennett, et al. 2019. "Conventional and Genetic Evidence on Alcohol and Vascular Disease Aetiology: A Prospective Study of 500 000 Men and Women in China." *The Lancet* 393 (10183): 1831–42. https://doi.org/10.1016/S0140-6736(18)31772-0.
137. Mohapatra, Satya, Jayadeep Patra, Svetlana Popova, Amy Duhig, and Jürgen Rehm. 2009. "Social Cost of Heavy Drinking and Alcohol Dependence in High-Income Countries." *International Journal of Public Health* 55 (3): 149–57. https://doi.org/10.1007/s00038-009-0108-9.
138. Muhammad, Andrew, Birgit Meade, David R Marquardt, and

Dariush Mozaffarian. 2019. "Global Patterns in Price Elasticities of Sugar-Sweetened Beverage Intake and Potential Effectiveness of Tax Policy: A Cross-Sectional Study of 164 Countries by Sex, Age and Global-Income Decile." *BMJ Open* 9 (8): e026390. https://doi.org/10.1136/bmjopen-2018-026390.

139. Naiman, A., R. H. Glazier, and R. Moineddin. 2010. "Association of Anti-Smoking Legislation with Rates of Hospital Admission for Cardiovascular and Respiratory Conditions." *Canadian Medical Association Journal* 182 (8): 761–67. https://doi.org/10.1503/cmaj.091130.
140. Nakamura, Ryota, Andrew J. Mirelman, Cristóbal Cuadrado, Nicolas Silva-Illanes, Jocelyn Dunstan, and Marc Suhrcke. 2018. "Evaluating the 2014 Sugar-Sweetened Beverage Tax in Chile: An Observational Study in Urban Areas." Edited by Claudia Langenberg. *PLOS Medicine* 15 (7): e1002596. https://doi.org/10.1371/journal.pmed.1002596.
141. Narain, A., C. S. Kwok, and M. A. Mamas. 2016. "Soft Drinks and Sweetened Beverages and the Risk of Cardiovascular Disease and Mortality: A Systematic Review and Meta-Analysis." *International Journal of Clinical Practice* 70 (10): 791–805. https://doi.org/10.1111/ijcp.12841.
142. Nargis, Nigar, A.K.M. Ghulam Hussain, Mark Goodchild, Anne C.K. Quah, and Geoffrey T. Fong. 2020. "Tobacco Industry Pricing Undermines Tobacco Tax Policy: A Tale from Bangladesh." *Preventive Medicine* 132 (March): 105991. https://doi.org/10.1016/j.ypmed.2020.105991.
143. Nargis, Nigar, AKM Ghulam Hussain, Mark Goodchild, Anne CK Quah, and Geoffrey T Fong. 2019. "A Decade of Cigarette Taxation in Bangladesh: Lessons Learnt for Tobacco Control." *Bulletin of the World Health Organization* 97 (3): 221–29. https://doi.org/10.2471/BLT.18.216135.
144. Nargis, Nigar, Michal Stoklosa, Ce Shang, and Jeffrey Drope. 2020. "Price, Income, and Affordability as the Determinants of Tobacco Consumption: A Practitioner's Guide to Tobacco Taxation." *Nicotine & Tobacco Research*, July. https://doi.org/10.1093/ntr/ntaa134.
145. National Research Council. 2015. "Understanding the U.S. Illicit Tobacco Market: Characteristics, Policy Context, and Lessons from International Experiences." Washington, D.C.: The National Academies Press. https://doi.org/10.17226/19016.
146. NBC News. 2004. "Philip Morris, EU Resolve Smuggling Charges." *NBC News*, July 9, 2004. https://www.nbcnews.com/id/wbna5402238.
147. Nelson, Jon P., and John R. Moran. 2019. "Effects of Alcohol Taxation on Prices: A Systematic Review and Meta-Analysis of Pass-through Rates." *The B.E. Journal of Economic Analysis & Policy* 20 (1). https://doi.org/10.1515/bejeap-2019-0134.
148. Nikaj, Silda, and Frank J. Chaloupka. 2013. "The Effect of Prices on Cigarette Use among Youths in the Global Youth Tobacco Survey." *Nicotine & Tobacco Research* 16 (Suppl 1): S16–23. https://doi.org/10.1093/ntr/ntt019.
149. Ornstein, SI. 1980. "Control of Alcohol Consumption through Price Increase." *Journal of Studies on Alcohol* 41 (9): 807–18. https://doi.org/10.15288/jsa.1980.41.807.
150. Pacula, Rosalie Liccardo. 1998. "Adolescent Alcohol and Marijuana Consumption: Is There Really a Gateway Effect?" *NBER Working Paper No. 6348*. Cambridge, MA: National Bureau of Economic Research (NBER). https://www.nber.org/papers/w6348.
151. Pan American Health Organization (PAHO). 2021. "Sugar-Sweetened Beverage Taxation in the Region of the Americas." Washington, D.C.: Pan American Health Organization. https://doi.org/10.37774/9789275122990.
152. Paraje, Guillermo. 2016. "The Effect of Price and Socio-Economic Level on the Consumption of Sugar-Sweetened Beverages (SSB): The Case of Ecuador." Edited by Aurora García-Gallego. *PLOS ONE* 11 (3): e0152260. https://doi.org/10.1371/journal.pone.0152260.
153. Paraje, Guillermo R., G. Emmanuel Guindon, and Frank J. Chaloupka. 2020. "Prices, Alcohol Use Initiation and Heavy Episodic Drinking among Chilean Youth." *Addiction*, July. https://doi.org/10.1111/add.15167.
154. Paraje, Guillermo, and Daniel Araya. 2018. "Relationship between Smoking and Health and Education Spending in Chile." *Tobacco Control* 27 (5): 560–67. https://doi.org/10.1136/tobaccocontrol-2017-053857.
155. Paraje, Guillermo, and Fabio S. Gomes. 2022a. "Expenditures on Sugar-Sweetened Beverages in Jamaica and Its Association with Household Budget Allocation." *BMC Public Health* 22 (1). https://doi.org/10.1186/s12889-022-12959-7.
156. ———. 2022b. "Expenditures on Sugar-Sweetened Beverages in Jamaica and Its Association with Household Budget Allocation." *BMC Public Health* 22 (1). https://doi.org/10.1186/s12889-022-12959-7.
157. Paraje, Guillermo, and Pablo Pincheira. 2018. "Asequibilidad de Cerveza Y Bebidas Azucaradas Para 15 Países de América Latina." *Revista Panamericana de Salud Pública* 42. https://doi.org/10.26633/rpsp.2018.49.
158. Paraje, Guillermo, Michal Stoklosa, and Evan Blecher. 2022. "Illicit Trade in Tobacco Products: Recent Trends and Coming Challenges." *Tobacco Control* 31 (2): 257–62. https://doi.org/10.1136/tobaccocontrol-2021-056557.
159. Parry, Ian, Sarah West, and Ramanan Laxminarayan. 2009. "Fiscal and Externality Rationales for Alcohol Policies." *The B.E. Journal of Economic Analysis & Policy* 9 (1): 1–48. https://econpapers.repec.org/article/bpjbejeap/v_3a9_3ay_3a2009_3ai_3a1_3an_3a29.htm.
160. Pedroza-Tobias, Andrea, Eric Crosbie, Melissa Mialon, Angela Carriedo, and Laura A Schmidt. 2021. "Food and Beverage Industry Interference in Science and Policy: Efforts to Block Soda Tax Implementation in Mexico and Prevent International Diffusion." *BMJ Global Health* 6 (8): e005662. https://doi.org/10.1136/bmjgh-2021-005662.
161. Pell, David, Oliver Mytton, Tarra L. Penney, Adam Briggs, Steven Cummins, Catrin Penn-Jones, Mike Rayner, et al. 2021. "Changes in Soft Drinks Purchased by British Households Associated with

the UK Soft Drinks Industry Levy: Controlled Interrupted Time Series Analysis." *BMJ* 372 (372). https://doi.org/10.1136/bmj.n254.

162. Petticrew, Mark, Srinivasa Vittal Katikireddi, Cécile Knai, Rebecca Cassidy, Nason Maani Hessari, James Thomas, and Heide Weishaar. 2017. "'Nothing Can Be Done until Everything Is Done': The Use of Complexity Arguments by Food, Beverage, Alcohol and Gambling Industries." *Journal of Epidemiology and Community Health* 71 (11): 1078–83. https://doi.org/10.1136/jech-2017-209710.
163. Pichon-Riviere, A, A Alcaraz, A Palacios, B Rodríguez , L M Reynales-Shigematsu , and M Pinto. 2020. "The Health and Economic Burden of Smoking in 12 Latin American Countries and the Potential Effect of Increasing Tobacco Taxes: An Economic Modelling Study." *The Lancet Global Health* 8 (10): e1282–94. https://doi.org/10.1016/S2214-109X(20)30311-9.
164. Popkin, Barry M., and Shu Wen Ng. 2021. "Sugar-Sweetened Beverage Taxes: Lessons to Date and the Future of Taxation." *PLOS Medicine* 18 (1): e1003412. https://doi.org/10.1371/journal.pmed.1003412.
165. Postolovska, Iryna, Rouselle F. Lavado, Gillian Tarr, and Stephane Verguet. 2017. "Estimating the Distributional Impact of Increasing Taxes on Tobacco Products in Armenia: Results from an Extended Cost-Effectiveness Analysis." Washington, D.C.: World Bank. https://doi.org/10.1596/26386.
166. Powell, Lisa M, JF Chriqui, T Khan, Roy Wada, and Frank J Chaloupka. 2012. "Assessing the Potential Effectiveness of Food and Beverage Taxes and Subsidies for Improving Public Health: A Systematic Review of Prices, Demand and Body Weight Outcomes." *Obesity Reviews* 14 (2): 110–28. https://doi.org/10.1111/obr.12002.
167. Powell, Lisa M., Julien Leider, and Pierre Thomas Léger. 2020. "The Impact of the Cook County, IL, Sweetened Beverage Tax on Beverage Prices." *Economics & Human Biology* 37 (May): 100855. https://doi.org/10.1016/j.ehb.2020.100855.
168. Powell, Lisa M., Roy Wada, Joseph J. Persky, and Frank J. Chaloupka. 2014. "Employment Impact of Sugar-Sweetened Beverage Taxes." *American Journal of Public Health* 104 (4): 672–77. https://doi.org/10.2105/ajph.2013.301630.
169. Powell, Lisa, Samantha Marinello, and Julien Leider. 2021. "A Review and Meta-Analysis of Tax Pass-through of Local Sugar-Sweetened Beverage Taxes in the United States." *P3RC Research Brief No. 120*. Chicago, IL: Policy, Practice, and Prevention Research Center (P3RC), University of Illinois, Chicago. https://p3rc.uic.edu/wp-content/uploads/sites/561/2021/09/Rvw-Meta-Anal-Tax-PssThrgh-SSB-Taxes_Rsrch-Brf-No.-120_Jul-2021.pdf.
170. Prince, Martin J, Fan Wu, Yanfei Guo, Luis M Gutierrez Robledo, Martin O'Donnell, Richard Sullivan, and Salim Yusuf. 2015. "The Burden of Disease in Older People and Implications for Health Policy and Practice." *The Lancet* 385 (9967): 549–62. https://doi.org/10.1016/s0140-6736(14)61347-7.
171. Reddy, Rohin K., Walton N. Charles, Alexandros Sklavounos, Atul Dutt, Paul T. Seed, and Ankur Khajuria. 2020. "The Effect of Smoking on COVID-19 Severity: A Systematic Review and Meta-Analysis." *Journal of Medical Virology* 93 (2). https://doi.org/10.1002/jmv.26389.
172. Rehm, Jürgen, Gerhard E. Gmel, Gerrit Gmel, Omer S. M. Hasan, Sameer Imtiaz, Svetlana Popova, Charlotte Probst, et al. 2017. "The Relationship between Different Dimensions of Alcohol Use and the Burden of Disease-an Update." *Addiction* 112 (6): 968–1001. https://doi.org/10.1111/add.13757.
173. Rehm, Jürgen, Colin Mathers, Svetlana Popova, Montarat Thavorncharoensap, Yot Teerawattananon, and Jayadeep Patra. 2009. "Global Burden of Disease and Injury and Economic Cost Attributable to Alcohol Use and Alcohol-Use Disorders." *Lancet (London, England)* 373 (9682): 2223–33. https://doi.org/10.1016/S0140-6736(09)60746-7.
174. Rehm, Jürgen, and Maristela Monteiro. 2005. "Alcohol Consumption and Burden of Disease in the Americas: Implications for Alcohol Policy." *Revista Panamericana de Salud Pública* 18 (4-5): 241–48. https://doi.org/10.1590/s1020-49892005000900003.
175. Rhum, Christopher J., Alison Snow Jones, Kerry Anne McGeary, William C. Kerr, Joseph V. Terza, Thomas K. Greenfield, and Ravi S. Pandian. 2012. "What U.S. Data Should Be Used to Measure the Price Elasticity of Demand for Alcohol?" *Journal of Health Economics* 31 (6): 851–62. https://doi.org/10.1016/j.jhealeco.2012.08.002.
176. Risi, Stephan, and Robert N Proctor. 2019. "Big Tobacco Focuses on the Facts to Hide the Truth: An Algorithmic Exploration of Courtroom Tropes and Taboos." *Tobacco Control*, September, tobaccocontrol-2019-054953. https://doi.org/10.1136/tobaccocontrol-2019-054953.
177. Rojas, Christian, and Everett B. Peterson. 2008. "Demand for Differentiated Products: Price and Advertising Evidence from the U.S. Beer Market." *International Journal of Industrial Organization* 26 (1): 288–307. https://doi.org/10.1016/j.ijindorg.2006.12.003.
178. Ross, Hana, Deliana Kostova, Michal Stoklosa, and Maria Leon. 2013. "The Impact of Cigarette Excise Taxes on Smoking Cessation Rates from 1994 to 2010 in Poland, Russia, and Ukraine." *Nicotine & Tobacco Research* 16 (Suppl 1): S37–43. https://doi.org/10.1093/ntr/ntt024.
179. Ross, Hana, Jean Tesche, and Nicole Vellios. 2017. "Undermining Government Tax Policies: Common Legal Strategies Employed by the Tobacco Industry in Response to Tobacco Tax Increases." *Preventive Medicine* 105 (December): S19–22. https://doi.org/10.1016/j.ypmed.2017.06.012.
180. Sargent, Richard P, Robert M Shepard, and Stanton A Glantz. 2004. "Reduced Incidence of Admissions for Myocardial Infarction Associated with Public Smoking Ban: Before and after Study." *BMJ : British Medical Journal* 328 (7446): 977–80. https://doi.org/10.1136/bmj.38055.715683.55.
181. Scarborough, Peter, Vyas Adhikari, Richard A. Harrington, Ahmed Elhussein, Adam Briggs, Mike Rayner, Jean Adams, Steven Cummins, Tarra Penney, and Martin White. 2020. "Impact

of the Announcement and Implementation of the UK Soft Drinks Industry Levy on Sugar Content, Price, Product Size and Number of Available Soft Drinks in the UK, 2015-19: A Controlled Interrupted Time Series Analysis." *PLOS Medicine* 17 (2): e1003025. https://doi.org/10.1371/journal.pmed.1003025.

182. Shang, Ce, Frank J. Chaloupka, Prakash C. Gupta, Mangesh S. Pednekar, and Geoffrey T. Fong. 2019. "Association between Tobacco Prices and Smoking Onset: Evidence from the TCP India Survey." *Tobacco Control* 28 (Suppl 1): s3–8. https://doi.org/10.1136/tobaccocontrol-2017-054178.
183. Shang, Ce, Frank J. Chaloupka, and Deliana Kostova. 2013. "Who Quits? An Overview of Quitters in Low- and Middle-Income Countries." *Nicotine & Tobacco Research* 16 (Suppl 1): S44–55. https://doi.org/10.1093/ntr/ntt179.
184. Shang, Ce, Anh Ngo, and Frank J. Chaloupka. 2020. "The Pass-through of Alcohol Excise Taxes to Prices in OECD Countries." *The European Journal of Health Economics* 21 (6): 855–67. https://doi.org/10.1007/s10198-020-01177-w.
185. Sharma, Anurag, Brian Vandenberg, and Bruce Hollingsworth. 2014. "Minimum Pricing of Alcohol versus Volumetric Taxation: Which Policy Will Reduce Heavy Consumption without Adversely Affecting Light and Moderate Consumers?" *PLoS ONE* 9 (1): e80936. https://doi.org/10.1371/journal.pone.0080936.
186. Silver, Lynn D, Shu Wen Ng, Suzanne Ryan-Ibarra, Lindsey Smith Taillie, Marta Induni, Donna R Miles, Jennifer M Poti, and Barry M Popkin. 2017. "Changes in Prices, Sales, Consumer Spending, and Beverage Consumption One Year after a Tax on Sugar-Sweetened Beverages in Berkeley, California, US: A Before-And-after Study." *PLoS Medicine* 14 (4): e1002283. https://doi.org/10.1371/journal.pmed.1002283.
187. Singh, Gitanjali M., Renata Micha, Shahab Khatibzadeh, Stephen Lim, Majid Ezzati, and Dariush Mozaffarian. 2015. "Estimated Global, Regional, and National Disease Burdens Related to Sugar-Sweetened Beverage Consumption in 2010." *Circulation* 132 (8): 639–66. https://doi.org/10.1161/circulationaha.114.010636.
188. Singh, Gitanjali M., Renata Micha, Shahab Khatibzadeh, Peilin Shi, Stephen Lim, Kathryn G. Andrews, Rebecca E. Engell, Majid Ezzati, and Dariush Mozaffarian. 2015. "Global, Regional, and National Consumption of Sugar-Sweetened Beverages, Fruit Juices, and Milk: A Systematic Assessment of Beverage Intake in 187 Countries." Edited by Michael Müller. *PLOS ONE* 10 (8): e0124845. https://doi.org/10.1371/journal.pone.0124845.
189. Slade, Tim, Cath Chapman, Wendy Swift, Katherine Keyes, Zoe Tonks, and Maree Teesson. 2016. "Birth Cohort Trends in the Global Epidemiology of Alcohol Use and Alcohol-Related Harms in Men and Women: Systematic Review and Metaregression." *BMJ Open* 6 (10): e011827. https://doi.org/10.1136/bmjopen-2016-011827.
190. Smith, Adam. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. McMaster University Archive for the History of Economic Thought, number smith 1776. https://ideas.repec.org/b/hay/hetboo/smith1776.html.
191. Smith, Katherine E., Emily Savell, and Anna B. Gilmore. 2013. "What Is Known about Tobacco Industry Efforts to Influence Tobacco Tax? A Systematic Review of Empirical Studies." *Tobacco Control* 22 (2): e1–1. https://doi.org/10.1136/tobaccocontrol-2011-050098.
192. Smith, Travis A., Biing-Hwan Lin, and Jong-Ying Lee. 2010. "Taxing Caloric Sweetened Beverages: Potential Effects on Beverage Consumption, Calorie Intake, and Obesity." *USDA-ERS Economic Research Report No. 100*. Washington, D.C.: United States Department of Agriculture (USDA). https://doi.org/10.2139/ssrn.2118636.
193. Sornpaisarn, Bundit, Kevin D. Shield, Joanna E. Cohen, Robert Schwartz, and Jürgen Rehm. 2015. "Can Pricing Deter Adolescents and Young Adults from Starting to Drink: An Analysis of the Effect of Alcohol Taxation on Drinking Initiation among Thai Adolescents and Young Adults." *Journal of Epidemiology and Global Health* 5 (4): S45–57. https://doi.org/10.1016/j.jegh.2015.05.004.
194. Srivastava, Preety, Keith R. McLaren, Michael Wohlgenant, and Xueyan Zhao. 2015. "Disaggregated Econometric Estimation of Consumer Demand Response by Alcoholic Beverage Types." *Australian Journal of Agricultural and Resource Economics* 59 (3). https://ideas.repec.org/a/ags/aareaj/283211.html.
195. Stacey, Nicholas, Aviva Tugendhaft, and Karen Hofman. 2017. "Sugary Beverage Taxation in South Africa: Household Expenditure, Demand System Elasticities, and Policy Implications." *Preventive Medicine* 105 (December): S26–31. https://doi.org/10.1016/j.ypmed.2017.05.026.
196. Stockings, Emily, Wayne D Hall, Michael Lynskey, Katherine I Morley, Nicola Reavley, John Strang, George Patton, and Louisa Degenhardt. 2016. "Prevention, Early Intervention, Harm Reduction, and Treatment of Substance Use in Young People." *The Lancet Psychiatry* 3 (3): 280–96. https://doi.org/10.1016/s2215-0366(16)00002-x.
197. Stoklosa, Michal, Jeffrey Drope, and Frank J. Chaloupka. 2016. "Prices and E-Cigarette Demand: Evidence from the European Union." *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco* 18 (10): 1973–80. https://doi.org/10.1093/ntr/ntw109.
198. Substance Abuse and Mental Health Services Administration (US), and Office of the Surgeon General (US). 2016. *Facing Addiction in America: The Surgeon General's Report on Alcohol, Drugs, and Health*. Washington, D.C.: US Department of Health and Human Services. https://pubmed.ncbi.nlm.nih.gov/28252892/.
199. Teng, Andrea M., Amanda C. Jones, Anja Mizdrak, Louise Signal, Murat Genç, and Nick Wilson. 2019. "Impact of Sugar-Sweetened Beverage Taxes on Purchases and Dietary Intake: Systematic Review and Meta-Analysis." *Obesity Reviews* 20 (9): 1187–1204. https://doi.org/10.1111/obr.12868.
200. Topiwala, Anya, Klaus P. Ebmeier, Thomas Maullin-Sapey, and Thomas E. Nichols. 2021. "No Safe Level of Alcohol Consumption for Brain Health: Observational Cohort Study of 25,378

UK Biobank Participants." MedRxiv Pre-print (May 12, 2021). https://doi.org/10.1101/2021.05.10.21256931.

201. ———. 2022. "Alcohol Consumption and MRI Markers of Brain Structure and Function: Cohort Study of 25,378 UK Biobank Participants." *NeuroImage: Clinical* 35 (January): 103066. https://doi.org/10.1016/j.nicl.2022.103066.
202. Tversky, Amos, and Daniel Kahneman. 1981. "The Framing of Decisions and the Psychology of Choice." *Science* 211 (4481): 453–58.
203. U.S. Department of Health and Human Services. 2014. "The Health Consequences of Smoking: 50 Years of Progress. A Report of the Surgeon General." Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. https://www.ncbi.nlm.nih.gov/books/NBK179276/.
204. U.S. National Cancer Institute, and World Health Organization. 2016. "The Economics of Tobacco and Tobacco Control." *National Cancer Institute Tobacco Control Monograph 21. NIH Publication No. 16-CA-8029A*. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute; and Geneva, Switzerland: World Health Organization. http://cancercontrol.cancer.gov/brp/tcrb/monographs/21/index.html.
205. United Nations. 2022. "Population - Standard Projections." World Population Prospects 2022. United Nations Department of Economic and Social Affairs (UNDESA). 2022. https://population.un.org/wpp/Download/Standard/Population/.
206. United States Public Health Service Office of the Surgeon General, and National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. 2020. "Smoking Cessation: A Report of the Surgeon General." Washington (DC): US Department of Health and Human Services. https://pubmed.ncbi.nlm.nih.gov/32255575/.
207. Van Walbeek, Cornelis, and Grieve Chelwa. 2021. "The Case for Minimum Unit Prices on Alcohol in South Africa." *South African Medical Journal* 111 (7): 680. https://doi.org/10.7196/samj.2021.v111i7.15430.
208. Vandenberg, Brian, and Anurag Sharma. 2015. "Are Alcohol Taxation and Pricing Policies Regressive? Product-Level Effects of a Specific Tax and a Minimum Unit Price for Alcohol." *Alcohol and Alcoholism* 51 (4): 493–502. https://doi.org/10.1093/alcalc/agv133.
209. Vartanian, Lenny R., Marlene B. Schwartz, and Kelly D. Brownell. 2007. "Effects of Soft Drink Consumption on Nutrition and Health: A Systematic Review and Meta-Analysis." *American Journal of Public Health* 97 (4): 667–75. https://doi.org/10.2105/ajph.2005.083782.
210. Vellios, Nicole, and Corné van Walbeek. 2016. "Determinants of Regular Smoking Onset in South Africa Using Duration Analysis." *BMJ Open* 6 (7): e011076. https://doi.org/10.1136/bmjopen-2016-011076.
211. Verguet, Stéphane, Cindy L Gauvreau, Sujata Mishra, Mary MacLennan, Shane M Murphy, Elizabeth D Brouwer, Rachel A Nugent, Kun Zhao, Prabhat Jha, and Dean T Jamison. 2015. "The Consequences of Tobacco Tax on Household Health and Finances in Rich and Poor Smokers in China: An Extended Cost-Effectiveness Analysis." *The Lancet Global Health* 3 (4): e206–16. https://doi.org/10.1016/s2214-109x(15)70095-1.
212. Villanti, Andrea C., Shelly Naud, Julia C. West, Jennifer L. Pearson, Olivia A. Wackowski, Raymond S. Niaura, Elizabeth Hair, and Jessica M. Rath. 2019. "Prevalence and Correlates of Nicotine and Nicotine Product Perceptions in U.S. Young Adults, 2016." *Addictive Behaviors* 98 (November): 106020. https://doi.org/10.1016/j.addbeh.2019.06.009.
213. Viscusi, W. Kip, and Joni Hersch. 2008. "The Mortality Cost to Smokers." *Journal of Health Economics* 27 (4): 943–58. https://doi.org/10.1016/j.jhealeco.2008.01.001.
214. Wada, Roy, Frank J. Chaloupka, Lisa M. Powell, and David H. Jernigan. 2017. "Employment Impacts of Alcohol Taxes." *Preventive Medicine* 105 (December): S50–55. https://doi.org/10.1016/j.ypmed.2017.08.013.
215. Wagenaar, Alexander C, Matthew J Salois, and Kelli A Komro. 2009. "Effects of Beverage Alcohol Price and Tax Levels on Drinking: A Meta-Analysis of 1003 Estimates from 112 Studies." *Addiction (Abingdon, England)* 104 (2): 179–90. https://doi.org/10.1111/j.1360-0443.2008.02438.x.
216. Wang, Hong, Jody L. Sindelar, and Susan H. Busch. 2006. "The Impact of Tobacco Expenditure on Household Consumption Patterns in Rural China." *Social Science & Medicine* 62 (6): 1414–26. https://doi.org/10.1016/j.socscimed.2005.07.032.
217. Wang, Meng, Min Yu, Le Fang, and Ru-Ying Hu. 2014. "Association between Sugar-Sweetened Beverages and Type 2 Diabetes: A Meta-Analysis." *Journal of Diabetes Investigation* 6 (3): 360–66. https://doi.org/10.1111/jdi.12309.
218. World Bank. 2019. "Confronting Illicit Tobacco Trade : A Global Review of Country Experiences." *World Bank Group Global Tobacco Control Program*. Washington, D.C.: World Bank. https://documents1.worldbank.org/curated/en/677451548260528135/pdf/133959-REPL-PUBLIC-6-2-2019-19-59-24-WBGTobaccoIllicitTradeFINALvweb.pdf.
219. ———. 2020. "Taxes on Sugar-Sweetened Beverages: International Evidence and Experiences." Washington, D.C.: World Bank. https://thedocs.worldbank.org/en/doc/d9612c480991c5408edca33d54e2028a-0390062021/original/World-Bank-2020-SSB-Taxes-Evidence-and-Experiences.pdf.
220. ———. 2023. "World Development Indicators." World Bank Open Data. World Bank. 2023. https://data.worldbank.org/.
221. World Health Organization (WHO). 2014. "Global Status Report on Alcohol and Health 2014." Geneva: Switzerland: World Health Organization. https://www.who.int/publications/i/item/global-status-report-on-alcohol-and-health-2014.
222. ———. 2017a. "Tackling NCDs: 'Best Buys' and Other Recommended Interventions for the Prevention and Control of Noncommunicable Diseases." Geneva: Switzerland: World Health

Organization. https://www.who.int/publications-detail-redirect/WHO-NMH-NVI-17.9.

223. ———. 2017b. "Taxes on Sugary Drinks: Why Do It?" Geneva: Switzerland: World Health Organization. https://iris.who.int/bitstream/handle/10665/260253/WHO-NMH-PND-16.5Rev.1-eng.pdf.

224. ———. 2018. *Global Status Report on Alcohol and Health 2018*. Geneva: Switzerland: World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/274603/9789241565639-eng.pdf.

225. ———. 2019a. "Tobacco Industry: Decades of Deception and Duplicity." Geneva, Switzerland: World Health Organization. https://applications.emro.who.int/docs/FS-TFI-198-2019-EN.pdf?ua=1.

226. ———. 2019b. *WHO Global Report on Trends in Prevalence of Tobacco Use 2000-2025*. Third Edition. Geneva, Switzerland: World Health Organization. https://www.who.int/publications/i/item/who-global-report-on-trends-in-prevalence-of-tobacco-use-2000-2025-third-edition.

227. ———. 2019c. "WHO Report on the Global Tobacco Epidemic, 2019 : Offer Help to Quit Tobacco Use." Geneva, Switzerland: World Health Organization.

228. ———. 2020. "Alcohol Pricing in the WHO European Region: Update Report on the Evidence and Recommended Policy Options." Geneva, Switzerland: World Health Organization.

229. ———. 2021. "WHO Report on the Global Tobacco Epidemic 2021: Addressing New and Emerging Products." Geneva: Switzerland: World Health Organization. https://www.who.int/publications/i/item/9789240032095.

230. ———. 2022. "Sugar-Sweetened Beverage Taxes in the WHO European Region: Success through Lessons Learned and Challenges Faced." Geneva: Switzerland: World Health Organization. https://www.who.int/europe/publications/i/item/WHO-EURO-2022-4781-44544-63081.

231. Wu, Daphne C., Geordan Shannon, Luz Myriam Reynales-Shigematsu, Belen Saenz de Miera, Blanca Llorente, and Prabhat Jha. 2021. "Implications of Household Tobacco and Alcohol Use on Child Health and Women's Welfare in Six Low and Middle-Income Countries: An Analysis from a Gender Perspective." *Social Science & Medicine* 281 (July): 114102. https://doi.org/10.1016/j.socscimed.2021.114102.

232. Yin, Jiawei, Yalun Zhu, Vasanti Malik, Xiaoqin Li, Xiaolin Peng, Fang Fang Zhang, Zhilei Shan, and Liegang Liu. 2021. "Intake of Sugar-Sweetened and Low-Calorie Sweetened Beverages and Risk of Cardiovascular Disease: A Meta-Analysis and Systematic Review." *Advances in Nutrition* 12 (1): 89–101. https://pubmed.ncbi.nlm.nih.gov/32696948/.

233. Young, Douglas J., and Agnieszka Bielińska-Kwapisz. 2002. "Alcohol Taxes and Beverage Prices." *National Tax Journal* 55 (1): 57–73. https://doi.org/10.17310/ntj.2002.1.04.

Gender and Aging

Chapter 8

Gender Gaps in Health and Well-Being of Older Adults: A Review of the Burden of Non-communicable Diseases and Barriers to Health Care for Women and Men

Chapter 9

Gendered Responsibilities, Elderly Care, and Labor Supply: Evidence from Four Middle-Income Countries



8

Gender Gaps in Health and Well-Being of Older Adults

A review of the burden of non-communicable diseases and barriers to healthcare for women and men

Seemeen Saadat[a], Meriem Boudjadja[a], Sameera Altuwaijri[a]

[a] Health, Nutrition and Population Global Practice, World Bank

INTRODUCTION

Women and men experience aging differently. Evidence from across the globe suggests that aging is not "gender-neutral", but rather "gender-imbalanced". Along with physical and physiological differences, social and gender norms contribute to different experiences for women and men that manifest across the life cycle (Box 8.1). These differences, such as in education, age at marriage, employment opportunities, as well as caregiving and living arrangements contribute to gender-based differences in socio-economic status as well as health outcomes in people as they age (Carmel 2019; Hosseinpoor et al. 2012; Weber et al. 2019).

While aging brings on the onset of non-communicable diseases (NCDs) for both women and men, their health outcomes vary due in part to gender-based differences. Several studies highlight higher male mortality at earlier ages due to heart disease or diabetes in high- and middle-income countries, for example. On the other hand, women in these countries also have similar levels of NCDs but tend to live longer with a lower quality of life.[1] Women's longer life expectancy compared to men means a greater concentration of women in older age groups and more years lived with disability. Women also go through menopause as they age, which takes a physical and mental toll, and is linked to an increased risk of contracting non-communicable diseases (Hess et al. 2012). At the same time, older women, especially in lower income countries, are less likely than men to receive proper healthcare due to their greater financial vulnerability – a direct consequence of gender gaps over the life cycle that affect women's patterns of labor force participation, income generation opportunities, and decision-making capacities (Quick, Jay, and Langer 2014; Cotlear 2011).

A multitude of factors contribute to differences in health outcomes of women, men, and other gender identities, and therefore healthcare needs. As highlighted above, epigenetic, and social determinants of health interact with gender (also considered a determinant of health) to influence knowledge, attitudes, and perceptions about health and health seeking behaviors, the ability to access and use health services, the capacity to pay for healthcare, and consequently health outcomes. Gender's interaction with race, ethnicity, or sexual orientation can further exacerbate barriers to health (Cené et al. 2016; Liu et al. 2019; O'Hanlan et al. 2004). Understanding and responding to these issues in policy and programs is essential for reducing gender gaps in availability of equitable, affordable, quality healthcare services.

Health systems play an important role in preventing and addressing age related disability and disease. However, health interventions for aging populations such as prevention and management of NCDs do not necessarily adopt a gender- responsive or transformative approach. There is a neutrality that assumes that women and men have similar needs for healthcare and have similar access and capacity to afford health services and, especially as they age. Yet, evidence on women's health and aging acknowledges the specific challenges older women such as increased risk of NCDs during menopause transition or social and financial constraints to access of health services (Anagnostis and Stevenson 2023; Carmel 2019; WHO 2015); and with the growing proportion of aging populations, the prevalence and severity of these issues is expected to increase (UN Women 2012). Health systems need to be at the very least responsive to the specific issues related to aging and longer life expectancies of women and men on the one hand, and their social and economic vulnerabilities on the other such as ability to pay and limited mobility.

With the progression of aging, older adults also require long-term care (LTC). While healthcare encompasses organized delivery of medical care, LTC is defined as the "day-to-day help with activities such as washing and dressing or help with household activities such as cleaning and cooking" that is likely accompanied with some type of medical care.[2] As with healthcare, long-term care policies and programs require a gender lens. Gender-based barriers to care that influence women's and men's health are also reflected in the access and use of LTC arrangements. For example, as women tend to live longer than men, they may need LTC services for a longer period of time. However, their capacity to pay for services may

1 On average life expectancy at birth for women is about 5 years higher than that for men, and in MICS the difference is generally about 8 to 10 years.

2 https://www.oecd.org/els/health-systems/long-term-care.htm

BOX 8.1 Gender gaps and the life course

As a social determinant of health, gender influences an individual's way of living, well-being and health, and patterns of seeking and receiving healthcare (e.g., Heise et al. 2019; Weber et al. 2019). Both the biological sex* and social constructs of gender influence health outcomes across the life cycle. This is seen in different demographic and health indicators observed in many countries, such as the distorted sex ratios at birth; in gender-based nutrition differentials; in the difference in health seeking behaviors for children based on their gender; in the quality of care; in the high proportion of maternal deaths despite being preventable and the excess high adult mortality among both women and men across different countries.

Gender roles are established from an early age and perpetuated across the life course. From the day they are born, children receive signals on what is expected of them and how they should behave based on their gender. These gender norms are passed on by parents and family, teachers and peers, as well as signaling from others in the community (Munoz-Boudet et al. 2013). Gender norms translate into power hierarchies and vulnerabilities, acting as powerful motivators to encourage or prohibit specific individual attitudes and behaviors by sanctioning deviation from these shared expectations.

Gender and health are fundamentally connected. Pre-determined gender roles and expectations about behavior create inequities in health and access to health services before birth and continue through the entire life course of a person. Women's limited empowerment, for example, in some countries makes it harder for them to access reproductive, maternal and child health services for themselves and their children freely. Similarly, men may deliberately ignore illness or avoid seeking medical help, to avoid being perceived as weak by their peers. These patterns influence the health outcomes of women and men and persist over their life course.

A life course approach to healthcare supports healthy longevity and can help reduce gender gaps. *Healthy longevity refers to the human life span lived to the best possible quality of health that helps to build and preserve human capital, especially as people age* (O'Keefe and Haldane 2024). Healthy longevity happens across the life course. While the seeds for healthy longevity are planted even before a person is born, as people age, healthy longevity means avoiding death and serious disability in middle age, enabling a high level of mental and social functioning through middle and older ages, and a socially connected and reasonably pain-free, short period of time before death.

Understanding and addressing gender gaps across the human life course such as reducing early marriages, facilitating use of reproductive and maternal health services, reducing delays in seeking healthcare for female children when sick, or ensuring access to affordable health services and mental health care, especially for vulnerable populations can help to promote healthy longevity for not only for women, but also their children, as well as men, and other gender identities.

** The differences in the biological determinants of health and illness include differential genetic vulnerability to illness, reproductive and hormonal factors, and differences in physiological characteristics that can contribute to gender gaps in health over the life-cycle.*

be more limited than that of men. Moreover, it is often women who provide LTC, whether through formal or informal arrangements. Thus, LTC provision can be a source of female employment (when formal arrangements are in place) or it can pull women from the labor markets (when informal arrangements are employed). These dynamics make it all the more important to approach LTC through a gender lens.

Objectives

This study is part of a series of papers on healthy longevity. It examines the sex disaggregated prevalence and mortality related to four key NCDs for older adults and discusses the key barriers to healthcare for older women. The paper aims to: (i) present a descriptive analysis of gender-based gaps in key NCD outcomes for populations aged 45 years and older; (ii) examine the barriers to access and use of healthcare, especially for women aged 45 years and above; and (iii) review the challenges associated with availability of health and long-term care.

The chapter discusses challenges related to healthy longevity and healthcare from a gendered perspective, especially for older women, and complements the discussion on LTC in other studies in the series. It draws heavily from the evidence base on high income and aging societies for LTC but it's focus is broader and covers, to the extent possible, gender gaps in health outcomes and health care for lower- and middle-income countries.

A life course approach to policy making is important for healthy longevity. So is consideration of gender, especially from the point of view of distribu-

BOX 8.2 The Healthy Longevity Framework and Gender

The Healthy Longevity Initiative (HLI) examines the links between human capital formation ((knowledge, skills, and other individual aspects that contribute to productivity) and its maintenance during adulthood and as people age. Gender is an important aspect of human capital formation, affecting health, education and employment opportunities and outcomes. The influence of gender is clear within the context of the HLI framework (O'Keefe and Haldane 2024):

- Decisions or choices made for girls and boys earlier in life, and across the life course influence health outcomes in older ages. Early marriage and childbirth, for example, affects women's health and life opportunities for the rest of their lives, and childhood health and nutrition influence adult health outcomes.
- As populations age, human capital accumulation increases at a decreasing rate and it starts to deplete among the very elderly, especially because of a decline in their health. Women and men can experience differences in depreciation of human capital due to a combination of health and social factors.

tional impacts. Cross-sector interventions, including those that target child and adolescent health, improve access to life-saving medicines and technologies, and promote healthy behaviors contribute to better health across the life cycle, including older age cohorts. Interventions that reduce gender gaps in healthy longevity benefits both men and women. Affording women and girls access to reproductive and maternal health, for example, supports better reproductive health (e.g., in managing menstruation, prevention of STIs) and pregnancy outcomes for mother and child, and reduces the burden of reproductive disability (e.g., uterine prolapse or fistula, or endometriosis) with long term benefits, especially as women age. Similarly, such an approach can contribute to reducing the burden of early mortality due to NCDs, especially among men.

Methodology

The study is based on a literature review of demand and supply issues combined with secondary data analysis to build a profile of health outcomes and barriers in access to care. The literature review is based on peer reviewed journal articles, white papers, and published reports on the topic for the time period 2006-2023, with the inclusion of some earlier documents dating back to 1990 when these were relevant to the topic at hand. The data analysis uses the Global Burden of Disease (IHME) database and World Development Indicators.

Literature was identified using string combinations of key words (Table 8.1). Databases searched included pub med, google scholar, google, and the World Bank's "imagebank" and "open repository" databases. In addition, a search request was also submitted to the World Bank Library search services on "menopause". Menopause (and reproductive health), while not covered in this study, were used as identifier terms for papers on health issues among middle-aged women who are not of reproductive age. The string "women, aging, and health" provided over 10,000 results because of the width of topics covered under it (epidemiology, supply, and demand). The search was refined with additional terms (as listed above. On the demand side, this still yielded over 500 articles. Article titles and abstracts were then reviewed, and 91 were selected as relevant to the topic at hand with about half used in the final write up. On the supply side, an initial 245 papers were identified and reviewed, with roughly 65 included in the final analysis. Seminal reports and other supporting evidence, when identified were also included in the review.

TABLE 8.1 Key search teams for the review (not an exhaustive list)

Aging	Health/healthcare	Access	Gender
Elderly	Reproductive health	Affordability	Caregivers
Women	Demand for healthcare	Quality	Gender differences
Men	Utilization of healthcare	Mobility	Female
Supply side care	Menopause	Long-term care/LTC	Informal care giving

For the quantitative review, the study focuses on women and men aged 45 years and above. We use the *Global Burden of Disease* for health data and the *World Development Indicators* database for data on income for the year 2019. We examine the proportion of deaths attributable to a disease, disease prevalence, and years of life lived with disability (YLD) due to disease in three age groups: 45-59 years, 60-79 years, and 80 years and above.[3,4] As most women experience menopause during age 45-59 years, we also include this age group. The data analysis examines gender gaps in four major NCDs affecting older age groups: cardio-vascular disease, diabetes, cancers, and mental health. For mental health outcomes, we consider prevalence and YLD due to depressive disorders as well as self-harm since they are both connected to mental health and have considerably different outcomes for women and men.

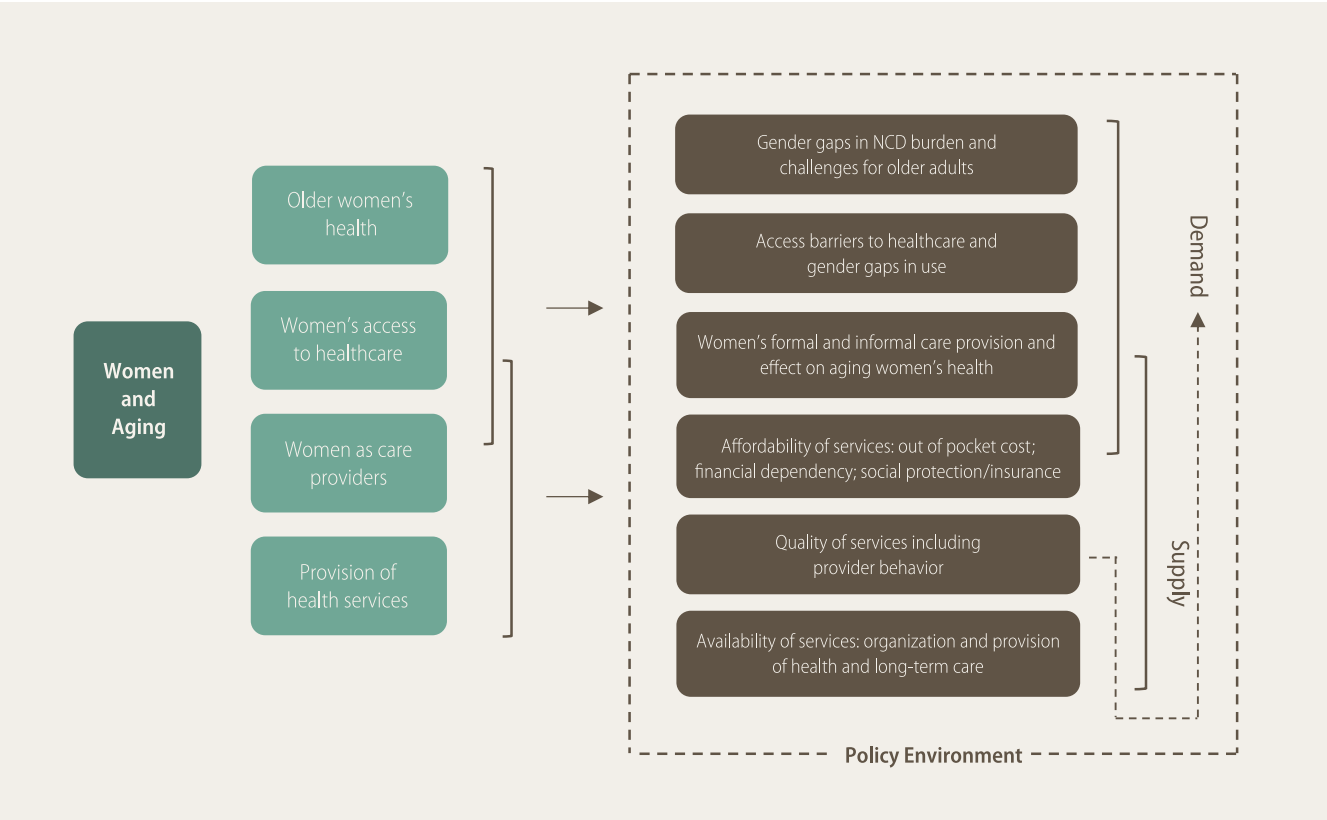
Structure of the review

The structure for this review follows the interactions individuals, and in particular, women may have with the healthcare system (Figure 8.1). The review focuses on four main areas that overlap health sector demand and supply issues:

a. Women's health needs as they age focusing on gender differences in mortality and prevalence of non-communicable diseases (NCDs) in women and men aged 45 years and above.

b. Women's access to and utilization of healthcare, including informal and long-term care. This also covers issues related to affordability such as the effects of out-of-pocket expenditures or insurance on demand for services.

FIGURE 8.1 Structure and Linkages for Women and Aging in Health Review



3 The authors acknowledge the limitations of the GBD dataset. However, for the purpose of this study, the protocols employed for data collection and analysis are sufficient and the dataset offers more complete information than other sources alone.

4 YLD is a widely used measure to convey the impact of disease on the quality of life prior to being resolved or death from the disease. While the methods used to calculate YLD have some limitations, it is a useful way of conveying the negative impact or the non-monetary cost of living with a disease. In most cases in this study, the YLD follows a similar pattern to the prevalence data and are shown only to strengthen the message that higher prevalence is linked to greater burden of disease.

c. Provision of health and long-term care services for aging women including availability and quality of services covering both formal and informal care; and

d. Women as providers of care. This focuses especially on the role women play as informal care givers in the context of long-term care.

Demand for health, and long-term care services, is associated with individuals' health status, their need for services, their ability to afford it, and the ease with which they can access and use these. An individual's health status is linked to many factors including their health and nutrition across the lifecycle, and their socio-economic status (which in turn also influences accessibility and affordability). Access to services depends on factors such as availability of services (supply), ease of physical access/transport, individuals' mobility, and their awareness of said services. Whether available services are used depends on socio-economic factors such as wealth and education, cultural norms, as well as quality of services. At the same time, availability of services and quality of services are interlinked and can affect demand for these services. The framework looks these issues from a gendered perspective, focusing on aging women and men. It helps to identify where the gaps are in terms of demand and supply of services, why these exist, and consequently how to address them (London 2008; WHO 2009).

GENDER DIFFERENTIATED HEALTH OUTCOMES OF AGING POPULATIONS

Men and women experience aging differently due to biological and socio-economic reasons. Women for example, have a longer life expectancy at birth compared to men which can increase their chances of living with illness or disability over longer periods. For instance, there are a greater number of blind women than men, and women bear a higher burden of Alzheimer's disease compared to men because of their longer life spans (Dubal 2020; WHO 2007). Moreover, women's reproductive cycle has a significant impact on their health and well-being (e.g., physiological changes due to childbirth or menopause) compared to men's. Socio-economic inequalities and gender norms that prevent women from generating income or accumulating savings, especially in lower income countries can adversely influence women's health further through restricting their access and use of health services, especially in LMICs (e.g., Dhar 2001; Prus and Gee 2003 ; Szanton et al. 2008; Zhan 2005). In addition, women's limited mobility and dependence on other family members, particularly males, restricts their access to timely care. On the other hand, gender norms can also create barriers for men to access timely healthcare, which can contribute to worsening health or early and avoidable mortality (Etienne 2018; McGraw, White, and Russell-Bennett 2021; Novak et al. 2019).

Examining data on major NCDS for women and men aged 45 and above shows across countries shows some common threads for women and men. These are discussed below:

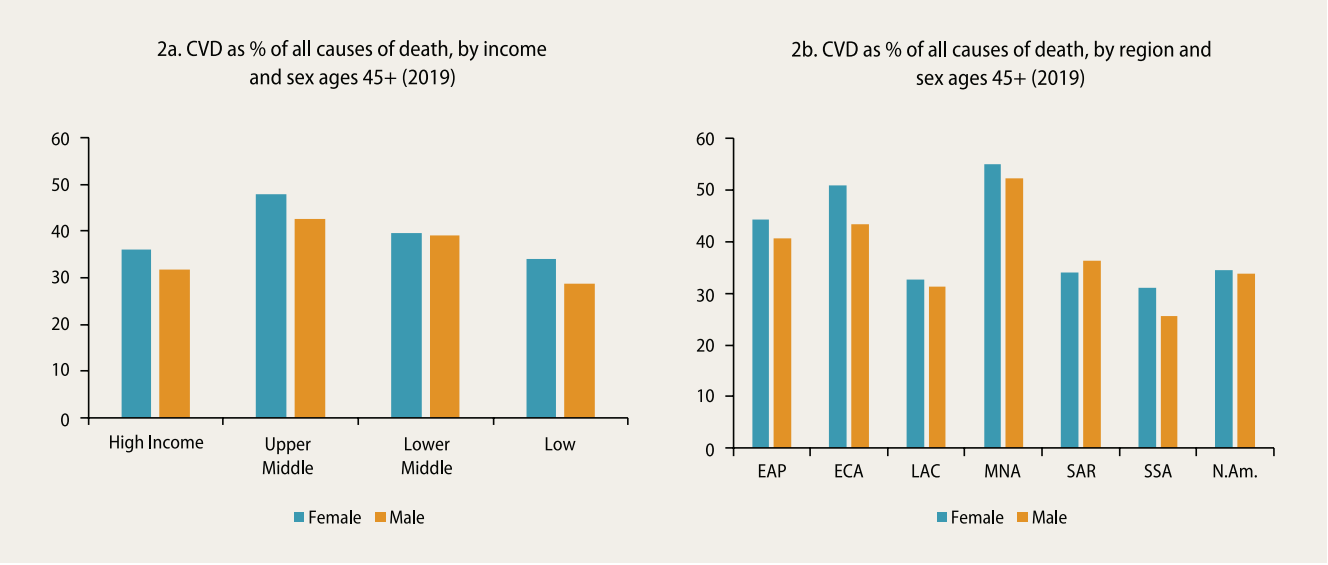
Cardiovascular diseases

Cardiovascular diseases (CVD) are the leading cause of mortality, responsible for roughly 18 million deaths each year (WHO 2021). This is especially the case for older adults, both women and men: in 2019, CVD accounted for 41.6 percent and 38.2 percent of all deaths globally among women and men aged 45 years and above respectively (IHME 2020). The largest burden of CVD deaths is in upper-middle income countries, particularly in the Middle East followed by Europe in Central Asia (Figure 8.2: 2a and 2b), with proportionally larger number of deaths due to CVD among women (when compared to all deaths among women) than men, with the exception of South Asia, which is likely driven by the larger proportion of CVD mortality among males in India, especially for those under age 60 years.[5]

When directly comparing CVD deaths for women and men, the picture is more mixed. Figure 3a and 3b show the ratio of female to male deaths due to CVD by income groups and at the regional level. As Figure 3a shows, in high- and low- income groups the ratio of female to male burden of mortality due to CVD is higher, but for middle income groups, a greater proportion of men than women are reported to have died due to CVD. When disaggregated by regions (Figure 3b), the ratio of female to male deaths due to CVD is especially high for Eastern and Central Europe and sub-Saharan Africa for those aged 45 years and older, while it is at parity in North America. In other regions, at the aggregate level, the ratio indicates a higher burden on men (IHME 2020).

5 IHME 2020. Global Burden of Disease database (accessed 11-16-23)

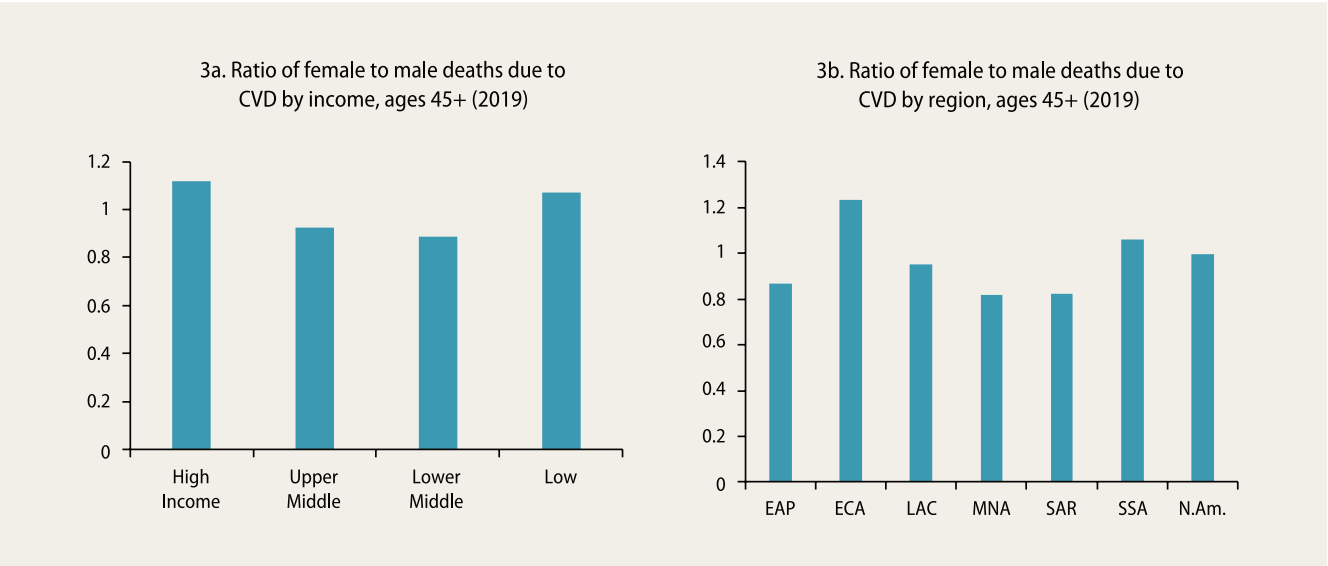
FIGURE 8.2 Cardiovascular Mortality among older adults by regional and income aggregates



Source: IHME Global Burden of Disease 2020

Globally, over 500 million people are estimated to live with cardio-vascular diseases. This represents a nearly a fifth of the total burden of all disease prevalence among older adults (ages 45 years and above), with about 11 women for every 10 men living with CVD. The largest burden is in higher income countries and the North America region followed by Eastern Europe and Central Asia and the Middle East and North Africa regions. In the Middle East and North Africa and South Asia regions, prevalence is higher for men than women, with roughly 8 women for every 10 men living with CVD (ages 45 years and above). On the other hand, in the East Asia and Pacific, there are about 13 women for every 10 men, and in Eastern Europe and Central Asia about 12 women for every 10 men live with CVD (IHME 2020).

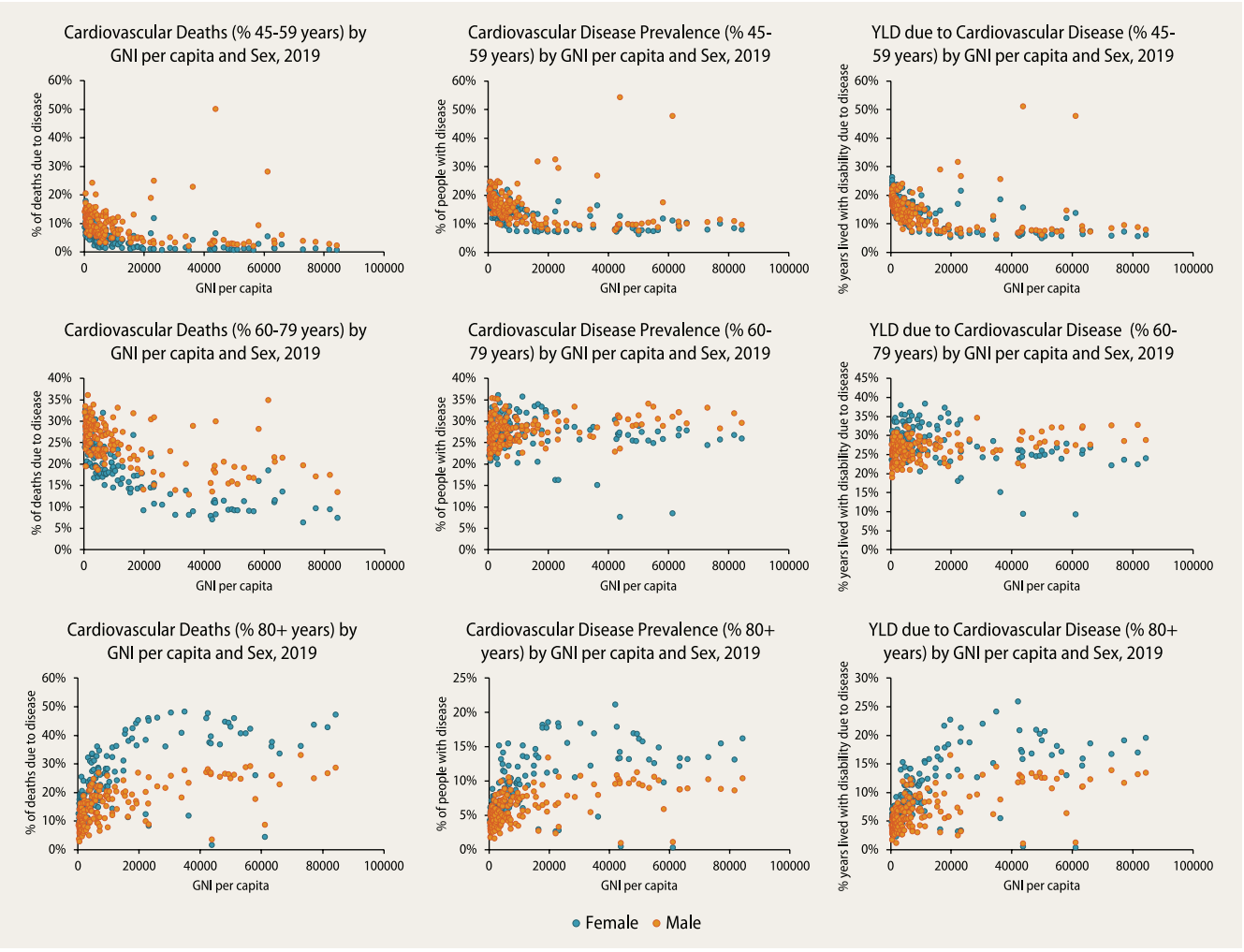
FIGURE 8.3 Ratio of female to male CVD mortality by regional and income aggregates



Source: IHME Global Burden of Disease 2020

When data is disaggregated further by age groups, the story gets more interesting. Figure 8.4 presents the breakdown by three indicators on mortality, prevalence, and years lived with disability (YLD) for CVD by sex (with blue for female and orange for male) and age groups at the country level[6]. The data indicate three things: (1) patterns of CVD prevalence, mortality, and YLD for women and men are fairly similar; (2) for the younger ages 45-59 years, gender gaps are minimal, but there are a handful of countries, particularly in the MENA region where the differences between women and men in terms of CVD mortality are stark, and significantly impact male mortality – the outliers in figure 8.4; and (3) as people age, the burden of CVD prevalence and deaths is greater among women, particularly for the oldest age group.

FIGURE 8.4 Cardio-Vascular Disease by Sex for Older Populations (ages 45 years and above)



Source: IHME Global Burden of Disease 2020; World Development Indicators (WDI) Database

6 Disaggregation by country allows to see the variations within regions which in some cases are driven by a handful of countries.

The figures on YLD indicate a similar pattern as prevalence. However, the gender gap in YLD begins to enlarge during ages 60 - 79 years, with women, especially in lower- and middle- income countries exhibiting higher YLD.

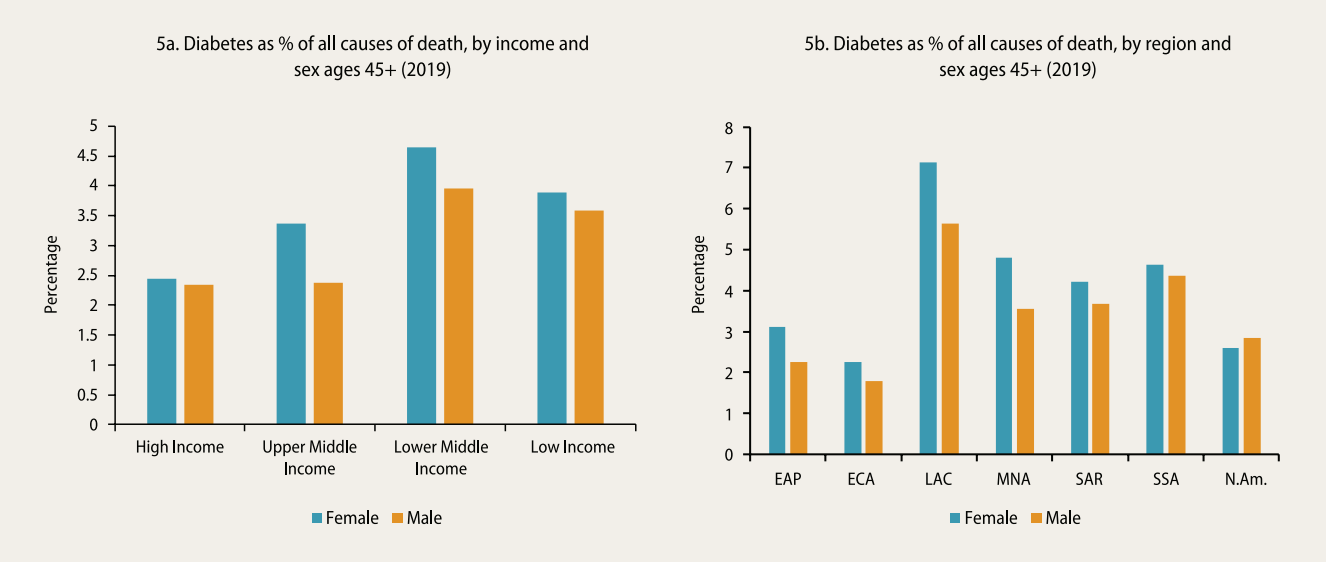
Studies on CVD and gender align with this evidence and indicate the increasing burden of disease on women. For example, Thielke and Diehr (2012) used data on adults aged 65 years and above from the US Cardiovascular Study (n=5888) to understand the probability of transitioning from one state of health to the next or dying. They found that when men were sick, they died more often than women in a similar state, but that they also remained healthier than women while alive and were more likely to recover from being sick. While earlier studies found that heart disease was more prevalent among women at older ages than men (Maas and Appelman 2010), the recent Lancet Women and Cardiovascular Disease Commission indicates that it is also increasing among younger women (Vogel et al. 2021).

Moreover, women are less likely to receive appropriate diagnosis or care because of misconceptions and poorer understanding of the incidence of disease among women, women's symptoms of heart disease, and other socio-economic and gender-based barriers to care (Papadopoulou and Kaski 2013; Peters and Woodward 2022; Vogel et al. 2021). Fabreau et al (2015) for example, examined the relationship between sex, neighborhood, and other socio-economic factors on acute coronary syndromes among elderly Canadians in Alberta. They found that these factors significantly affected women's access to timely care (measured as receiving cardiac catheterization) but not so for men. They conclude that special attention needs to be paid towards improving the quality of care for women, especially those in lower income groups. The Lancet Women and Cardiovascular Disease Commission also underscored these issues and recommended a 10-point agenda that promotes better data collection and research, inclusion of women in clinical trials, training of healthcare personnel, and heart health services and programs aimed at women in different settings, in poor socio-economic settings (Vogel et al. 2021).

Diabetes mellitus

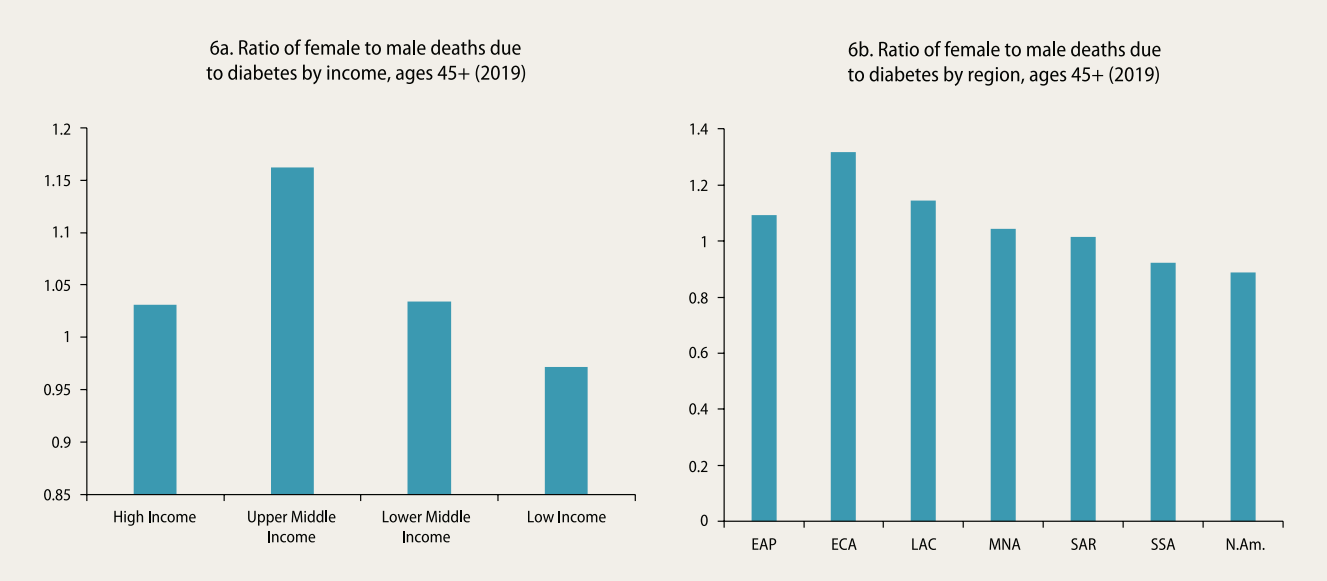
Gender based gaps are also clearly visible in diabetes outcomes. Diabetes is among the top ten NCDs globally, accounting for roughly 1.55 million deaths of which 95 percent were among persons aged 45 years and above in 2019 (IHME 2020). Aggregate level data show that slightly more women than men die due to diabetes among the 45 and older age groups (3.6 percent vs. 2.9 percent). When comparing the burden of diabetes proportional to other causes of deaths by sex, the burden is higher among women than men. This is evident among different country income groups and across all regions except for North America (Figure 8.5 – 5a and 5b). The largest burden of deaths from diabetes is in lower mid-

FIGURE 8.5 Deaths due to Diabetes, Ages 45+ (by Income Groups and Regional Aggregates)



Source: IHME Global Burden of Disease 2020

FIGURE 8.6 Ratio of female to male mortality due to diabetes by regional and income aggregates



Source: IHME Global Burden of Disease 2020

dle-income countries (4.7 percent for women and 3.9 percent for men), while the largest gender gap is in upper-middle income countries (3.4 percent for women and 2.4 percent for men). At the regional level, the largest gender gap is in the Latin America and Caribbean region (7.1 percent for women; 5.7 percent for men) followed by the Middle East and North Africa (4.8 percent for women; 3.6 percent for men).

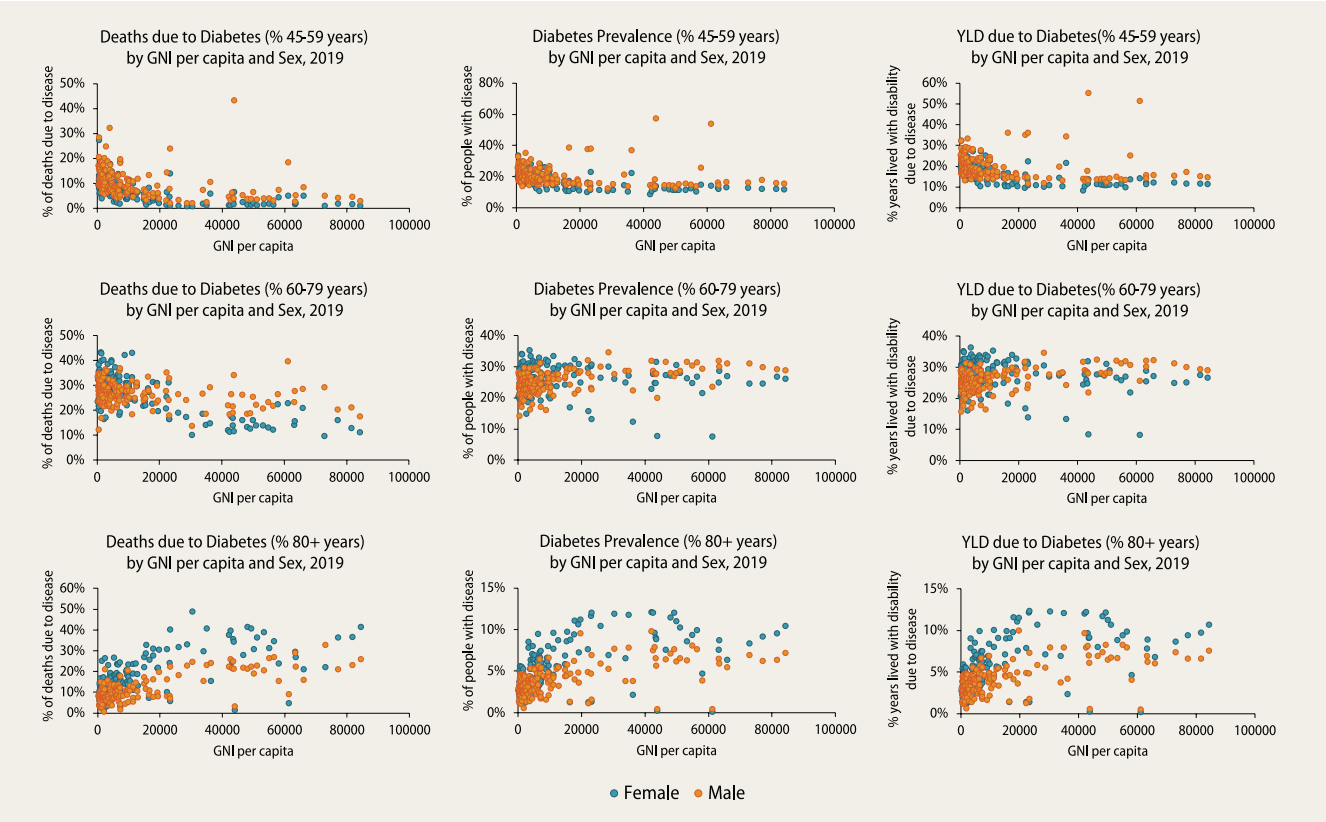
A similar pattern emerges when directly comparing male and female deaths due to diabetes at the aggregate level. Figure 8.6 presents this comparison. Proportionally, nearly 12 women for every 10 men above the age of 45 die due to diabetes in upper-middle income countries (Figure 6a). In other income groups the gaps are not as large and in low-income countries are reversed. At the regional level (Figure 6b), the largest gaps are in the Eastern Europe and Central Asia region with about 13 women for every 10 men over the age of 45 dying due to diabetes. In Sub-Saharan Africa and North America, the gap is reversed with about 11 men for every 10 women dying from diabetes.

Nearly 460 million people live with diabetes globally of which 80 percent are aged 45 years or above. Diabetes accounts for about 16 percent of all the disease prevalence among older adults, with about 97 women for every 100 men living with diabetes. This is mainly driven by a higher prevalence of diabetes among men in North America, South Asia and Middle East and North Africa regions (roughly about 9 women for every 10 men living with diabetes). When aggregated by income groups, a similar gap exists for high income and lower-middle income countries.

However, when further disaggregated by age, the data show growing gender gaps across countries – a patten similar to that for CVD outcomes. Figure 8.7 presents the data on deaths, prevalence, and years lived with disability due to diabetes at the country level for three age groups: 45-59, 60-79, and 80+ years. For each outcome, countries follow a similar trend. For ages 45- 59 years, the burden of disease is mostly similar for women and men, with a few outliers. However, for those between ages 60 and 79 years, a shift begins to happen with gender gaps growing between women and men. While in the oldest age group of 80 years and above there is a clear shift towards a greater burden of disease for women.

These gaps represent the growing vulnerability of women as they age and compound their poorer health outcomes. For instance, older women with diabetes have been found to have higher risk of CVD mortality compared to men (Clemens et al., 2020; Juutilainen et al., 2004; Pan et al., 2011) or lose any biological advantage they may have compared to men in developing a risk of CVD (Wannamethee et al. 2012). Recent evidence on COVID-19 outcomes also suggests that older women's biological advantage for survival compared to men disappeared if they had multimorbidity such as diabetes or heart disease (Kautzky-Willer, 2021). Moreover, in addition to risk

FIGURE 8.7 Gender Gaps in Diabetes for Older Populations (ages 45 years and above)



Source: IHME Global Burden of Disease 2020; World Development Indicators (WDI) Database

factors such as obesity and genetics that can lead to diabetes in both women and men, women face an additional risk from gestational diabetes which can predispose them to developing diabetes after birth or later in life. Women with diabetes are more likely to experience poor physical function due to lower bone strength (Nillson et al 2016). One recent qualitative examination of health-related quality of life for persons with diabetes in Spain, for example, also found that women had a lower quality of life than men, and older women (over 75 years of age) had the worst quality of life (Gálvez Galán et al., 2021).

Socio-economic conditions and gender norms also contribute to these gender gaps that also affect men. For example, in their study in India, Perkins et al (2016) found that while women's health was poorer than men's in general, widowed men had a higher likelihood of developing diabetes within the first 4 years of their wife's death. Social and gender norms are likely to influence behaviors. For instance, older men are more likely to have poor mental health especially after retirement. Gender norms prevalent in most of the world place the task of income generation to men, but when this is no longer the case, they may feel lonely, isolated, or a burden. This - coupled with loss of a partner and poorer social networks (compared to women) this can contribute to poor mental and physical health. In their study of diabetes patients in Germany, Kramer et al (2012), found significant differences in the utilization of healthcare between elderly women and men, with men having fewer visits and prescriptions which the authors ascribe to socio-economic characteristics, and perhaps an over-utilization of health services by women. It may also be an under-utilization of services by men as highlighted in other literature on male behavior, attitudes about masculinity, and use of health services.

In addition, challenges such as financial or mobility barriers can prevent access to timely care. An examination of expenditure data between 2002 and 2011 for diabetes treatment in the United States showed that women paid significantly and consistently more in out-of-pocket payments for prescriptions and office as well as home-based care when compared to men (Williams et al. 2017). While majority of the population is covered by health insurance in the United States, in

a lower-middle-income country such as Bangladesh, this can be cost prohibitive where payments are out of pocket and the annual cost of diabetes care is roughly around US$ 865/- (Afroz et al. 2019).

Cancers

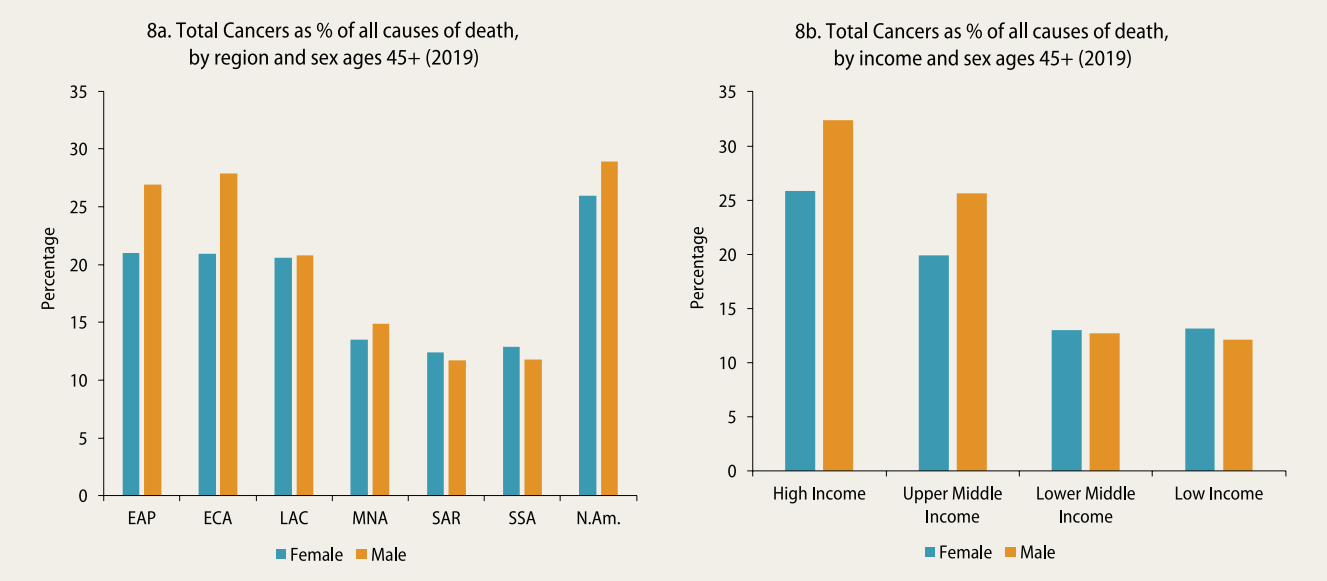
Globally, an estimated 10 million people die of cancers each year (WHO 2022). The myriad of cancers affect men and women differently. Some are unique to women (e.g., breast cancer) or men (e.g., prostate cancer) while others affect both (e.g., lung, skin, thyroid) but to different extents based on genetic, environmental, and behavioral factors (Dorak & Karpuzoglu, 2012; Hatano et al. 2022; Lipsky et al. 2021).

Unlike CVD and diabetes, evidence suggests that overall, mortality from cancers is higher for men than women among older age groups. Figure 8.8 presents the data on cancer mortality as a percentage of all-cause mortality among women and men ages 45 years and above. Across regions, the largest gender gaps are in Eastern Europe and Central Asia (ECA) and the East Asia, and the Pacific (EAP) regions followed by North America (Figure 8a). This is also reflected in Figure 8b which shows that across all cancers for ages 45 and above the largest gender gaps are in high- and upper-income countries.

However, in low- and lower-middle income countries (mainly in Sub-Saharan Africa and South Asia), where the burden of cancer mortality is lower, gender gaps are also narrower, with slightly greater mortality among women as a proportion of all causes of mortality for women compared to men (also Figures 8a and 8b). While research on the determinants of gender differences in cancer related outcomes in low and lower-income countries is lacking, a larger share of other diseases, including maternal mortality, as well as known barriers to access to healthcare for women such as availability of cancer screenings and treatment services, lack of information, limited mobility and financial constraints that create barriers and may account for reversed gender gaps in these regions (Black, Hyslop, and Richmond, 2019; Getachew et al. 2019; Mascara & Constantinou 2021; Okoronkwo et al. 2015; Rivera-Franco & Leon-Rodriguez, 2018).

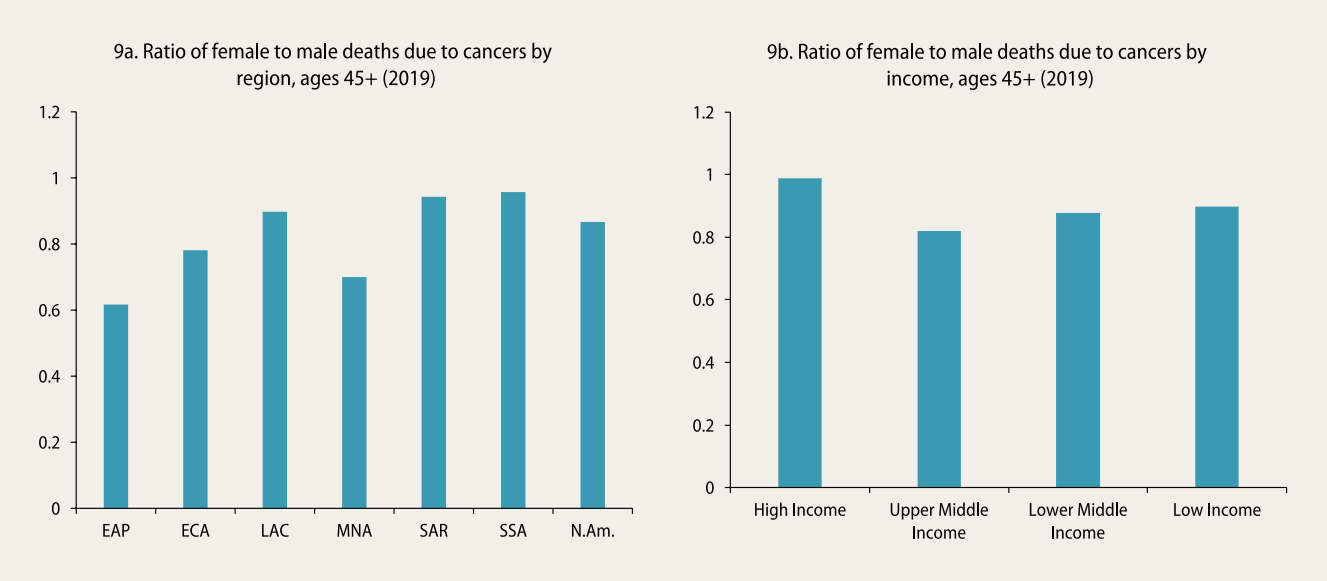
When comparing the number of deaths for women to that of men directly at the global level, there are 134 men for every 100 women above the age of 45 years that die from cancers (IHME 2020). Figure 8.9 shows the breakdown of gender gaps by region and income group when comparing the deaths due to cancers among women and men in absolute numbers, which shows near parity in high income countries where in other income groups, gender gaps increase with a greater burden of deaths for men. When comparing geographical regions, gender gaps are most significant in East Asia and the Pacific and the Middle East and North Africa regions, where for every 100 women there are roughly 162 and 142 men respectively that also die from cancers.

FIGURE 8.8 Deaths due to Cancers, Ages 45+ (by Income Groups and Regional Aggregates)



Source: IHME Global Burden of Disease 2020

FIGURE 8.9 Ratio of female to male mortality due to cancers by regional and income aggregates



Source: IHME Global Burden of Disease 2020

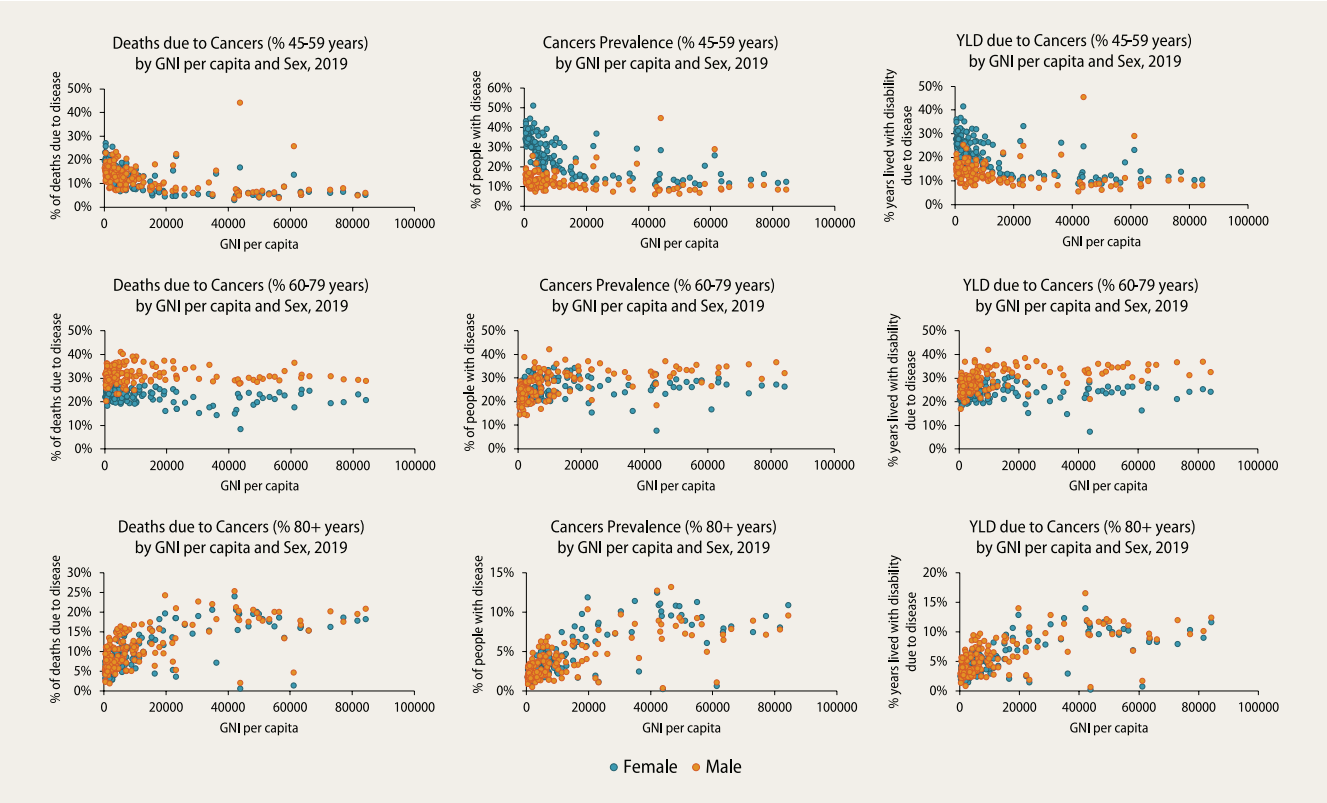
Interestingly, when the data is further disaggregated to the country level by sex and age groups, a consistent cross-country pattern emerges. The burden of cancer related mortality is relatively low, and similar for women and men aged 45 to 59 years, especially for LMICs. Gender gaps appear in mortality from cancers in the 60 to 79 age group, as cancer mortality increases (Figure 8.10), with a larger proportion of death among men compared to women across all countries. However, for the oldest age group (80 + years) the gaps close again, but mortality (as expected) is especially high for all but low-income countries, likely because of the lower (albeit growing) burden of NCDs and a lower life expectancy in low-income countries.

On the other hand, global prevalence of cancers and years lived with disability (YLD) presents a slightly different pattern, but again with some consistency in gender outcomes across three age groups of older adults. Globally, 103 women for every 100 men live with cancer. Gender gaps exist among the 45 to 59 years age group with clearly higher prevalence and YLD among women compared to men (Figure 8.10, last column). These gaps tend to close for older populations, particularly among LMICs. In upper-middle income countries men begin to exhibit higher prevalence and years lived with disability compared to women among the 60 to 79 years age group. However, for those aged 80 years and above, gender gaps not only minimize but also reverse as the prevalence rates among women reach similar levels as that of men, particularly in upper-middle income countries.

Female cancers make up nearly 60 percent of the cancers prevalent among women aged 45 and above. This includes breast, uterine, ovarian, and cervical cancers, with breast cancer being the most prevalent (44.7 percent) and leading cause of mortality (27 percent) from cancer among women (IHME 2020). By far the largest burden of these cancers is in the 45-59 years age group (68 percent) i.e., towards the end of woman's reproductive cycle. The prevalence drops to 45 percent for those ages 80 years and above. On the other hand, cancers such as prostate and testicular cancers make up around 30 percent of the cancers prevalent among men over 45 years, with the largest prevalence among men 60-79 years (IHME 2020). This includes breast cancer, which although rare among men, can occur. Annex 8.1 presents the breakdown of mortality and prevalence of cancers by type among women and men.

Gender gaps in prevalence and mortality for cancers that are common to both sexes are complex. Bronchial, Tracheal, and Lung cancers together are the leading cause of cancer-related mortality for men (25.5 percent of total cancers among men aged 45 years and above) but responsible for only 9.6 percent of cancers among women in the same cohort (IHME 2020). Similarly, 2 men for every 1 woman have oral cancer (Lipsky et al. 2021). Men's more frequent use of tobacco and alcohol, poorer oral hygiene, and delayed care-seeking compared to women as well as higher

FIGURE 8.10 Gender Gaps in Cancers among Older Populations (ages 45 and above)



Source: IHME Global Burden of Disease 2020; World Development Indicators (WDI) Database

likelihood of multimorbidity are well-documented risk factors behind these outcomes (Dorak & Karpuzoglu, 2012; Jha 2020). On the other hand, women who smoke are 3 times more likely to develop it than men who smoke (Barta, Powell, and Wisnivesky 2019). Thyroid cancers are also more prevalent among women than men (2.2 vs. 1.1 percent of all cancers for those ages 45 years and above), which may be linked to post-menopausal changes in women's metabolism and weight gain (Cui et al. 2021; Dorak & Karpuzoglu, 2012; Rahbari et al. 2010; Suteau et al. 2021).

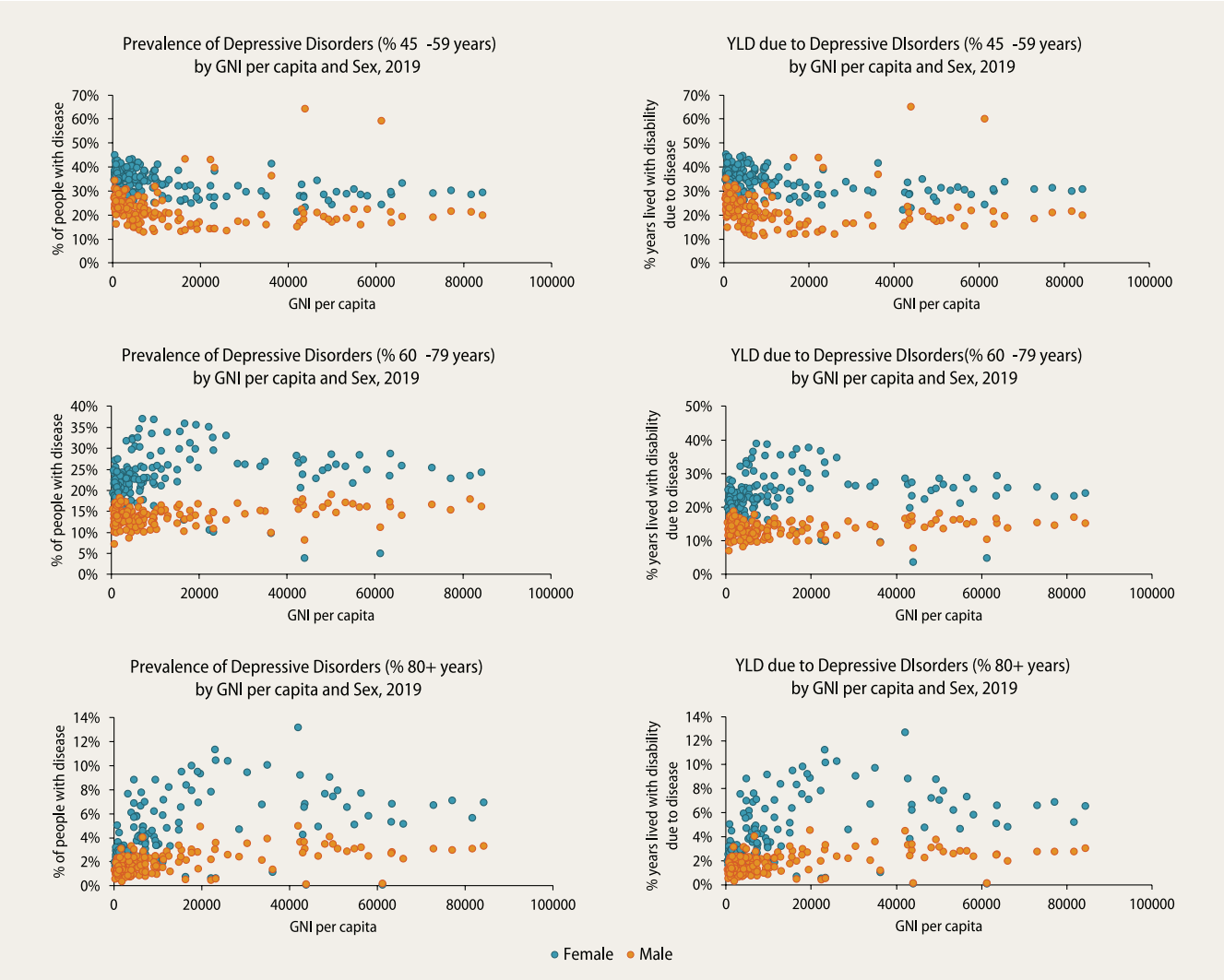
Men's and women's lived experience with cancer can also be different. A study that looked at sex differences in the prevalence of physical and emotional symptoms as well as loss of functioning in 5339 cancer survivors in the Dutch PROFILES registry, identified gender gaps with female survivors experiencing greater net loss in physical and cognitive functioning and male survivors with greater net loss in role and social functioning when compared to an age and sex matched reference population. Female patients in the cohort were also less likely to be employed (20% vs 24%, $p < 0.01$), received less formal education; and were less likely to have a partner (70% versus 83%, $p < 0.01$) (Oertelt-Prigione et al. 2021). Hatano et al. 2022 highlight the differences in end-of-life experiences for women and men in a sample of patients in palliative care in East Asian countries (n=1632). Their findings show that men were more likely to have multiple diseases and experience illness such as bronchitis and fever compared to women (43% vs 36%, p=0.05; 42% vs 30%, p<0.01), while women stayed longer in palliative care units than men (28 days vs 21 days, p<0.01). Understanding these types of differences can help to design more responsive/effective policies and interventions to provide care for women and men.

Mental health and self harm

One in five persons globally suffers from a mental health issue. Among these, depressive disorders are the most common and merit special attention among aging populations. As figure 8.11 shows, prevalence levels of depression and the years lived with disability (YLD) due to depressive disorders are consistently higher for women compared to men. This gap

persists across all countries, for all ages 45 years and above and income groups. While there are variations in these gaps, in some countries such as Viet Nam, Ukraine, and Pakistan the female burden of major depressive disorders is up to double that of men, and these gaps persist in older age groups. Two outliers to this overall trend are United Arab Emirates and Qatar, where for ages 45 to 59 years, the prevalence of depressive disorders is considerably higher than that of women in these countries, as well as the prevalence rates globally. However, these decline for older age groups and are among the lowest for ages 80 years and above. On the other hand, among those aged 80 years and above, Japanese women have the highest rates of depressive disorders compared to other countries, and this is roughly three times that of depression among men in this age group in Japan (13.17% vs. 4.96%)- (IHME 2020).

FIGURE 8.11 Gender Gaps in Depressive Disorders among Older Adults



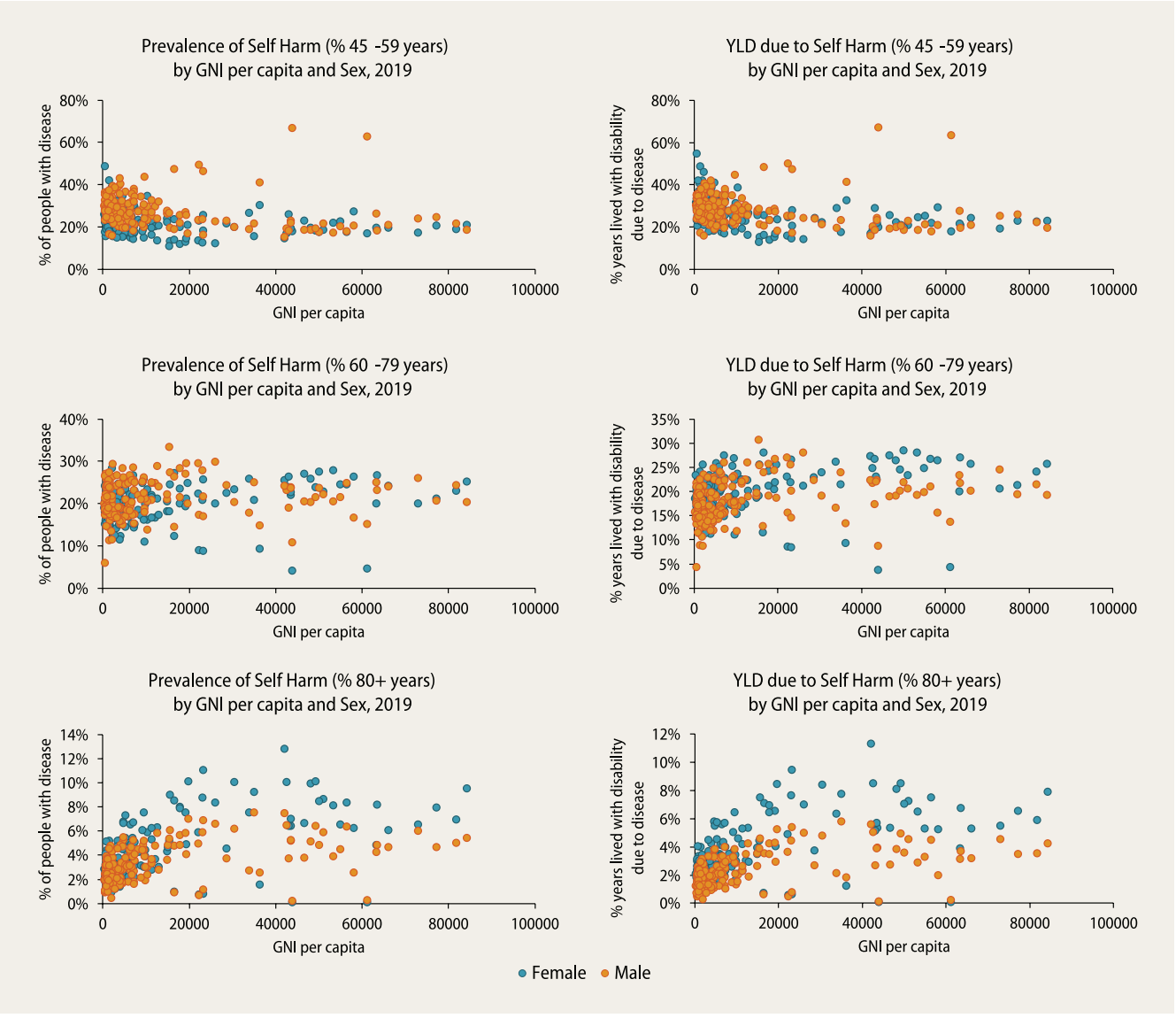
Source: IHME 2020; WDI

While women tend to have higher rate of depressive disorders than men, the rate of deaths due to self-harm among older men is higher. As a proxy for deaths related to depressive disorders, male deaths due to self-harm significantly outpace those among women, although the gaps begin to close those over 80 years of age in lower income countries (Figure 8.12, first column, bottom graph). In some cases, particularly in Middle Eastern countries, the mortality from self-harm among men is extremely high, even

higher than that of males in other countries (Figure 8.12). This is likely because of more violent methods of self-harm that men employ which are more likely to result in death than women. As epidemiological studies on middle eastern (and other) countries point to higher numbers of suicides attempts by women (El Halabi 2020; Mergl et al. 2015).

Self-harm takes various forms, and not all end in death. Data also show that prevalence of self-harm (e.g., cutting or burning of one's own skin) is equally prevalent among older women and men, with some exceptions (Figure 8.12, middle column), and in fact increases for women ages 80 years and above. The years lived with disability (Figure 8.12, last column) follow a similar pattern as prevalence, except for those aged 60-79 years where for middle income countries, the years lived with disability for women are slightly higher than those of men.

FIGURE 8.12 Gender gaps in self-harm among older adults (ages 45 and above)



Source: IHME 2020; WDI

Gender norms likely contribute to how women and men approach mental health and seeking support to address their depression, or stress. The roles men and women engender during their lifecycles and the social support systems they can access, and use contribute to their mental health and well-being (Adams et al. 2015; Cheung and Mui 2021; Mudege and Ezeh 2009; Obuobi-Donkor, Nkire, and Agyapong 2021; Treviño-Siller et al. 2006). A recent study in India, for example, found that 56 percent of older adults who were widowed and living alone were significantly more likely to suffer from depression [AOR: 1.56; CI 1.28,1.91] compared to those who were married and living with others (Srivastava et al. 2021). In often cases, this is women (Perkins et al. 2016; Pilania et al. 2019) and is a global experience (Beutel et al. 2018; Keily, Brady, and Byles 2019; Lin et al. 2021).

Although genetics can predispose people to depressive disorders, women's lived experiences also contribute to their higher rates of the disease. One in three women for example have experienced intimate partner violence in their lives (WHO 2021b). Exposure to rape has been found to contribute to the development of psychological problems, such as depression, dissociation, substance abuse, feelings of guilt and shame, and suicidal ideation (Covers et al. 2021). Childbirth can also contribute to depression in women and girls. One study found that new mothers of low socioeconomic status were 11 times more likely to develop postpartum depression symptoms than women of higher socioeconomic status (Carberg 2019). Gender norms that contribute to unequal power dynamics and inequalities such as limited control over finances or limited decision-making power, often beginning during adolescence, can lead to depression (Bone, Lewis, and Lewis 2020; Rungreangkulkij et al. 2019).

In a similar vein, the negative effect of male perceptions on their value may be linked to men's greater propensity for self-harm leading to suicide (Rivera and Scholar 2020). For example, results from the *Australian Longitudinal Study on Male Health* (Ten to Men, n = 13,884) found that "self-reliance" was the dominant dimension of masculinity linked to suicidal ideation (AOR 1.34; 95% CI 1.26–1.43) among men aged 18 to 55 years (Pirkis et al. 2017). For older adults, after retirement or loss of job men are more likely to feel isolated and less valuable as members of society. Earlier work by Dhar (2001) in India found that social and familial support was linked to better health, especially among men. Kendig et al. (2014) find that Australian men perceived low social activity as linked to aging poorly. Some studies suggest that as women's roles tend to be more complex than men's, and go beyond the labor markets, their ties within their communities can be beneficial in overcoming social isolation. While women face persistently greater barriers in access to healthcare and their quality of life is often lower than that of men (Carmel 2019; Griffin, Loh, and Hesketh 2012), their ability to cope with social and individual changes that come with aging may an important factor in their lower rates of suicides compared to men (Carlo et al. 2019).

AGING, GENDER, AND DEMAND FOR SERVICES

Older women's access to healthcare services

Access to health services refers to the ease with which an individual can get the healthcare they need. On the demand side, a key question is how the distributional effects of factors such as income, mobility, distance, and availability of services affect access to health services for aging populations, and especially women. As people age, their reliance on others to help care for them is expected to increase, especially if they have a disability or their health deteriorates. In addition, they may depend on other household members for financial support or transport, especially in the case of women.

One of the ways to estimate access to healthcare is through delays in health seeking behavior. Evidence on gender differences in seeking healthcare among aging populations is mixed. While some studies find evidence of higher utilization of health services, most often in higher income countries (Bertakis et al. 2000), others find just the opposite results (Cameron et al. 2010; Song and Bian 2014; Azad et al. 2020). All evidence however points to women's lower economic status and higher costs for healthcare (Azad et al. 2020; Bertakis et al. 2000; Cameron et al. 2010). Several studies focusing on

higher income countries highlight wealth/income as having a greater role in determining delays to accessing and using healthcare than gender. Relatively lower gender inequality, health insurance coverage, and longer employment histories may contribute to this. However, there are other disparities that can be overlooked (Cameron et al. 2010). For example, even though in their study on older adults in Japan, Murata et al (2010), find that income and time are more relevant to health seeking behavior than gender, they also report that significantly more men had a regular source of health care compared to women (~ 23% compared to 17%). This is likely because of more regular employment (e.g., women may step out of the labor market for childbirth of care provision). It may then be argued that gender differences in income or wealth then do tend to play a role in how women and men seek and use health services differently. Income inequalities across the life course can compound over time, and in the absence of equitable social protection, making it more costly to access healthcare for older women.

Literature on women's access to healthcare focuses mainly on younger populations or minority groups. Few studies examine the pathways and barriers to access for older women beyond financial issues. Transportation, or the lack of it, is one of the key challenges for women in general, and especially older women. Women's experiences point to multiple transportation challenges such as availability of suitable transport, especially in rural areas, cost of the transport, safety, or poor infrastructure making travel difficult (Hamiduzzaman et al. 2017; Naud et al. 2019). Women's care giving responsibilities for example can limit their mobility. While this may especially be a challenge in lower income countries, evidence points across the board barrier, with older women from diverse countries such as Viet Nam and Switzerland experiencing transportation barriers (Hamiduzzaman et al. 2017). One study of female veterans in the United States (n=3,608), for example, found that while there were considerable gender gaps in access to healthcare, measured as delays in health seeking behavior, transportation was the leading cause among women over age 65 years for such delays (36 percent), followed by childcare or other responsibilities (18 percent), and affordability (11.5 percent) - (Washington et al. 2011). Another systematic review in the United States attributed the transport gap as a barrier for 3 to 21 percent of the older population, across different settings in the country (Syed et al. 2013).

At the same time, women's burden of care influences their own access to, and utilization of health services. For instance, as Albertini (2016) points out, adult women are the risk of becoming "sandwiched" between caring for the young and the elderly. Using data from three waves of the SHARES survey in Europe (n=79359) the study also finds, rather counter-intuitively, that being more educated and having higher market incomes increases the risk of women to be "caught in between the care needs of the younger and the older family members" and leaving the labor market. Certainly, evidence from Eastern Europe highlights the social pressure on women to fulfill this role (Bussulo, Koettl, and Sinnot 2015). This is also highlighted in evidence from East Asia, where the "provision of family-based care [by women] is associated with fewer working hours and a higher probability of exit from the workforce". Similarly, in China, 28 percent of people aged 45 + years (mainly women) provide care for grandchildren, and 14% provide care for the elderly (World Bank 2016).

Often as people age, their need for reliance on family and other sources of support increases. In low- and lower-middle income countries, it is not uncommon for elderly to live with their adult children and their families or to rely on them financially. This is especially the case for older and widowed women, who may rely on their families for residential, financial, or other support. Due to women's lower labor force participation, gender-based pay gaps, and often limited autonomy, they are relatively more likely to be dependent on family for their residence, mobility, and accessing the health sector or informal care. While this intergenerational support has benefits, it can also erode the agency of elderly persons, and can lead to foregoing the healthcare needs of elderly to save resources for other, younger members of a household, especially in poorer households (Hossen and Westhues 2010; Lena et al. 2009), direct neglect or abuse (Jamuna 2003; Mansur et al. 2010), or stress from being in state of dependence on children or other relatives (Jeon et al. 2013). For instance, in their study of 9615 adults from seven States in India, Perkins et al. (2016) find that widowed women were more likely to have poor health outcomes compared to married women. This was linked to hypertension and stress. Widowhood had no similar effect on men. Another study in Karnataka (n=415) found that the elderly in the study suffered from hypertension followed by arthritis, diabetes, asthma, cataract, and anemia. In terms of

attitudes, about 48 percent felt they were not happy, and 68 percent said that elderly were often neglected (Lena et al. 2009).

Social and gender norms also play a role in setting different expectations from and for women and men, which contribute to their limitations. While for women, gender-based socio-economic constraints such as limited decision-making power, norms that limit their mobility and/or financial resources may be larger barriers to access, norms surrounding masculinity tend to be greater barriers to men in seeking help or treatment.

Affordability of health services for older women

A main barrier to access to healthcare, especially among the aging is the high cost of care. Research, especially in high income countries, has shown that poverty is a main barrier to access. Those with lower incomes tend to have a higher level of illness, either self-assessed or otherwise. This is likely the result of avoiding health care services because of the costs involved. For example, using data from the Aichi Gerontological Evaluation Study (AGES, n=15,302), Murata et al. (2010) found that low-income older persons (aged 65 and above) experienced more illness that required medical attention (such as hypertension) than their richer counterparts. They also had lower levels of self-perceived health than those in high income groups. Although the study did not find any gender differences, poverty seemed to be the driving factor for access to healthcare, with low-income group 1.4 times less likely to complete needed treatments compared to those in the high-income groups.

Poverty is clearly linked to health outcomes for the elderly, evidence on gender differences in outcomes is often mixed. This is likely because of the extent of interaction with other socio-economic factors. Prus and Gee (2003), in their study of elderly in Canada found that socio-economic status significantly affects women's health but not men's. Szanton et al (2008) find that elderly women in the US, ages 70-79 years who reported financial stress were 60% more likely to die within the next 5 years compared to those who did not. More recently, Palta et al. (2015) found that among older women, financial stress was linked to higher oxidative stress. Earlier studies in Brazil and US found that socioeconomic inequalities across the life course contribute to higher levels of disability among older women compared to men (Guerra, Alvarado and Zunzunegui, 2008; Thorpe et al. 2008).

Women, especially in lower income settings, tend to face greater financial constraints to health services compared to men, making it harder to seek appropriate and timely healthcare. In India, widowhood is significantly associated with women's use of lower cost public health services in older ages but not so for men or married women, who are more likely to use higher quality and more expensive private healthcare (Hossain et al. 2021). As highlighted earlier, dependency on others particularly financial and tradeoffs such as care for other household members often play into these decisions. Evidence from a small-scale study (n=152) in seven urban settings in Europe highlighted that while poverty is a barrier for access to prescribed medication, it is significantly more so for women than men (Stankuniene et al. 2015). The interaction of race or ethnicity with gender and other socio-economic characteristics exacerbate women's poor health outcomes. In their study of bladder cancer survival among Floridians, Brookfield et al. (2009) found that while white, non-Hispanic men with higher incomes had the highest survival rates, being from poor communities, female, and African American had the lowest survival outcomes (n=31,100).

Evidence shows that overall wealth, and not just income, is an important indicator of health outcomes for older adults. People with more material wealth also report a higher level of subjective health (Adena and Myck 2014; Hornby-Turner, Peel, and Hubbard 2017; Nummela et al. 2007). Adena and Myck (2014), for example, examine the effect of poverty over a 4-to-5-year period among Europeans aged 50+ from 12 countries using the Survey of Health, Ageing and Retirement in Europe (SHARE). They found that while relative income had no effect on changes in health, broader measures of poor material conditions, such as subjective poverty or low wealth, significantly increased the probability of transition to poor health and reduced the chance of recovery from poor health. Using a sample of Medicare recipients in the US, Fitzpatrick et al. (2004) found that women perceived higher barriers to healthcare access compared to men independent of other factors such as poverty and race.

Women's quality of life as they age can deteriorate considerably due to illness and lack of resources. Control over financial resources and access to care are two important dimensions of healthy aging (McMaughan, Oloruntoba, and Smith 2020; MIszkurka et al. 2012; Read, Grundy and Foverskov 2015). For women, this

is also rooted in their voice and agency. Traditionalism, negative attitudes towards aging, and stigma can also contribute to self-perceived lower quality of life (Sun et al. 2022). For example, a recent Finnish study found that in the aftermath of COVID-19 women reported more symptoms and a lower quality of life than men (Lindahl et al. 2022). With a significant proportion of the population over the age of 60 by 2050, including in sub-Saharan Africa, women will also constitute a larger proportion of the elderly.

Interventions that empower women across their life course and support their access to resources such as income, social protection measures, and health insurance that enable them to take control over their lives are pivotal for strengthening their capacity to seek, access, and use health service.

Simultaneously, it is important to ensure health and other data systems are not gender neutral. Women especially in lower income and more traditional communities may be left out of formal markets and social systems because of the lack of proper documentation and non-reporting. For example, in communities with more stereotypical gender norms such as those that promote female seclusion or *'purdah'*, not all female births and deaths are recorded in civil registration and vital statistics (CRVS) systems. This excludes women from formal spaces and social protection programs due to lack of appropriate identification papers. Similarly, health information and management systems may underreport on women's and men's health when data are not sex-disaggregated and when collection is incomplete (Muñoz et al. 2020).

SUPPLY OF HEALTH AND CARE SERVICES FOR AGING POPULATIONS

The following section examines issues related to the supply of care services. Although broader health system issues are of relevance for the aging, as they are for all age groups; the availability, cost, and quality of long-term care in particular is important in understanding their health and well-being as populations age. Moreover, long term care is inclusive of the medical and healthcare needs of the elderly. In this vein, this section focuses on the supply of care for aging population from the perspective of long-term care.

Availability of services

The current majority of aging economies are high- or middle- income countries, with considerable variation in the quality and availability of services. In higher income countries of Western Europe and North America, there is generally greater availability of key health services and long-term care arrangements compared to middle income countries. Availability of health services is dependent on a number of factors such as availability of health insurance, adequate supply and distribution of the health workforce, how essential and specialized healthcare is provided, and availability of essential drugs and medicines.

Policy decisions on how health and other services are organized affects women's access to these services. For instance, availability of health services may be limited due to sub-optimal distribution of physicians across regions or clustering of service delivery infrastructure (Chan et al. 2005; Mobley et al. 2006), which may contribute to access barriers for older people, and women in particular. Integrated primary healthcare (PHC) that brings services closer to the populations they serve have the potential of addressing some of these challenges. Several studies also show that this can also reduce the cost of care (Hou, Sharma, and Zhao 2023; Rocks et al. 2020), another key barrier for elderly, especially women. Models of bringing care closer to women, such as community-based nutrition programs aimed at pregnant and lactating mothers and their children, and provision of door-to-door family planning services have played an important role in improving maternal and child health outcomes in low- and middle-income countries (Cortez et al. 2014; Kuruvilla et al. 2014).

Similarly, at the country level, long-term care (LTC) arrangements are varied, depending on government policy as well as social norms (Ngai and Pissarides, 2009) and influence how and when women and men access and use these services - the way that LTC is defined, how LTC is arranged and who is responsible for its delivery. It should be noted that the aim of LTC is to prevent deterioration and adjust to stages of decline and is broader than medical or acute care. Whereas the primary goal of medical or acute care is to return an individual to a previous functioning level or to at least ease the burden of pain, the goals of LTC are much more complex and encompass social and emotional well-being. This necessitates a broader array of services and arrangements for care provision.

LTC services can be organized in a broad variety,

ranging from family care, public institutions, private residences and assisted-living environments depending on the needed level of care (Frank 2012). "Some countries (Denmark, Finland, Norway, or Sweden) chose to frame care provision as a societal task rather than a private matter where comprehensive care provision is done through public care providers, both in institutional and in social care. This public responsibility is funded through general taxation and social insurance contributions. Under this Scandinavian care regime, characterized by predominance of public care services, families who can provide care would be recompensed for doing so. In contrast, Southern European countries (Cyprus, Greece, Italy, Malta, Portugal, or Spain) would represent the other extreme, with almost exclusively family care provision, saving on public expenditure through the continuation of traditional caregiving roles by the family" (Hoff, Feldman, and Vidovicova 2010).

BOX 8.3 Understanding Long-Term Care Arrangements

In May 2016, at the World Health Assembly, 194 countries agreed that every country should have a long-term-care system (WHO 2017a). Yet, many countries are far from instituting any formal LTC arrangements. Many countries, especially the lower income ones, are mostly reliant on informal family care; in other countries social norms contribute to the same reliance. Larger cohorts of younger populations and family networks that can provide this care, also facilitate family care. In other countries, particularly higher income ones, with larger cohorts of aging populations, and declining working age populations, there are also publicly and privately funded formal long-term care arrangements that aim to support the needs of elderly populations.

However, to date there is no formal systematic method to categorize and compare LTC systems cross nationally. Applebaum (2013) building on previous work by Colombo et al. (2011) and Kraus et al. (2010), offers a five-category typology to classify approaches to LTC services and support arrangements, combining issues of financial and functional disability requirements with the supply, balance, and array of long-term services available (Table 8.2 below). This classification approach draws heavily on the OECD financial categories —universal versus means-tested or mixed—availability of services and the amount of out-of-pocket expenditures by individuals. In addition, they have combined these factors with additional delivery system indicators, such as the availability of residential care and the balance of formal and informal LTC services.

TABLE 8.2 Typology to Classify a Country's Long-Term Care Services and Supports System

Group 1	Group 2	Group 3	Group 4	Group 5
Public insurance funding available for long-term care-services	Mixture of public insurance and means-tested funding available	All funding for long-term services is means-tested	Funds are means tested but quite limited in availability	No public funds are available for long-term care-services
HCBS (home- and community-based services) widely available	HCBS widely available	HCBS commonly available	HCBS are of limited availability	HCBS not available
Institutional care widely available	Institutional care widely available	Institutional care widely available	Institutional care somewhat available	Institutional care rarely available
Housing with services widely available	Housing with services widely available	Housing with services available	Housing with services is of limited availability	Housing with services not available
Cash payments often available for long-term services	Cash payments generally available	Cash payments available on a limited basis	Cash payments not available	Cash payments not available
Informal care is one component of the system	Informal care is an important part of the system	Informal care is a critical element of the system	Very heavy reliance on informal care	Exclusive reliance on informal care
Examples: Germany, Japan, Korea, the Netherlands	Examples: Australia, France, Ireland, Spain, Switzerland	Examples: Estonia, Italy, Poland, Romania, United States	Examples: Argentina, Brazil, China, Egypt, India, Mexico, South Africa, Thailand	Examples: Bangladesh, Ghana, Kenya, Nepal

Source: OECD 2011

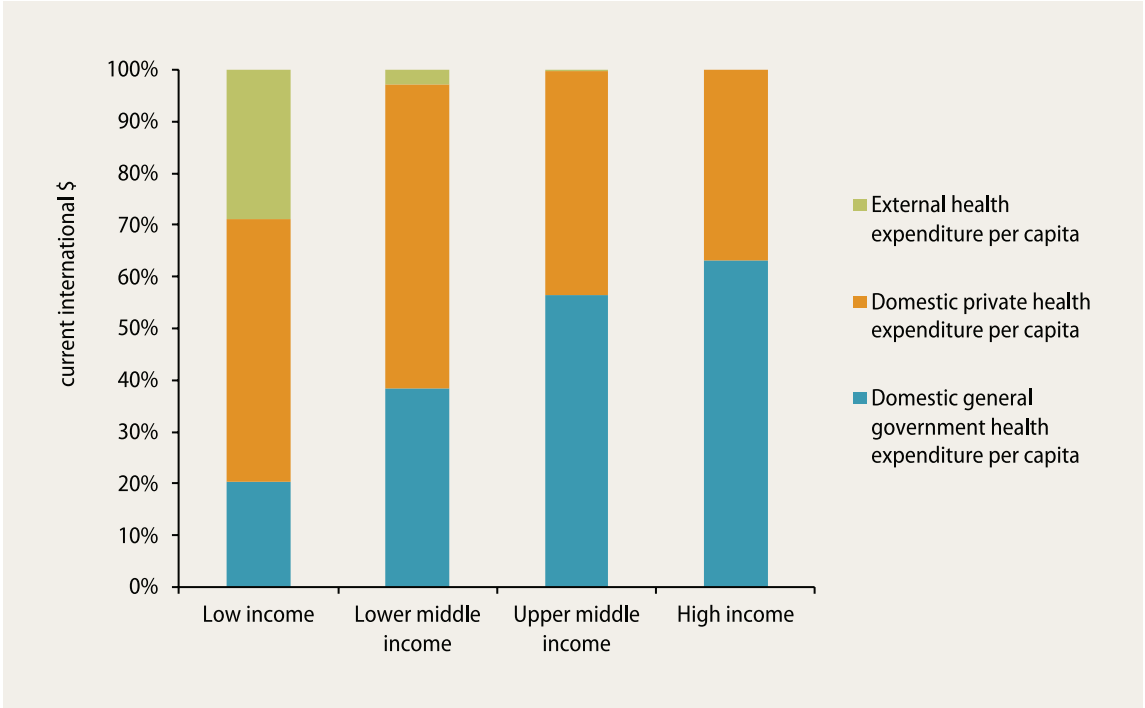
These various approaches reflect the contrasting solutions to the dilemma of growing demand for care with ultimate responsibility for caregiving assigned to different societal actors. The differences in interpretation of whether LTC issues should be relevant to the public sphere vs. the private sphere have implications in terms of development of long-term care systems (OECD 2011). Regardless of these differences, the form this system takes varies, depending on each country's context, available resources and societal choices about the distribution of the overall costs of care.

The cost of health and LTC services: supply and affordability

Availability of services is tied to the public and private spending on health care. Decisions about healthcare financing and the mix of public and private healthcare spending depend on factors such as GDP growth, social protection, and private insurance, health infrastructure and technologies, and demographics such as life expectancy, infant mortality, the age structure of the population, and the evolution of its health status. Affordability of healthcare, then, is dependent on these national level decisions, and household wealth which influence the level of out-of-pocket payments for different services. Given the high burden of NCDs for older populations, affordability of services plays an important role in the type of services the population 45 and older receives.

Health and other social sector expenditures generally form a very small proportion of public expenditures in lower income countries, with higher out of pocket payments for health care. Figure 8.13 shows the breakdown of health expenditure by source. In high income countries majority of healthcare is covered through domestic public expenditures, whereas for countries in lower income groups, private expenditures make up the larger proportion of expenditures, and the health system (particularly in low-income countries) is also dependent on external resources. This has implications for availability of health services and their affordability for those who are poorer and more vulnerable. As discussed earlier, in majority of the cases, this puts women at a disadvantage since they lack similar resources and opportunities as men.

FIGURE 8.13 Breakdown of Health Expenditure per capita in PPP, 2019



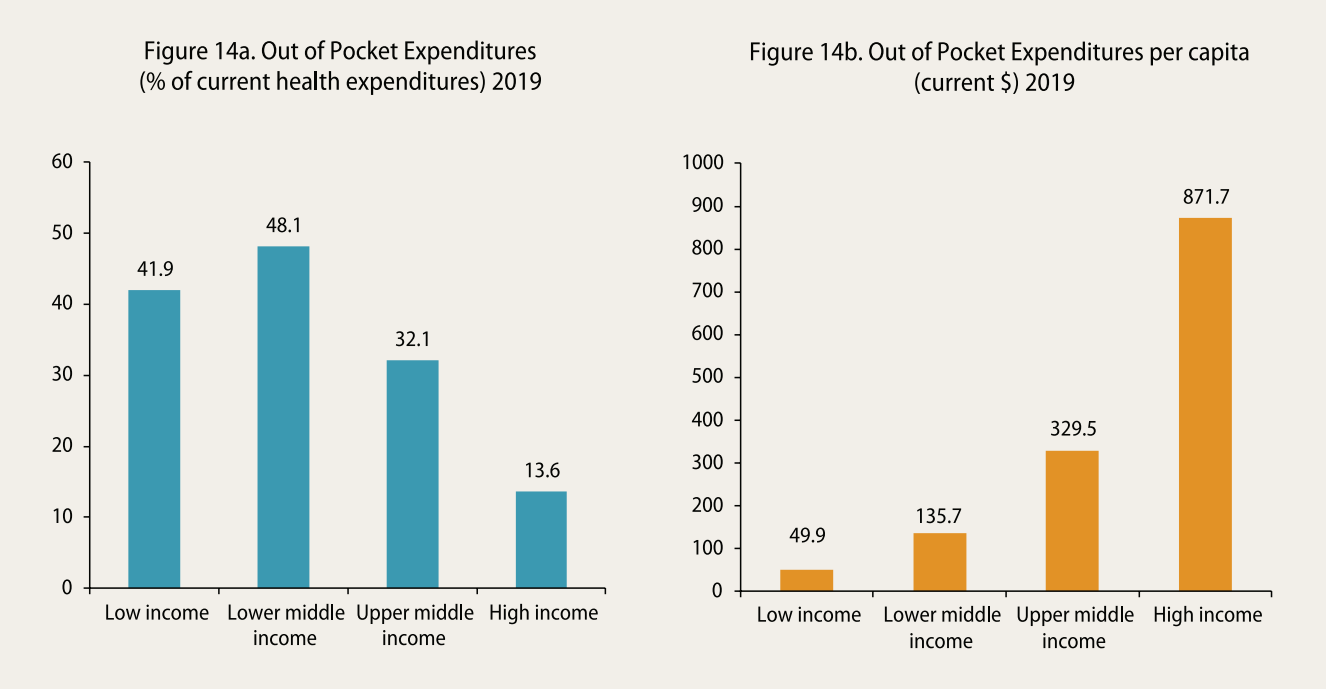
Source: World Bank, Health Nutrition and Population Statistics 2019 (Accessed December 15, 2022)

Figure 8.14 shows pre-COVID out of pocket healthcare expenditures as a percentage of total health expenditures and per capita. While the per capita expenditure in lower income countries is low (Figure 14b), the proportion of out of pocket is considerably high at 42 percent of the total health expenditure. On the other hand, in higher income countries, which also have a higher prevalence of NCDs and larger cohorts of older populations, the per capita cost of healthcare is relatively very high but because of greater public expenditure and availability of private health insurance, the out-of-pocket expenditures are considerably lower (13 percent).

Affordability of long-term care services also varies dramatically. Although data are limited to aging economies, mainly of the OECD, there is considerable variation between them. Public spending on long-term care ranges from more than 4% of GDP in the Netherlands to less than half a percent of GDP in countries such as Israel, Latvia, and Poland (OECD n.d.[7]) This variability is reflected in the supply and quality of care, as well as the variations in out-of-pocket payments for those seeking LTC care.[8]

The cost of LTC is generally high relative to the income of individuals. Formal LTC, especially, is often unaffordable in the absence of social protection. All OECD countries have some form of social protection for LTC, but even where coverage is comprehensive, people pay some of the cost out of pocket (OOP). In Germany and the United Kingdom, for example, OOP payments amount to approximately 25 and 30 percent of total LTC expenditures, respectively (Kraus 2016). Moreover, formal coverage for home care for moderate or severe needs is often insufficient and expensive. This contributes to large OOP payments. Levels of difficulty with daily tasks was found to be strongly associated with unmet needs. Compared with recipients of spousal care, men receiving care from one non-spousal caregiver, and men and women receiving care from any other configuration, had higher odds of unmet needs (Potter 2017). Unless there are familial or other arrangements for in-

FIGURE 8.14 Out of Pocket Expenditures, 2019



Source: World Bank, Health Nutrition and Population Statistics Database (Accessed December 15, 2022)

7 http://www.oecd.org/els/health-systems/long-term-care.htm

8 Comparing LTC expenditures is a difficult since National LTC systems differ widely in terms of eligibility criteria, level of benefits, institutional variety and regional heterogeneity (Geyer, 2020).

formal care, many people are unable to afford LTC in their own home, leaving them with unmet needs or at risk of early institutionalization (Muir 2017).

In lower income countries with less developed social protections systems and limited coverage for LTC, OOP tend to be even higher, with many families depending on more traditional, home-based family care. A 2016 global study found that almost two out of three older citizens live in a country where families rather than governments have the legal duty to provide LTC services for older family members who cannot cover their needs on their own. While in several Asian countries the nuclear family is held responsible, in many African countries a more widely defined family is obligated (Scheil-Adlung 2015). However, these requirements can overlook the capabilities of family caregivers and increase pressure on them in terms of physical and emotional stress, limiting social interactions, and increasing financial obligations, especially for women (Glinskaya et al. 2023). Chapter 14 on adequacy pensions and healthcare provides additional discussion on financial coverage for health and long-term care."

Improving the quality of services

the quality of health and long-term care services is crucial to the quality of life of people who rely on these services. Quality of healthcare is defined as, "*the extent to which health care services provided to individuals and patient populations improve desired health outcomes. In order to achieve this, health care must be safe, effective, timely, efficient, equitable and people-centred*" (WHO). The WHO also conceptualizes the quality of LTC as "*care that achieves gains in health, and is responsive to the legitimate expectations of LTC recipients*" (Brodsky et al. 2003). Quality of care, as perceived or experienced, can affect its use. Quality of care is affected by a multitude of factor from provider skill, knowledge, and behavior (Box 8.4) to supply chain interruptions, old and malfunctioning equipment to poor infrastructure. Thus, if the quality of public healthcare is perceived as poor, people will avoid it and prefer to use other sources such as private sector providers if they can. Whether for health services or LTC, it is important that systems are safe, effective, and meet the needs of their users so that these expectations are met.

BOX 8.4 Provider behaviors and access to care for older adults

Healthcare providers are a crucial part of service delivery and play an important role in influencing peoples' health seeking behaviors. Poor patient-provider communication can for example, affect the quality of care. A handful of studies also point to the lack of communication or limited discussion about subjects that may be considered intimate or taboo such as sexual health or incontinence among older, middle-aged women and their providers. While women's socio-economic characteristics play a role in women themselves approaching the topic with their healthcare providers, the limited evidence that exists also suggests that providers very seldom initiate the discussion (Bergeron et al. 2017; Chapman et al. 2019; Hughes and Lewinson 2015).

Provider behaviors and attitudes towards specific groups of older women may also put them at a disadvantage. Research identifies a consistent pattern of gender bias in diagnosis and clinical treatment for the same illnesses. One population-based study on trauma treatment found that when adults surviving trauma arrived at hospitals, women were more likely to be directed towards non-trauma care compared to men, indicating a potential gender bias, although the authors could not rule out other factors (Gomez et al. 2016). In Sweden, hospital level data on waiting times and triage priority for older adults (mean age 54 years, n = 135,417) indicated presence of gender bias in combination with age and socioeconomic status (Roberston 2014). Using data from primary care practices associated with two academic medical institutions Madonis, Skelding, and Robert (2017) note that women are less likely to receive an early diagnosis of CVD than their male counterparts. In addition, they are less likely to receive appropriate, timely interventions despite having worse outcomes than men after acute coronary syndromes and higher postintervention complications (Cook et al. 2009; Pagidipat and Peterson, 2016; Vaccarino et al. 2009). In a similar vein, Fitzpatrick et al. (2004) reported that physician attitude was a greater barrier to seeking healthcare rather than transport or cost among the elderly in their study of Medicare beneficiaries in the United States. Fabreau et al. (2015) also point towards a need for improving the quality of care for women, especially those with low incomes.

Recognizing these challenges and taking steps such as provider education to reduce bias, periodic skills training and refreshers, and ensuring that health information is available and clearly communicated to patients can counter this gap in quality of care.

Ensuring quality of care achieves these ideals necessitates standardized protocols, appropriate regulation, and accountability. For example, regulatory standards guiding accreditation of care homes and qualification requirements for care providers can improve quality of formal LTC services. Certainly, Regulatory oversight and quality assurance is more visible and rigorous in institutional care settings, while home or community-based care settings are subject to little or no regulation (OECD/European Union 2013). When available, a 2022 study found that the complex process of achieving care: the functional fragmentation and geographical dispersion of care institutions made the care-seeking process challenging and confusing for older adults to access (Gong et al. 2022). Similarly, trained physicians, nurses, and other hospital staff, that can provide comprehensive health services in a timely manner can improve the quality of care. A recent study on treating elderly in Japan for instance found that elderly patients with pneumonia admitted to a hospital had better quality of care compared to those not at the hospital. From a service provision perspective, the care was both cost effective and timelier (e.g., administration of drugs or change of IV tube) as compared to that for elderly not admitted to hospital (Hamada et al. 2019).

However, few countries systematically measure whether their LTC systems are safe, effective, and centered around the needs of service users. Indicators of LTC quality, including measures of clinical quality, user satisfaction or quality of life surveys are useful for assessing service provision. However, because of the costs and logistics involved, only a few countries measure quality of care; and where measures are available, they only capture narrow aspects of clinical quality rather than providing a complete profile of the quality of life experienced by LTC users. This leaves space for quality of care to decline, especially when issues such as negative provider attitudes (discussed earlier), or treatment of elderly in LTC homes or institutions are not captured in data or addressed in practice. This is especially of concern for countries where implementation of quality controls is already weak.

OECD countries, where aging is a reality today, have taken different pathways to improving the quality of care, and offer examples of how to bridge the quality gap. Quality oversight especially related to institutional care – and incentives to improve quality are the most common. To bridge the gap between clinical care quality and quality of life of the

BOX 8.5 Improving Quality of Care through Standards and Practice in the OECD

Compulsory accreditation of LTC facilities – Although all countries have legislation regarding adequate and safe care, only in two-thirds of OECD countries, accreditation or certification of care facilities is compulsory or common practice (e.g., England, Spain, Ireland, France, Australia, Germany, Portugal, the United States, Switzerland). Some countries (e.g., Poland) issue certificates for care establishments where minimum standards are often used as evaluation criteria for the authorization of provision. However, enforcement of standards has often lagged behind, given the difficulties and costs ·entailed for both the authorities and providers to supervise/comply with them (Chawla, Betcherman, and Banerji 2007).

Standards to normalize care practice - Standardized assessment tools can be helpful to develop care plans and interventions, promote consistency in care and prevent adverse events. Examples include: the Resident Assessment Instrument (RAI) used in Belgium, Canada, Finland, Iceland, Italy, the United States, and Spain; the Autonomie, Gérontologie, Groupes Iso-Ressources (AGGIR) scale in France*; and the Katz Index of Independence in Activities of Daily Living in Belgium and elsewhere. Public reporting on LTC quality is also mandatory in some countries, such as the United States, Japan, England, Germany, Portugal, the Netherlands, and Canada. Evidence about the effectiveness of such tool to encourage providers to improve their standards is however mixed (Yeh 2021).

Australia set up a new quality system, including a review of accreditation procedures for providers, improved monitoring and dealing with complaints. The Czech Republic and the Slovak Republic implemented oversight policies, authorization, and compliance of providers' quality, while Germany enhanced quality supervision and aims at enhancing quality management of providers, together with improved consumer voice. Ireland published in 2009 the National Quality Standards for Residential Care Settings for older people, while Austria produced a handbook on dementia and Luxembourg has installed a committee on quality of care (OECD 2011).

* The AGGIR grid is designed to assess an elderly person's degree of dependence or autonomy.

end user, a third of the countries employ market incentives for providers and users, allow users to make decisions on service provision, for example through cash benefits. The Netherlands implements a Care Innovation Platform, aimed at the development, structural dissemination, and implementation of innovations in (long-term) care provision. In some countries, caregivers are offered the possibility of further education, training and professional growth courses are provided within the nursing home care. New caregivers go through a training where they are assessed on specific caregiver assessment criteria including aptitude for teamwork, attitude to elders, empathy, commitment, and independence. Box 8.5 highlights some ways in which the OECD is addressing quality of care for the elderly.

WOMEN AS LONG-TERM CARE PROVIDERS

With population aging, especially in middle- and high- income countries, the need for long-term care (LTC) is growing. This is a labor-intensive sector comprised of a formal workforce as well as family care givers. Care arrangements across countries vary, with greater reliance on informal, family-based care in lower income countries, and a greater mix of formal and informal arrangements in higher income ones. In all cases, women form a large proportion of the care providers. In 2020, a study that focused on LTC workers found that essential long-term care workers commonly held second jobs and double- or triple-duty caregiving roles (Van Houtven, DePasquale, and Coe 2020).

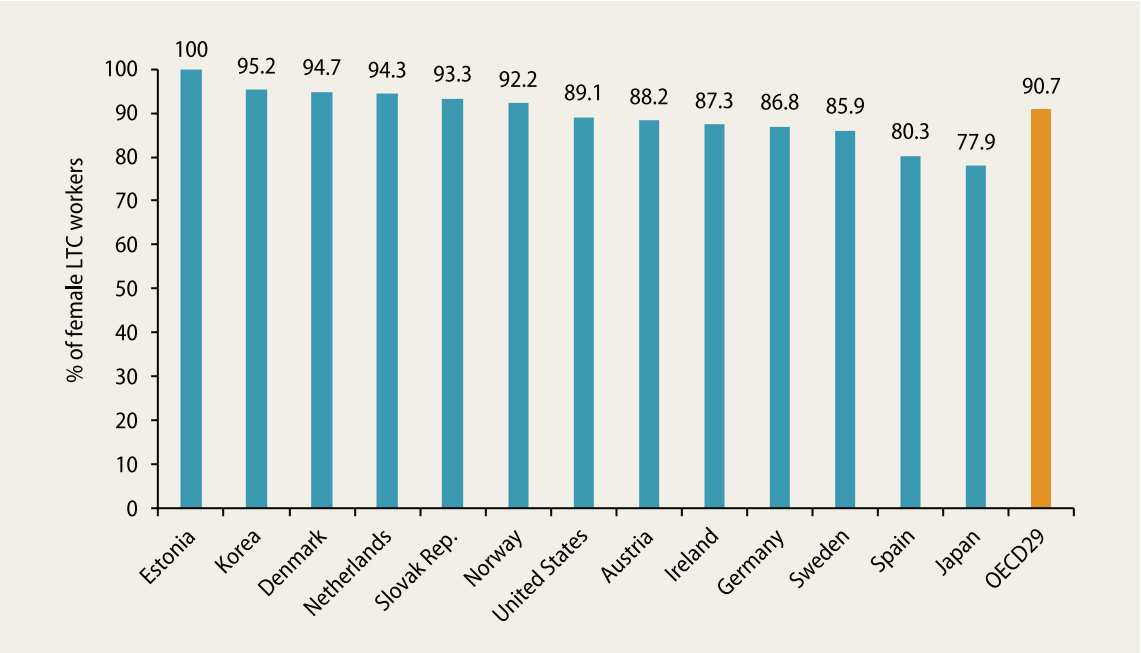
Information on female long-term caregivers however is limited in scope. While data exist on women's burden of caregiving for the elderly in several countries, in most cases these are higher income countries and formal caregiver. Less is available on the impact of caregiving on the lives of these women, or the types of support they need. The little evidence that exists however, points to increase in vulnerability of female caregivers, particularly informal caregivers. This section highlights some of the key issues that have been identified in the literature review on female caregivers in the context of LTC.

Whether through formal or informal arrangements, women are often the providers of long-term elderly care. According to one estimate about 67 percent of the healthcare workforce globally is comprised of women (WHO 2017b). About 60 percent of informal healthcare providers in OECD countries are women (OECD 2013), and a much higher proportion (90.7 percent) of LTC providers are women (Figure 8.14). An earlier study found that up to 80 percent of all health care and 90 percent of HIV/AIDS related illness care was provided at home, with little recognition of, or support for the care provider (Östlin 2009). Women's concentration in caregiving is related, at least in part, to the underlying gender-based division of labor and social norms that assign certain tasks, activities, and occupations as more suitable for one gender or the other. Occupations such as nursing and caregiving have thus been viewed as more suitable for women.

In many cases, women provide this care as they are aging themselves. Albertini et al. (2016) document that the largest amount of intergenerational time transfers are provided by middle-aged (45–65 years old) women to both the younger and older generations within the family in OECD countries. In China, an estimated 14 percent of people aged 45 years and over provide care for the elderly, with an additional 28 percent engaged in providing care for grandchildren. While women assume a crucial role in intrafamily care services, constituting the chief contributors of long-term care and childcare, their care contributions at home are not recognized as "social achievements" and are not monetarily compensated by the Chinese welfare state (Wang and Liu 2020). Women aged 55-59 years provide about 16 percent of elderly care, with another 45 percent providing childcare (World Bank 2016). In Colombia, Indonesia, and Poland, women aged 40 to 59, are 2 to 3 times more likely to provide care for older parents than men (Gatti et al. 2024). In the United States, the majority of care providers are also women, with a mean age of 46 years (Stone and Dawson 2008; Yamada 2002; Montgomery et al. 2005). Many are even older, with the proportion of home care workers over 65 years, roughly triple the mean age in other industries (Montgomery et al. 2005).

With population aging, the demand for LTC is expected to increase. According to estimates, by 2050, there will be roughly 1.5 billion persons aged 65 years or above (United Nations 2019). This is going to contribute to increase in the demand for formal and informal LTC arrangements. For example, in the United States about 71 percent of long-term care providers are direct care workers. It is estimat-

FIGURE 8.15 Share of female LTC workers in select OECD countries (% of total, latest available year)



Source: Adapted from OECD 2019.

ed that with population aging, the demand for their services will increase by 48 percent by 2030 if all else remains the same (U.S. Department of Health and Human Services 2017). In China, the demand for LTC services has already increased dramatically due to the aging population with an increase in population over 65 years from 96 million in 2003 to about 150 million in 2018. New studies examining disability patterns in 23 lower- and middle-income countries predict that the rate of severe activity limitations among older adults will remain relatively stable over the next three decades. Nevertheless, the total number of individuals facing activity limitations is expected to rise due to the significant growth in the older population (Glinskaya et al. 2024).

Given the trend for female employment in this field, it is likely that increased demand will draw more women into the care economy. Comprising nursing assistants, home health aides, personal care aides, and psychiatric aide, direct care workers play a crucial role in providing the majority of paid hands-on care, including supervision, medication administration and emotional support to the elderly and disabled. Notably, they are responsible for 8 out of every 10 hours of care provided (Dawson and Surpin 2001). An ILO study of 2020 confirmed that although in all countries women continue to be overrepresented in occupational categories associated with nursing and less-skilled health- and care-related functions (ILO/WHO 2022).

One of the key features of the care economy is its draw on migrant labor to provide care services. There are significant flows of care workers from low- and middle-income countries to high-income countries globally. For instance, 20 percent of care providers in the United States were migrants, mainly of Hispanic or Latino origin (Montgomery et al. 2005). Similarly, in Italy 83 percent of care providers were migrants (Polverini and Lamura 2004). Several countries are both, countries of origin and destination for the flow of migrant care workers. For instance, while Polish care workers have migrated for work across Europe (in particular, in Germany, Ireland, Italy, Sweden, and the United Kingdom), the country - at least the metropolitan area around Warsaw - has also experienced an influx of migrant care workers from Belarus and the Ukraine (Hoff 2011). These flows have also resulted in subtle changes in the gendered experience of migration: while in the past migration was typically associated with young male workers, increasing numbers of contemporary migrants are female working in eldercare (Leeson and Harper 2006).

While elderly care is a source of employment for women, it is generally associated with low waged work. In Japan, the United Kingdom, and the Unit-

ed States, caregivers typically earn between 50-70 percent of the average wage. Similarly, work-related benefits for LTC workers, such as pension or childcare benefits, tend to be limited (Hickey, Sawo, and Wolfe 2022). In addition, caregivers are frequently subject to long and irregular working hours, while their working situations are often precarious since part-time and short-term employment contracts are common (Witters 2011). Almost half (45 percent) of LTC workers in OECD countries work part-time, over twice the share in the economy as a whole (OECD 2020).

In Europe, where more information on LTC is available, evidence points to a high turnover of care providers. Difficult working conditions such as long shifts; having to manage complex health and physical care needs of elderly and providing end of life care to patients, which can take a mental and physical toll on the care giver, as well as being exposed to illness or aggressive behaviors from patients with mental health conditions such as dementia, combined with and low pay often generate high turnover among workers, and create difficulties in attracting highly motivated, highly qualified care staff. Overall, labor intensity in the LTC sector varies widely throughout Europe. Sweden and Germany have the highest ratio of formal workers against service users (1.1 and 1.0 respectively), compared with 0.19 and 0.15 in Estonia and the Czech Republic where formal LTC is still relatively under-developed. Moreover, qualification levels tend to be lower on average in relation to the healthcare sector overall, and the ratio of nurses to care workers is also low (Witters 2011). Poor job quality limits retention in LTC with a large body of evidence suggesting that shift work is associated with a wide range of health risks, such as anxiety, burnout, and depressive disorders (OECD 2020).

Stressful work conditions contribute to caregiver absenteeism. For example, in the US, it is estimated that this absenteeism is responsible for US$ 25.2 billion in lost productivity for the economy based on the average number of workdays missed per working caregiver, assuming US$200 million in lost productivity per day (Witters 2011).

The gap in care supply is often made up through the provision of informal supply by family and friends. The size of the informal family care workforce is at least double that of the formal care workforce in Denmark for example, and in some cases, it is estimated to be more than ten times the size of the formal-care workforce such as in Canada, New Zealand, United States, and The Netherlands (ENNHRI 2017). In fact, when formal services are unable to meet the demand for care because of high costs, or because of unavailability of services, it often falls on the shoulders of women in the household to provide care (e.g., Chawla, Betcherman, and Banerji 2007). Home-based support relies greatly on informal care provision (Sunwoo 2017), many older adults receive care from one or more family caregiver, and some caregivers may help more than one older adult. The circumstances of individual caregivers and the caregiver context are extremely variable with either family caregivers living with, nearby, or far away from the person receiving care. Nevertheless, the family caregiver's involvement is determined primarily by a personal relationship rather than by financial remuneration. The care they provide may be episodic, daily, occasional, or of short or long duration and can be provided in a variety of settings such as nursing homes, residential care facilities, and individual homes, and can include a variety of tasks.[9]

The balance between informal and formal care differs substantially from country to country and changes over time within countries as it is connected to particular political, economic, demographic, and cultural factors. In southern European countries, informal care remains the dominant source of home care. Without the work of these unpaid care givers, home care would be totally unsustainable, and many acute needs would remain unattended. The situation is different in northern European countries where informal care is less common because municipalities provide extensive personal care and domestic services (such as home help in Denmark, although private organizations may provide this with municipal funding), and informal care tends to focus on providing companionship and social support.

While the care economy has given a boost to women workers and female migration, several studies also find that care workers are also vulnerable to specific risks. In Europe for instance, care policies have exposed women migrants to three interconnected levels of inequalities through: (a) the

9 The scope of services ranges from in kind service provided to family members on a non-paid basis to bathing, eating, dressing, running errands, help with medication management, paying bills, transportation, meal preparation, and health maintenance tasks and managing financial affairs.

gendered and racialized everyday experiences of migrant women workers; (b) the polices of national welfare states to find ways of reducing the care costs associated with increased women's employment and an ageing society; and (c) in a transnational political economy of care in which big business and states drain poorer countries of their care resources by drawing on their labor force (Williams 2011).

Care work is labor intensive and has consequences for the care provider. One estimate puts the mean hours of informal care at 46 hours per week and the mean length of time spent on care related tasks is 60 months. Most often this care is provided by adult daughters or daughters in law, who may have to forego their own employment to provide the care (Albertini 2016; Karpinska et al. 2016; World Bank 2015). In 2018, the ILO estimated that at this pace, it will take 210 years to close the gender gap in unpaid care work (ILO 2018). Women may also make alternate work arrangements such as part-time or less demanding jobs. Evidence from the US suggests that compared to their male counterparts, women caregivers are more likely to make alternate work arrangements: taking a less demanding job (16% women vs. 6% men), giving up work entirely (12% women vs. 3% men), and losing job-related benefits (7% women vs. 3% men).[10]

In fact, informal care can be a major constraint to female labor force participation. A large body of evidence from different countries indicates that intensive (i.e., 20+ hours per week) informal care work has a negative impact on the likelihood of staying in the workforce (OECD 2011; Schmitz and Westphal 2017). A study conducted in Poland, Colombia, Egypt, and Indonesia reveals that there is a notable decrease in the likelihood of employment among both men and women who provide parental care, with the impact being more pronounced for women, in particular (Gatti et al. 2024). Women may face higher barriers to labor market entry or re-entry because of ageism or may be more likely stay out of the labor force to cater to the needs of children (or grandchildren) and elderly relatives - the so-called "sandwich generation". Indeed, this peak of inelastic care responsibilities usually coincides with women's most productive middle-age years. This has consequences for their present and future income as well as affecting their potential for qualifying for pensions and the size of these pensions when they are eligible to receive them. In turn, this has implication for their economic wellbeing. Stepping out of the labor market can reduce their lifetime income significantly and the amount of pension they qualify for. Moreover, those engaged in elderly care lack predictability in timing, duration, and intensity that comes with care, making it more difficult to negotiate a care and paid employment, particularly full-time employment (Keck and Saraceno 2009).

For those women who remain in employment while engaged in informal care, productivity (and thus, earnings) can be substantially reduced through different channels, such as change in choice of employment to accommodate care demands, including informal jobs that are less stable and offer lower wages and impacts on physical and mental health. Even timing of retirement is moderated by gender. For example, wives caring for their husbands have retirement odds 5 times greater than women who are not caregivers, whereas husbands caring for their wives are substantially slower to retire (Dentinger and Clarkberg 2002). Changes in the labor force participation of women do not appear to alter their caregiving responsibilities. In fact, time-demanding support obligations are more likely to fall on the shoulders of women, requiring them to multitask regardless of whether or not they were employed (Moen, Robison, and Fields 1994).

Female caregivers also suffer health challenges and other hardships due to caregiving. In low- and middle-income countries, despite having received inadequate attention health risks among informal caregivers were found to result in greater health burdens, particularly mental health, for women that were more prominent and manifested in more diverse ways for women relative to men (Bhan, Rao, and Raj 2020). For example, the prevalence of mental health issues is 20 percent higher in caregivers than in non-caregivers. Caregivers, especially those caring for men, were often distressed, and remained so over time (Li et al. 2022). This is partly because older men have more health, functional and behavioral problems that require more care, and partly because their caregivers are more likely to be their spouse and living together. Similarly, caregivers experience more hypertension, stress related chronic illness, and physical injuries since very often they

10 National Alliance for Caregiving and AARP. (2009). Caregiving in the U.S.: https://www.aarp.org/pri/topics/ltss/family-caregiving/caregiving_09.html [Accessed: December 8, 2022]

are untrained themselves and may lack sufficient support networks. Family members who spend long hours caring for older relatives with advanced dementia, for example, are especially at risk. Caregivers may lose income, Social Security and other retirement benefits, and career opportunities if they have to cut back on work hours or leave the workforce. This is especially true for caregivers with lower education. They may also incur substantial out-of-pocket expenses that may undermine their own future financial security. Certainly, earlier evidence from the US showed that single women caring for their elderly parents are 2.5 times more likely than non-caregivers to live in poverty in their own old age (Wakabayashi and Donato 2006).

However, overall data on these issues appears to be limited. While studies found that female caregivers (working or not) may suffer a particularly high level of economic hardship due to caregiving, none will address how these choices were made or whether they benefited from a support system (whether emotional, financial or network support). Women caregivers above 49 years fall in the intersectionality trap of menopause and caregiving. These women have specific reproductive health needs of their own. Although there are studies that focus on women as caregivers, there was limited information on menopause related health needs and support for caregivers for example. A 2019 study surveyed residents that recognized important knowledge gaps with regards to menopause, provision of comprehensive and compassionate care and definite room for improvement (Berga and Garovic 2019). Usually, when and if studied, mature women are done so often in the context of informal care or in the realm of dementia and their ability to deal with the stress of LTC of mentally ill patients. The choices these caregivers face at pivotal moments of their lives and the type of support available to them or lack thereof are not documented.

Women need cross-cutting support when they step into the care giving role – support to not only provide care to the elderly (e.g., training and awareness about resources), but also to take care of themselves (e.g., social protection). Thus, as also highlighted in literature, there is a necessity for policy makers and program planners to work together to provide accessible, affordable, and innovative support services and programs to support caregivers, especially women.

DISCUSSION

Men and women tend to experience aging differently, not just because of their biological differences, but also the socio-economic environment. This affects their health needs, demand, and access to health services. While there is a considerable body of literature that examines gender differences in health outcomes, few examine the structural and socio-economic factors behind these gender differences, particularly among aging populations. For instance, considerable attention is paid to certain reproductive health issues such as female and male cancers and menopause, but mainly in terms of clinical research. There is less focus on the socio-economic aspects or the quality of care for women as they exit their reproductive years. There is scope for further work in terms of access to healthcare services and barriers to health seeking behaviors among older women and men.

While each country has its own story to tell, gender differences exist in the prevalence of major non-communicable diseases such as CVD and diabetes, as well as in the burden of deaths. While the mortality from CVD is higher among men overall, for older age groups, the gap narrows among women and men, and the burden of deaths increases for women in the oldest age group (80 years and above). A similar pattern can be observed for diabetes. On the other hand, as women live longer, they also live longer with multimorbidity. It is important to recognize these differences and the implications of prolonged prevalence of diseases among women in terms of policy and practice. Interventions that bring services closer to women and make them more affordable for them, for example are necessary to ensure that older adults receive appropriate and timely care. At the same time, such approaches can also support healthy decisions and health seeking behaviors across the life course delaying onset of NCDs as discussed in other studies in the healthy longevity series.

Women's burden of depression is considerably higher than of men across the globe. On the other hand, a higher number of men die of self-harm (e.g., suicide). Some studies suggest that women's social lives, which are more integrated within their communities compared to men's, act as a buffer against self-harm and suicide among the older populations. On the other hand, studies also suggest that aging women face greater risks in terms of neglect or

abuse due to their dependence on others and epidemiological studies suggest similar if not higher rates of attempted suicides as men. Addressing these issues necessitates not only availability of affordable and accessible mental health services (e.g., through different channels including online therapy) but also social and behavior change interventions that promote healthy behaviors and normalize the use of these services. This is particularly important for men, who often will avoid seeking help due, in part, to norms around masculinity and strength.

Women's vulnerabilities tend to exacerbate over time, especially in lower income settings and where social and gender norms create barriers to women's financial and social empowerment. Many women tend to rely on their families for support including their residence, mobility, and accessing health services or other formal or informal care. Although aging men also experience a growing dependence on others, they are less financially vulnerable compared to women. In higher incomes countries, these differences are less magnified, especially in the presence of some form of health insurance or social protection that both women and men have access to. However, affordability issues remain forefront, with mixed evidence on gender-based differences. This is likely due to the particular contexts of the countries being studied in terms of social norms, women's employment, and their access to social protection and health insurance.

A similar case can be made for access and affordability of health and long-term care (LTC) for the elderly. While informal, family-based care may still be the norm in many low-income countries, medical costs remain a barrier to appropriate care for the aging, particularly women (for all the reasons discussed earlier). In middle- and higher- income countries with more options for formal LTC, affordability is still a critical issue. Since women have lower labor force participation and employment rates or may drop out of the labor force early to provide care for family members (children, elderly), they are less likely to have adequate savings or social protection coverage compared to men. This puts them at a disadvantage.

When people do not have access to, or cannot afford, formal care, and when their families cannot or will not support them, LTC needs remain unmet. This leaves the elderly without the support they need for daily tasks such as washing and getting dressed. This can have a catastrophic effect their quality of life and contribute to early death. However, it is hard to discern the true extent of the problem, as highlighted by the OECD, since people who do not benefit from LTC are often outside formal systems, and may not have a voice because of their vulnerable position (OECD 2011).

Moreover, there are gendered considerations related to the supply of LTC, primarily due to the large proportion of women who provide care services. Female caregivers are more likely than males to make alternate work arrangements, for instance; or taking up fewer demanding jobs, or even giving up work entirely and losing job-related benefits.[11] Very little attention has been paid to the impact care giving has on their own health or their resources as they age, while caring for others. Although several studies have found that female caregivers (working or not) may risk economic hardship due to caregiving (e.g., Albertini 2016), more work is needed to understand how these decisions are made, their impact on women's overall health, and what type of support systems (whether emotional, financial or networks) if any, women benefit from.

This is also important for future policy making in an era of global aging. As it stands, women represent an invaluable underutilized reservoir of labor and productivity for countries. Ensuring their continued engagement in the labor markets, access to finance, and participation in social safety nets can improve their future access to health and long-term care. At the same time, women are an important human resource for LTC, both formal and informal. Policies and programs that support their roles as care givers and provide them with platforms for standardized training or other support, are important for improving the quality of care as well as enhancing the quality of life of care providers. While it is true that country contexts matter, and interventions may differ based on the specific policy environment, this is an important aspect to consider within these frameworks. Especially with the changes in family values and the international migration movements that leave aged parents behind and alone, making family care more difficult and increasing the demand for care offered by the government.

At the same time, quality of care matters. While standardized protocols and regulations are at the crux of quality control, their implementa-

11 Ibid.

tion varies. Unconscious bias may enter into standards and protocols of care for example because of a poor understanding of the age and sex differences in illness progression and treatment needs such as appropriate dosage. Similarly, implicit gender biases may exist in the treatment of patients, which in turn, can contribute to delays in women receiving appropriate care at the appropriate time. Elderly patients are also more likely to experience abuse at the hands of care givers, yet it can go unnoticed and unaddressed. While there has been some progress, better representation of women in clinical trials and in medical texts is still needed. On the latter, focus on provider training to improve their understanding of signs of abuse and reduce their own biases in service provision can go a long way in improving the quality of care for older adults.

All these issues indicate the need for examining gender differences further and making concerted efforts to address any gaps at the policy and programmatic levels in ensuring access to care, and provision of services. The findings are relevant for the World Bank and other organizations for strengthening country level work on human development. First, health is an important consideration in building human capital. As the findings indicate, there are gender differences in prevalence and mortality from NCDs especially in older age groups, as well as in access to and use of health care. It is crucial to recognize and address gender-based challenges, including for LGBTQ, when considering health policies and programs. This requires a systematic approach to examine, define, and include the needs of health care provision for the aging populations, focusing not only on currently aging societies but also younger countries such as in Africa where there is a dual burden of communicable and non-communicable diseases. This is especially relevant for the World Bank as it works with countries to implement Universal Health Coverage (UHC). The existence of UHC alone may not be a guarantee that people receive the services they need as the above discussion highlights. UHC too needs to be implemented as part of larger reforms within the health sector that aims to close gender gaps and reduce biases in service delivery as well as multi-sector interventions that reduce social and other access barriers to healthcare.

Second, the findings underscore the importance of addressing gender gaps in social protection and labor markets especially when considering 'retirement income' or pensions i.e., social security. Women's limited access to and use of health services is often to them being 'locked out' of formal systems, have disrupted employment, and lack financial resources, especially when they are old. The feminization of aging and poverty (i.e., there is a greater concentration of women in older age groups due to their longer life spans and limited financial capacity) exacerbates their vulnerability. Continued work on expanding labor market opportunities for women and strengthening social protection systems will be one key area for reducing the gender gaps in the healthcare sector and expanding women's access to health services. Earlier analytical work on aging by the World Bank (Brodmann, Coll-Black, and Von Lenthe 2023; Chawla, Betcherman, and Banerji 2007; Miglena, Arribas-Banos and DeMarco 2023; World Bank 2016) and in this HLI series (DeMarco et al. 2024; deSilva and Santos 2024) point to opportunities that can address these challenges such as reducing gender gaps in retirement age, exploring alternative pension schemes such as non-contributary pensions, promoting pay equity, and expanding women's opportunities in formal job markets. This also requires a paradigm shift on aging and older populations that recognizes them as active participants in the community and fosters their abilities for continued contribution to society.

Finally, good data is an important precursor to policy and programmatic intervention. The HLI has developed pilot dashboards that present key indicators relevant to measuring healthy longevity within the context of a country's priorities along the life course (Haldane et al. 2024; Wu et al. 2024). These indicators should be, to the extent possible, sex-disaggregated, and where necessary gender specific indicators should be added. However, the strength of these dashboards is only as good as the available data. Often data is incomplete and only disaggregated for a handful of indicators, especially in lower income countries with weak systems. Therefore, it remains important that HMIS and CRVS systems are strengthened and ensure wider coverage and collection of sex-disaggregated data.

REFERENCES

1. [Editorial]. 2021. "It's Time to Expand the Definition of 'Women's Health.'" *Nature* 596 (7870): 7–7. https://doi.org/10.1038/d41586-021-02085-6.
2. Abels, Miglena, Loli Arribas-Banos, and Gustavo DeMarco. 2023. "The Gender Pension Gap: What Does It Tell Us and What Should Be Done About It?" *Jobs and Development - World Bank Blogs [Blog]*. June 27, 2023. https://blogs.worldbank.org/jobs/gender-pension-gap-what-does-it-tell-us-and-what-should-be-done-about-it.
3. Adena, Maja, and Michal Myck. 2014. "Poverty and Transitions in Health in Later Life." *Social Science & Medicine* 116 (September): 202–10. https://doi.org/10.1016/j.socscimed.2014.06.045.
4. Afroz, Afsana, Khurshid Alam, Liaquat Ali, Afsana Karim, Mohammed J. Alramadan, Samira Humaira Habib, Dianna J. Magliano, and Baki Billah. 2019. "Type 2 Diabetes Mellitus in Bangladesh: A Prevalence Based Cost-of-Illness Study." *BMC Health Services Research* 19 (1). https://doi.org/10.1186/s12913-019-4440-3.
5. Albertini, Marco. 2016. "Ageing and Family Solidarity in Europe: Patterns and Driving Factors of Intergenerational Support." Social Science Research Network. Rochester, NY. May 17, 2016. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2781299.
6. Anagnostis, Panagiotis, and John C. Stevenson. 2023. "Cardiovascular Health and the Menopause, Metabolic Health." *Best Practice & Research Clinical Endocrinology & Metabolism*, April, 101781. https://doi.org/10.1016/j.beem.2023.101781.
7. Applebaum, Robert., Anthony and Emily Robbins, E. 2013. "International approaches to long-term services and supports." *Generations* 37(1): 59–65. https://www.jstor.org/stable/26555977.
8. Argyrakopoulou, Georgia, Maria Dalamaga, Nikolaos Spyrou, and Alexander Kokkinos. 2021. "Gender Differences in Obesity-Related Cancers." *Current Obesity Reports* 10 (February). https://doi.org/10.1007/s13679-021-00426-0.
9. Azad, Amee D., Anthony G. Charles, Qian Ding, Amber W. Trickey, and Sherry M. Wren. 2020. "The Gender Gap and Healthcare: Associations between Gender Roles and Factors Affecting Healthcare Access in Central Malawi, June–August 2017." *Archives of Public Health* 78 (1). https://doi.org/10.1186/s13690-020-00497-w.
10. Barta, Julie A., Charles A. Powell, and Juan P. Wisnivesky. 2019. "Global Epidemiology of Lung Cancer." *Annals of Global Health* 85 (1). https://doi.org/10.5334/aogh.2419.
11. Berga, Sarah L., and Vesna D. Garovic. 2019. "Barriers to the Care of Menopausal Women." *Mayo Clinic Proceedings* 94 (2): 191–93. https://doi.org/10.1016/j.mayocp.2018.12.016.
12. Bergeron, Caroline D., Heather Honoré Goltz, Leigh E. Szucs, Jovanni V. Reyes, Kelly L. Wilson, Marcia G. Ory, and Matthew Lee Smith. 2017. "Exploring Sexual Behaviors and Health Communication among Older Women." *Health Care for Women International* 38 (12): 1356–72. https://doi.org/10.1080/07399332.2017.1329308.
13. Bertakis, K. D., R. Azari, L. J. Helms, E. J. Callahan, and J. A. Robbins. 2000. "Gender Differences in the Utilization of Health Care Services." *The Journal of Family Practice* 49 (2): 147–52. https://pubmed.ncbi.nlm.nih.gov/10718692/.
14. Beutel, Manfred E., Elmar Brähler, Joerg Wiltink, Jasmin Ghaemi Kerahrodi, Juliane Burghardt, Matthias Michal, Andreas Schulz, et al. 2018. "New Onset of Depression in Aging Women and Men: Contributions of Social, Psychological, Behavioral, and Somatic Predictors in the Community." *Psychological Medicine* 49 (07): 1148–55. https://doi.org/10.1017/s0033291718001848.
15. Bhan, Nandita, Namratha Rao, and Anita Raj. 2020. "Gender Differences in the Associations between Informal Caregiving and Wellbeing in Low- and Middle-Income Countries." *Journal of Women's Health* 29 (10). https://doi.org/10.1089/jwh.2019.7769.
16. Black, Eleanor, Fran Hyslop, and Robyn Richmond. 2019. "Barriers and Facilitators to Uptake of Cervical Cancer Screening among Women in Uganda: A Systematic Review." *BMC Women's Health* 19 (1). https://doi.org/10.1186/s12905-019-0809-z.
17. Bone, Jessica K, Gemma Lewis, and Glyn Lewis. 2020. "The Role of Gender Inequalities in Adolescent Depression." *The Lancet Psychiatry* 7 (6): 471–72. https://doi.org/10.1016/s2215-0366(20)30081-x.
18. Brodmann, Stefanie, Sarah Coll-Black, and Cornelius Von Lenthe. 2023. "Breaking the Cycle of Poverty: Empowering Women through Enhanced Social Protection in the Western Balkans." *Investing in People - World Bank Blogs [blog]*. September 14, 2023. https://blogs.worldbank.org/investinpeople/breaking-cycle-poverty-empowering-women-through-enhanced-social-protection-western.
19. Brodsky, Jenny, Jack Habib, Miriam J. Hirschfeld, and WHO Initiative on Home-Based Long-Term Care. 2003. *Key Policy Issues in Long-Term Care*. Geneva, Switzerland: World Health Organization. https://iris.who.int/handle/10665/42604.
20. Brookfield, Kathleen F., Michael C. Cheung, Christopher Gomez, Relin Yang, Alan M. Nieder, David J. Lee, and Leonidas G. Koniaris. 2009. "Survival Disparities among African American Women with Invasive Bladder Cancer in Florida." *Cancer* 115 (18): 4196–4209. https://doi.org/10.1002/cncr.24497.
21. Bussolo, Maurizio, Johannes Koettl, and Emily Sinnott. 2015. *Golden Aging*. *Openknowledge.worldbank.org*. Washington, DC: World Bank. https://openknowledge.worldbank.org/entities/publication/f77bc092-6cfa-5ace-9526-2c02f3b0221b.
22. Cameron, Kenzie A., Jing Song, Larry M. Manheim, and Dorothy D. Dunlop. 2010. "Gender Disparities in Health and Healthcare Use among Older Adults." *Journal of Women's Health* 19 (9): 1643–50. https://doi.org/10.1089/jwh.2009.1701.
23. Carlo, Crestani, Masotti Vittoria, Corradi Natalia, Laura Schirripa Maria, and Cecchi Rossana. 2019. "Suicide in the Elderly: A 37-Years Retrospective Study." *Acta Bio Medica: Atenei Parmensis* 90 (1): 68–76. https://doi.org/10.23750/abm.v90i1.6312.
24. Carmel, Sara. 2019. "Health and Well-Being in Late Life: Gender Differences Worldwide." *Frontiers in Medicine* 6 (218). https://doi.org/10.3389/fmed.2019.00218.
25. Cené, Crystal W., Peggye Dilworth-Anderson, Iris Leng, Lorena Garcia, Viola Benavente, Milagros Rosal, Leslie Vaughan, et al. 2016. "Correlates of Successful Aging in Racial and Ethnic Minority Women Age 80 Years and Older: Findings from the Women's Health Initiative." *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 71 (Suppl 1): S87–99. https://doi.org/10.1093/gerona/glv099.
26. Chapman, Christina Hunter, Gerard Heath, Pamela Fairchild, Mitchell B. Berger, Daniela Wittmann, Shitanshu Uppal, Anagha

Tolpadi, Katherine Maturen, and Shruti Jolly. 2018. "Gynecologic Radiation Oncology Patients Report Unmet Needs Regarding Sexual Health Communication with Providers." *Journal of Cancer Research and Clinical Oncology* 145 (2): 495–502. https://doi.org/10.1007/s00432-018-2813-3.
27. Chawla, Mukesh, Gordon Betcherman, and Arup Banerji. 2007. *From Red to Gray: The "Third Transition" of Aging Populations in Eastern Europe and the Former Soviet Union*. World Bank. https://doi.org/10.1596/978-0-8213-7129-9.
28. Cheung, Ethan Siu Leung, and Ada C. Mui. 2021. "Gender Variation and Late-Life Depression: Findings from a National Survey in the USA." *Ageing International* 48 (November): 263–80. https://doi.org/10.1007/s12126-021-09471-5.
29. Clemens, Kristin K., Mark Woodward, Bruce Neal, and Bernard Zinman. 2020. "Sex Disparities in Cardiovascular Outcome Trials of Populations with Diabetes: A Systematic Review and Meta-Analysis." *Diabetes Care* 43 (5): 1157–63. https://doi.org/10.2337/dc19-2257.
30. Cook, Nakela L, John Z Ayanian, E. John Orav, and LeRoi S Hicks. 2009. "Differences in Specialist Consultations for Cardiovascular Disease by Race, Ethnicity, Gender, Insurance Status, and Site of Primary Care." *Circulation* 119 (18): 2463–70. https://doi.org/10.1161/circulationaha.108.825133.
31. Colombo, F., et al., F. 2011. Help Wanted? Providing and Paying for Long-Term Care. Paris, France: OECD Health Policy Studies, Organisation for Economic Co-operation and Development. https://doi.org/10.1787/9789264097759-en.
32. Cortez, Rafael, Seemeen Saadat, Sadia Chowdhury, and Intissar Sarker. 2014. "Maternal and Child Survival: Findings from Five Countries' Experience in Addressing Maternal and Child Health Challenges." Health, Nutrition, and Population (HNP) Discussion Paper. Washington, D.C.: World Bank. http://hdl.handle.net/10986/20757.
33. Cotlear, Daniel. 2011. *Population Aging: Is Latin America Ready?* Directions in Development: Human Development. The World Bank. https://doi.org/10.1596/978-0-8213-8487-9.
34. Cui, Yiran, Sumaira Mubarik, Ruijia Li, Nawsherwan, and Chuanhua Yu. 2021. "Trend Dynamics of Thyroid Cancer Incidence among China and the U.S. Adult Population from 1990 to 2017: A Joinpoint and Age-Period-Cohort Analysis." *BMC Public Health* 21 (1). https://doi.org/10.1186/s12889-021-10635-w.
35. Dawson, Steven, and Rick Surpin. 2001. "Direct-care healthcare workers: You get what you pay for." *Generations* 25(1): 23-28. https://www.jstor.org/stable/26555063.
36. de Silva, Sara Johansson, and Indhira Santos. 2024. "Productive longevity: what can work in low- and middle- income countries?" in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative.* Washington D.C.: World Bank.
37. Demarco, Gustavo, Johannes Koettl, Miglena Abels, and Andrea Petrelli. 2024. "Adequacy pensions and access to healthcare: maintaining human capital during old age," in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative.* Washington D.C.: World Bank.
38. Deng, Yuanyuan, Katja Hanewald, Yafei Si, and Melantha Wang. 2022. "Gender Effect in Long-Term Care: Evidence from China." Sydney: ARC Centre of Excellence in Population Ageing Research (CEPAR), UNSW Sydney. https://www.netspar.nl/assets/uploads/39_Deng.pdf.
39. Dentinger, Emma, and Marin Clarkberg. 2002. "Informal Caregiving and Retirement Timing among Men and Women." *Journal of Family Issues* 23 (7): 857–79. https://doi.org/10.1177/019251302236598.
40. Dhar, H. L. 2001. "Gender, Aging, Health and Society." *The Journal of the Association of Physicians of India* 49 (October): 1012–20. https://pubmed.ncbi.nlm.nih.gov/11848308/.
41. Dorak, M. Tevfik, and Ebru Karpuzoglu. 2012. "Gender Differences in Cancer Susceptibility: An Inadequately Addressed Issue." *Frontiers in Genetics* 3. https://doi.org/10.3389/fgene.2012.00268.
42. Dubal, Dena B. 2020. "Chapter 16 - Sex Difference in Alzheimer's Disease: An Updated, Balanced and Emerging Perspective on Differing Vulnerabilities." Edited by Rupert Lanzenberger, Georg S. Kranz, and Ivanka Savic. ScienceDirect. Elsevier. January 1, 2020. https://www.sciencedirect.com/science/article/abs/pii/B9780444641236000187.
43. European Network of National Human Rights Institutions (ENNHRI). 2017. "Overview: long-term care in Europe." January 30, 2017. Available at: https://ennhri.org/news-and-blog/overview-long-term-care-in-europe/. [Accessed: December 12, 2022].
44. Eke, C. B., I. B. Omotowo, O. M. Ukoha, and B. C. Ibe. 2015. "Human Rabies: Still a Neglected Preventable Disease in Nigeria." *Nigerian Journal of Clinical Practice* 18 (2): 268–72. https://doi.org/10.4314/njcp.v18i2.
45. El Halabi, Sarah, Rawad El Hayek, Karine Kahil, Marwa Nofal, and Samer El Hayek. 2020. "Characteristics of Attempted Suicide in the Middle East and North Africa Region: The Mediating Role of Arab Culture and Religion." *Mediterranean Journal of Emergency Medicine & Acute Care* 1 (3). https://doi.org/10.52544/2642-7184(1)3002.
46. Etienne, Carissa F. 2018. "Addressing Masculinity and Men's Health to Advance Universal Health and Gender Equality." *Revista Panamericana de Salud Pública* 42 (December): 1–2. https://doi.org/10.26633/rpsp.2018.196.
47. Fabreau, G. E., A. A. Leung, D. A. Southern, M. L. Knudtson, J. M. McWilliams, J. Z. Ayanian, and W. A. Ghali. 2014. "Sex, Socioeconomic Status, Access to Cardiac Catheterization, and Outcomes for Acute Coronary Syndromes in the Context of Universal Healthcare Coverage." *Circulation: Cardiovascular Quality and Outcomes* 7 (4): 540–49. https://doi.org/10.1161/circoutcomes.114.001021.
48. Frank, Richard G. 2012. "Long-Term Care Financing in the United States: Sources and Institutions." *Applied Economic Perspectives and Policy* 34 (2): 333–45. https://www.jstor.org/stable/23273828.
49. Gálvez Galán, Isabel, Macarena Celina Cáceres León, Jorge Guerrero-Martín, Casimiro Fermín López Jurado, and Noelia Durán-Gómez. 2021. "Health-Related Quality of Life in Diabetes Mellitus Patients in Primary Health Care." *Enfermería Clínica (English Edition)* 31 (5): 313–22. https://doi.org/10.1016/j.enfcle.2021.03.003.
50. Gatti Roberta, Daniel Halim, Allen Hardiman and Shuqiao Sun. 2024. "Gendered Responsibilities, Elderly Care, and Labor Supply: Evidence from Four Countries," in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative.* Washington D.C.: World Bank.
51. Getachew, Sefonias, Eyerusalem Getachew, Muluken Gizaw, Wondimu Ayele, Adamu Addissie, and Eva J. Kantelhardt. 2019. "Cervical Cancer Screening Knowledge and Barriers among Women in Addis Ababa, Ethiopia." Edited by Violet Naanyu. *PLOS ONE* 14 (5): e0216522. https://doi.org/10.1371/journal.pone.0216522.
52. Geyer, Johannes. 2019. "Notes about Comparing Long-Term Care Expenditures across Countries Comment on 'Financing

Long-Term Care: Lessons from Japan.'" *International Journal of Health Policy and Management* 9 (2): 80–82. https://doi.org/10.15171/ijhpm.2019.87.
53. Gong, Ni, Ya Meng, Qin Hu, Qianqian Du, Xiaoyu Wu, Wenjie Zou, Mengyao Zhu, et al. 2022. "Obstacles to Access to Community Care in Urban Senior-Only Households: A Qualitative Study." *BMC Geriatrics* 22 (1). https://doi.org/10.1186/s12877-022-02816-y.
54. Griffin, Barbara, Vanessa Loh, and Beryl Hesketh. 2012. "Age, Gender, and the Retirement Process." In *The Oxford Handbook of Retirement*, edited by Mo Wang, 202–14. New York: Oxford University Press.
55. Glinskaya, Elena, Xiaohui Hou, Zhanlian Feng, Marco Angrisani, Guadalupe Suarez, Jigyasa Sharma, Drystan Phillips, et al. 2024. "Demand for and Supply of Long-Term Care for Older persons in Low- and Middle-Income Countries," in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington D.C.: World Bank.
56. Guerra, Ricardo O., Beatriz Eugenia Alvarado, and Maria Victoria Zunzunegui. 2008. "Life Course, Gender and Ethnic Inequalities in Functional Disability in a Brazilian Urban Elderly Population." *Aging Clinical and Experimental Research* 20 (1): 53–61. https://doi.org/10.1007/bf03324748.
57. Haldane, Victoria, Gisela M. Garcia, Tahir Bockarie, Daphne Wu, Cristian A Herrera, Maria Luisa Latorre Castro, Debapriya Chakraborty, Beverly Essue, Prabhat Jha, and Jeremy Veillard. 2024. "Healthy Longevity Initiative: A Performance Dashboard for Decision-making in Low- and Middle-income Countries," in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington D.C.: World Bank.
58. Hamada, O., Tsutsumi, T., Miki, A., Fukui, T., Shimokawa, T. and Imanaka, Y., 2020. Impact of the Hospitalist System in Japan on the Quality of Care and Healthcare Economics. Internal Medicine, pp.2872-19.
59. Hamiduzzaman, Mohammad, Anita De Bellis, Wendy Abigail, and Evdokia Kalaitzidis. 2017. "The Social Determinants of Healthcare Access for Rural Elderly Women - a Systematic Review of Quantitative Studies." *The Open Public Health Journal* 10 (1): 244–66. https://doi.org/10.2174/1874944501710010244.
60. Hatano, Yutaka, Masanori Mori, Hiroaki Izumi, Koji Amano, Tetsuya Ito, Junko Nozato, Keisuke Kaneishi, Tomohiro Kawamura, and Tatsuya Morita. 2022. "End-of-Life Experiences in Advanced Cancer: Gender Differences." *BMJ Supportive & Palliative Care*, June. https://doi.org/10.1136/bmjspcare-2022-003761.
61. Heise, Lori, Margaret E Greene, Neisha Opper, Maria Stavropoulou, Caroline Harper, Marcos Nascimento, Debrework Zewdie, et al. 2019. "Gender Inequality and Restrictive Gender Norms: Framing the Challenges to Health." *The Lancet* 393 (10189): 2440–54. https://doi.org/10.1016/s0140-6736(19)30652-x.
62. Hess, Rachel, Rebecca C. Thurston, Ron D. Hays, Chung-Chou H. Chang, Stacey N. Dillon, Roberta B. Ness, Cindy L. Bryce, Wishwa N. Kapoor, and Karen A. Matthews. 2012. "The Impact of Menopause on Health-Related Quality of Life: Results from the STRIDE Longitudinal Study." *Quality of Life Research* 21 (3): 535–44. https://doi.org/10.1007/s11136-011-9959-7.
63. Hickey, Sebastian Martinez, Marokey Sawo, and Julia Wolfe. 2022. "The State of the Residential Long-Term Care Industry: A Comprehensive Look at Employment Levels, Demographics, Wages, Benefits, and Poverty Rates of Workers in the Industry." Washington, D.C.: Economic Policy Institute. https://www.epi.org/publication/residential-long-term-care-workers/.
64. Hoff, Andreas, Susan Feldman, and Lucie Vidovicova. 2011. "Migrant Home Care Workers Caring for Older People: Fictive Kin, Substitute, and Complementary Family Caregivers in an Ethnically Diverse Environment." *International Journal of Ageing and Later Life* 5 (2): 7–16. https://doi.org/10.3384/ijal.1652-8670.10527.
65. Holme, Francesca, Sharon Kapambwe, Ashrafun Nessa, Partha Basu, Raul Murillo, and Jose Jeronimo. 2017. "Scaling up Proven Innovative Cervical Cancer Screening Strategies: Challenges and Opportunities in Implementation at the Population Level in Low- and Lower-Middle-Income Countries." *International Journal of Gynecology & Obstetrics* 138 (July): 63–68. https://doi.org/10.1002/ijgo.12185.
66. Hornby-Turner, Yvonne Claire, Nancye May Peel, and Ruth Eleanor Hubbard. 2017. "Health Assets in Older Age: A Systematic Review." *BMJ Open* 7 (5): e013226. https://doi.org/10.1136/bmjopen-2016-013226.
67. Hossain, Babul, K.S. James, Varsha P. Nagargoje, and Papai Barman. 2021. "Differentials in Private and Public Healthcare Service Utilization in Later Life: Do Gender and Marital Status Have Any Association?" *Journal of Women & Aging* 35 (2): 1–11. https://doi.org/10.1080/08952841.2021.2011562.
68. Hosseinpoor, Ahmad Reza, Jennifer Stewart Williams, Avni Amin, Islene Araujo de Carvalho, John Beard, Ties Boerma, Paul Kowal, Nirmala Naidoo, and Somnath Chatterji. 2012. "Social Determinants of Self-Reported Health in Women and Men: Understanding the Role of Gender in Population Health." Edited by Beverley J. Shea. *PLoS ONE* 7 (4): e34799. https://doi.org/10.1371/journal.pone.0034799.
69. Hossen, Abul, and Anne Westhues. 2010. "A Socially Excluded Space: Restrictions on Access to Health Care for Older Women in Rural Bangladesh." *Qualitative Health Research* 20 (9): 1192–1201. https://doi.org/10.1177/1049732310370695.
70. Hou, Xiaohui, Jigyasa Sharma, and Feng Zhao, eds. 2023. *Silver Opportunity: Building Integrated Services for Older Adults around Primary Health Care*. Washington, D.C.: World Bank. http://hdl.handle.net/10986/39422.
71. Hughes, Anne K., and Terri D. W. Lewinson. 2014. "Facilitating Communication about Sexual Health between Aging Women and Their Health Care Providers." *Qualitative Health Research* 25 (4): 540–50. https://doi.org/10.1177/1049732314551062.
72. IHME (Institute for Health Metrics and Evaluation). 2020. Global Burden of Disease Study 2019 (GBD 2019) Results. Global Burden of Disease Collaborative Network. Seattle, United States: Institute for Health Metrics and Evaluation. Available from https://vizhub.healthdata.org/gbd-results/. [Accessed: November 16, 2022].
73. ILO (International Labor Organization). 2018. "Women do 4 times more unpaid care work than men in Asia and the Pacific." https://www.ilo.org/asia/media-centre/news/WCMS_633284/lang--en/index.htm
74. ILO/WHO (International Labor Organization/World Health Organization). 2022. "The Gender Pay Gap in the Health and Care Sector a Global Analysis in the Time of COVID-19." Geneva: World Health Organization and the International Labour Organization; https://www.who.int/publications-detail-redirect/9789240052895.
75. Jamuna, D. 2003. "Issues of Elder Care and Elder Abuse in the Indian Context." *Journal of Aging & Social Policy* 15 (2-3): 125–42. https://doi.org/10.1300/j031v15n02_08.
76. Jeon, G.-S., S.-N. Jang, D.-S. Kim, and S.-I. Cho. 2013. "Widowhood and Depressive Symptoms among Korean Elders: The Role of Social Ties." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 68 (6): 963–73. https://doi.org/10.1093/geronb/gbt084.

77. Jha, Prabhat. 2020. "The Hazards of Smoking and the Benefits of Cessation: A Critical Summation of the Epidemiological Evidence in High-Income Countries." *ELife* 9 (1). https://doi.org/10.7554/elife.49979.
78. Juutilainen, Auni, Saara Kortelainen, Seppo Lehto, Tapani Ronnemaa, Kalevi Pyörälä, and Markku Laakso. 2004. "Gender Difference in the Impact of Type 2 Diabetes on Coronary Heart Disease Risk." *Diabetes Care* 27 (12): 2898–2904. https://doi.org/10.2337/diacare.27.12.2898.
79. Karpinska, K., Dykstra, P.A., van den Broek, T., Djundeva, M., Abramowska-Kmon, A., Kotowska, I.I. and Marí-Klose, P. 2016. "Intergenerational linkages in the family: The organization of caring and financial responsibilities: Summary of results." *FamiliesAndSocieties*, Working Paper Series, 61.
80. Kautzky-Willer, Alexandra. 2021. "Does Diabetes Mellitus Mitigate the Gender Gap in COVID-19 Mortality?" *European Journal of Endocrinology* 185 (5): C13–17. https://doi.org/10.1530/eje-21-0721.
81. Keck, W. and Saraceno, C. 2009. "Balancing elderly care and employment in Germany." (No. SP I 2009-401). WZB Discussion Paper.
82. Kiely, Kim M., Brooke Brady, and Julie Byles. 2019. "Gender, Mental Health and Ageing." *Maturitas* 129 (November): 76–84. https://doi.org/10.1016/j.maturitas.2019.09.004.
83. Krämer, Heike U, Gernot Rüter, Ben Schöttker, Dietrich Rothenbacher, Thomas Rosemann, Joachim Szecsenyi, Hermann Brenner, and Elke Raum. 2012. "Gender Differences in Healthcare Utilization of Patients with Diabetes." *The American Journal of Managed Care* 18 (7): 362–69. https://europepmc.org/article/med/22823530.
84. Kraus, Markus, Monika Riedel, Monika , Esther Mot, Peter Willeme, Gerald Röhrling and Thomas Czypionka. 2010. A Typology of Long-Term Care Systems in Europe. ENEPRI Research Report No. 91, August 2010. https://aei.pitt.edu/32248/.
85. Kuruvilla, Shyama, Julian Schweitzer, David Bishai, Sadia Chowdhury, Daniele Caramani, Laura Frost, Rafael Cortez, et al. 2014. "Success Factors for Reducing Maternal and Child Mortality." *Bulletin of the World Health Organization* 92 (7): 533–44. https://doi.org/10.2471/blt.14.138131.
86. Leeson, George and Sarah Harper. 2006. "The Status Quo of Foreign Workers in the Health and Social Care Sector in the UK, Germany and the Netherlands." *Japan National Council of Social Welfare*, Tokyo. ISBN4-9903255-0-8.
87. Lena, A, K Ashok, M Padma, V Kamath, and A Kamath. 2009. "Health and Social Problems of the Elderly: A Cross-Sectional Study in Udupi Taluk, Karnataka." *Indian Journal of Community Medicine* 34 (2): 131. https://doi.org/10.4103/0970-0218.51236.
88. Li, Wenshan, Douglas G. Manuel, Sarina R. Isenberg, and Peter Tanuseputro. 2022. "Caring for Older Men and Women: Whose Caregivers Are More Distressed? A Population-Based Retrospective Cohort Study." *BMC Geriatrics* 22 (1). https://doi.org/10.1186/s12877-022-03583-6.
89. Lin, Hongyan, Mengdi Jin, Qian Liu, Yue Du, Jingzhu Fu, Changqing Sun, Fei Ma, et al. 2021. "Gender-Specific Prevalence and Influencing Factors of Depression in Elderly in Rural China: A Cross-Sectional Study." *Journal of Affective Disorders* 288 (June): 99–106. https://doi.org/10.1016/j.jad.2021.03.078.
90. Lindahl, Anna, Miia Aro, Jere Reijula, Mika J. Mäkelä, Jukka Ollgren, Mervi Puolanne, Asko Järvinen, and Tuula Vasankari. 2022a. "Women Report More Symptoms and Impaired Quality of Life: A Survey of Finnish COVID-19 Survivors." *Infectious Diseases (London, England)* 54 (1): 53–62. https://doi.org/10.1080/23744235.2021.1965210.
91. Lindahl, Anna, Miia Aro, Jere Reijula, Mika J. Mäkelä, Jukka Ollgren, Mervi Puolanne, Asko Järvinen, and Tuula Vasankari. 2022b. "Women Report More Symptoms and Impaired Quality of Life: A Survey of Finnish COVID-19 Survivors." *Infectious Diseases (London, England)* 54 (1): 53–62. https://doi.org/10.1080/23744235.2021.1965210.
92. Lipsky, Martin S., Sharon Su, Carlos J. Crespo, and Man Hung. 2021. "Men and Oral Health: A Review of Sex and Gender Differences." *American Journal of Men's Health* 15 (3): 155798832110163. https://doi.org/10.1177/15579883211016361.
93. Liu, Zuyun, Brian H. Chen, Themistocles L. Assimes, Luigi Ferrucci, Steve Horvath, and Morgan E. Levine. 2019. "The Role of Epigenetic Aging in Education and Racial/Ethnic Mortality Disparities among Older U.S. Women." *Psychoneuroendocrinology* 104 (June): 18–24. https://doi.org/10.1016/j.psyneuen.2019.01.028.
94. Maas, A.H.E.M., and Y.E.A. Appelman. 2010. "Gender Differences in Coronary Heart Disease." *Netherlands Heart Journal* 18 (12): 598–603. https://doi.org/10.1007/s12471-010-0841-y.
95. Madonis, Stephanie M, Kimberly A Skelding, and Madhur Roberts. 2017. "Management of Acute Coronary Syndromes: Special Considerations in Women." *Heart* 103 (20): 1638–46. https://doi.org/10.1136/heartjnl-2016-309938.
96. Mascara, Mariah, and Constantina Constantinou. 2021. "Global Perceptions of Women on Breast Cancer and Barriers to Screening." *Current Oncology Reports* 23 (7). https://doi.org/10.1007/s11912-021-01069-z.
97. McGraw, Jacquie, Katherine M. White, and Rebekah Russell-Bennett. 2021. "Masculinity and Men's Health Service Use across Four Social Generations: Findings from Australia's Ten to Men Study." *SSM - Population Health* 15 (September): https://doi.org/10.1016/j.ssmph.2021.100838.
98. McMaughan, Darcy Jones, Oluyomi Oloruntoba, and Matthew Lee Smith. 2020. "Socioeconomic Status and Access to Healthcare: Interrelated Drivers for Healthy Aging." *Frontiers in Public Health* 8 (231). https://doi.org/10.3389/fpubh.2020.00231.
99. Mergl, Roland, Nicole Koburger, Katherina Heinrichs, András Székely, Mónika Ditta Tóth, James Coyne, Sónia Quintão, et al. 2015. "What Are Reasons for the Large Gender Differences in the Lethality of Suicidal Acts? An Epidemiological Analysis in Four European Countries." Edited by Thomas Niederkrotenthaler. PLOS ONE 10 (7): e0129062. https://doi.org/10.1371/journal.pone.0129062.
100. Miszkurka, Malgorzata, Slim Haddad, Étienne V Langlois, Ellen E Freeman, Seni Kouanda, and Maria Victoria Zunzunegui. 2012. "Heavy Burden of Non-Communicable Diseases at Early Age and Gender Disparities in an Adult Population of Burkina Faso: World Health Survey." *BMC Public Health* 12 (1). https://doi.org/10.1186/1471-2458-12-24.
101. Mobley, L.R., Root, E.D., Finkelstein, E.A., Khavjou, O., Farris, R.P. and Will, J.C. 2006. "Environment, Obesity, and Cardiovascular Disease Risk in Low-Income Women." *American Journal of Preventive Medicine*, 30(4), pp. 327-332.e1. https://doi.org/10.1016/j.amepre.2005.12.001.
102. Moen, Phyllis, Julie Robison, and Vivian Fields. 1994. "Women's Work and Caregiving Roles: A Life Course Approach." *Journal of Gerontology* 49 (4): S176–86. https://doi.org/10.1093/geronj/49.4.s176.
103. Montgomery, Rhonda J. V., Lyn Holley, Jerome Deichert, and Karl Kosloski. 2005. "A Profile of Home Care Workers from the 2000 Census: How It Changes What We Know." *The Gerontologist* 45 (5): 593–600. https://doi.org/10.1093/geront/45.5.593.
104. Muir, Tim. 2017. "Measuring Social Protection for Long-Term Care." OECD I Library. Paris. March 27, 2017. https://www.

oecd-ilibrary.org/social-issues-migration-health/measuring-social-protection-for-long-term-care_a411500a-en.
105. Muñoz Boudet, Ana María, Patti Petesch, Carolyn Turk, and Angélica Thumala. 2013. *On Norms and Agency: Conversations about Gender Equality with Women and Men in 20 Countries*. Washington, D.C.: World Bank. http://hdl.handle.net/10986/13818.
106. Murata, Chiyoe, Tetsuji Yamada, Chia-Ching Chen, Toshiyuki Ojima, Hiroshi Hirai, and Katsunori Kondo. 2010. "Barriers to Health Care among the Elderly in Japan." *International Journal of Environmental Research and Public Health* 7 (4): 1330–41. https://doi.org/10.3390/ijerph7041330.
107. Muñoz, Daniel Cobos, Carmen Sant, Rebeca Revenga Becedas, and Doris Ma Fat. 2020. "Dangers of Gender Bias in CRVS and Cause of Death Data : The Path to Health Inequality." Brief 3. Paper 3. Canada: International Development Research Centre. http://hdl.handle.net/10625/60102.
108. Naud, Daniel, Mélissa Généreux, Jean-François Bruneau, Aline Alauzet, and Mélanie Levasseur. 2019. "Social Participation in Olθder Women and Men: Differences in Community Activities and Barriers according to Region and Population Size in Canada." *BMC Public Health* 19 (1). https://doi.org/10.1186/s12889-019-7462-1.
109. Ngai, L. Rachel and Christopher A. Pissarides. 2009. "Welfare policy and the distribution of hours of work." CEP Discussion Paper (962). London School of Economics and Political Science. Centre for Economic Performance, London, UK. https://eprints.lse.ac.uk/id/eprint/28698.
110. Nilsson, Anna G., Daniel Sundh, Lisa Johansson, Martin Nilsson, Dan Mellström, Robert Rudäng, Michail Zoulakis, Märit Wallander, Anna Darelid, and Mattias Lorentzon. 2017. "Type 2 Diabetes Mellitus Is Associated with Better Bone Microarchitecture but Lower Bone Material Strength and Poorer Physical Function in Elderly Women: A Population-Based Study." *Journal of Bone and Mineral Research: The Official Journal of the American Society for Bone and Mineral Research* 32 (5): 1062–71. https://doi.org/10.1002/jbmr.3057.
111. Novak, Josh R., Terry Peak, Julie Gast, and Melinda Arnell. 2019. "Associations between Masculine Norms and Health-Care Utilization in Highly Religious, Heterosexual Men." *American Journal of Men's Health* 13 (3): 155798831985673. https://doi.org/10.1177/1557988319856739.
112. Nummela, Olli P., Tommi T. Sulander, Heikki S. Heinonen, and Antti K. Uutela. 2007. "Self-Rated Health and Indicators of SES among the Ageing in Three Types of Communities." *Scandinavian Journal of Public Health* 35 (1): 39–47. https://doi.org/10.1080/14034940600813206.
113. O'Hanlan, Katherine A., Suzanne L. Dibble, H. Jennifer J. Hagan, and Rachel Davids. 2004. "Advocacy for Women's Health Should Include Lesbian Health." *Journal of Women's Health* 13 (2): 227–34. https://doi.org/10.1089/154099904322966218.
114. O'Keefe, Philip, and Victoria Haldane. 2024. "Towards a framework for impact pathways between non-communicable diseases, human capital and healthy longevity, economic and wellbeing outcomes," in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington D.C.: World Bank.
115. Obuobi-Donkor, Gloria, Nnamdi Nkire, and Vincent I. O. Agyapong. 2021. "Prevalence of Major Depressive Disorder and Correlates of Thoughts of Death, Suicidal Behaviour, and Death by Suicide in the Geriatric Population—a General Review of Literature." *Behavioral Sciences* 11 (11): 142. https://doi.org/10.3390/bs11110142.
116. OECD (Organization for Economic Cooperation and Development). 2011. "Help Wanted?: Providing and Paying for Long-Term Care." Paris: OECD Publishing. https://www.oecd.org/els/health-systems/help-wanted-9789264097759-en.htm.
117. _____. 2013. "Health at a Glance 2013: OECD Indicators." Paris: OECD Publishing. https://www.oecd.org/els/health-systems/Health-at-a-Glance-2013.pdf.
118. _____. 2019. "Women Are Well-Represented in Health and Long-Term Care Professions, but Often in Jobs with Poor Working Conditions," OECD Gender Equality Data. March 2019. https://www.oecd.org/gender/data/women-are-well-represented-in-health-and-long-term-care-professions-but-often-in-jobs-with-poor-working-conditions.htm.
119. _____. 2020. "Who Cares? Attracting and Retaining Care Workers for the Elderly." *OECD Health Policy Studies*. Paris: OECD Publishing. https://www.oecd.org/publications/who-cares-attracting-and-retaining-elderly-care-workers-92c0ef68-en.htm.
120. OECD (Organization for Economic Cooperation and Development)/European Union. 2013. "A Good Life in Old Age? : Monitoring and Improving Quality in Long-Term Care." *OECD Health Policy Studies*. Paris: OECD Publishing. https://doi.org/10.1787/9789264194564-en.
121. Oertelt-Prigione, Sabine, Belle H. de Rooij, Floortje Mols, Simone Oerlemans, Olga Husson, Dounya Schoormans, John B. Haanen, and Lonneke V. van de Poll-Franse. 2021. "Sex-Differences in Symptoms and Functioning in >5000 Cancer Survivors: Results from the PROFILES Registry." *European Journal of Cancer* 156 (October): 24–34. https://doi.org/10.1016/j.ejca.2021.07.019.
122. Östlin, Piroska. 2009. "Transforming Health Systems and Services for Women and Girls". Paper prepared for the *Expert Group Meeting on The Impact of the Implementation of the Beijing Declaration and Platform for Action on the Achievement of the Millennium Development Goals*, 11-13 November 2009, United Nations, New York.
123. Pagidipati, Neha J., and Eric D. Peterson. 2016. "Acute Coronary Syndromes in Women and Men." *Nature Reviews. Cardiology* 13 (8): 471–80. https://doi.org/10.1038/nrcardio.2016.89.
124. Palta, Priya, Sarah L. Szanton, Richard D. Semba, Roland J. Thorpe, Ravi Varadhan, and Linda P. Fried. 2015. "Financial Strain Is Associated with Increased Oxidative Stress Levels: The Women's Health and Aging Studies." *Geriatric Nursing* 36 (2): S33–37. https://doi.org/10.1016/j.gerinurse.2015.02.020.
125. Pan, An, Michel Lucas, Qi Sun, Rob M. van Dam, Oscar H. Franco, Walter C. Willett, JoAnn E. Manson, Kathryn M. Rexrode, Alberto Ascherio, and Frank B. Hu. 2011. "Increased Mortality Risk in Women with Depression and Diabetes Mellitus." *Archives of General Psychiatry* 68 (1): 42. https://doi.org/10.1001/archgenpsychiatry.2010.176.
126. Papadopoulou, Sofia A., and Juan Carlos Kaski. 2013. "Ischaemic Heart Disease in the Ageing Woman." *Best Practice & Research Clinical Obstetrics & Gynaecology* 27 (5): 689–97. https://doi.org/10.1016/j.bpobgyn.2013.03.003.
127. Perkins, Jessica M., Hwa-young Lee, K. S. James, Juhwan Oh, Aditi Krishna, Jongho Heo, Jong-koo Lee, and S. V. Subramanian. 2016. "Marital Status, Widowhood Duration, Gender and Health Outcomes: A Cross-Sectional Study among Older Adults in India." *BMC Public Health* 16 (1). https://doi.org/10.1186/s12889-016-3682-9.
128. Peters, Sanne A E, and Mark Woodward. 2022. "Sex and Gender Matter in Cardiovascular Disease and Beyond." *Heart* 108 (13): heartjnl-2021-320719. https://doi.org/10.1136/heartjnl-2021-320719.

129. Pilania, Manju, Vikas Yadav, Mohan Bairwa, Priyamadhaba Behera, Shiv Dutt Gupta, Hitesh Khurana, Viswanathan Mohan, Girish Baniya, and S. Poongothai. 2019. "Prevalence of Depression among the Elderly (60 Years and Above) Population in India, 1997–2016: A Systematic Review and Meta-Analysis." *BMC Public Health* 19 (1). https://doi.org/10.1186/s12889-019-7136-z.
130. Pirkis, Jane, Matthew J Spittal, Louise Keogh, Tass Mousaferiadis, and Dianne Currier. 2017. "Masculinity and Suicidal Thinking." *Social Psychiatry and Psychiatric Epidemiology* 52 (3): 319–27. https://doi.org/10.1007/s00127-016-1324-2.
131. Polverini, Francesca and Giovanni Lamura. 2005. "Labour Supply in Care Services" National Report on Italy. https://api.semanticscholar.org/CorpusID:201697054.
132. Potter, Andrew J. 2017. "Care Configurations and Unmet Care Needs in Older Men and Women." *Journal of Applied Gerontology* 38 (10): 1351–70. https://doi.org/10.1177/0733464817733239.
133. Prus, Steven G., and Ellen Gee. 2003. "Gender Differences in the Influence of Economic, Lifestyle, and Psychosocial Factors on Later-Life Health." *Canadian Journal of Public Health* 94 (4): 306–9. https://doi.org/10.1007/bf03403611.
134. Quick, Jonathan, Jonathan Jay, and Ana Langer. 2014. "Improving Women's Health through Universal Health Coverage." *PLoS Medicine* 11 (1): e1001580. https://doi.org/10.1371/journal.pmed.1001580.
135. Rahbari, Reza, Lisa Zhang, and Electron Kebebew. 2010. "Thyroid Cancer Gender Disparity." *Future Oncology* 6 (11): 1771–79. https://doi.org/10.2217/fon.10.127.
136. Rivera, Ashley, and Jonas Scholar. 2020. "Traditional Masculinity: A Review of Toxicity Rooted in Social Norms and Gender Socialization." *Advances in Nursing Science* 43 (1): E1–10. https://doi.org/10.1097/ans.0000000000000284.
137. Rivera-Franco, Monica M, and Eucario Leon-Rodriguez. 2018. "Delays in Breast Cancer Detection and Treatment in Developing Countries." *Breast Cancer: Basic and Clinical Research* 12 (January): 117822341775267. https://doi.org/10.1177/1178223417752677.
138. Robertson, Josefina. 2014. "Waiting Time at the Emergency Department from a Gender Equality Perspective." MSc. Thesis, Institute of Medicine at the Sahlgrenska Academy, University of Gothenburg. https://gupea.ub.gu.se/bitstream/handle/2077/39196/gupea_2077_39196_1.pdf;jsessionid=005E6B1A7CAB3E2C8DADD1F49AE79ADB?sequence=1.
139. Rocks, Stephen, Daniela Berntson, Alejandro Gil-Salmerón, Mudathira Kadu, Nieves Ehrenberg, Viktoria Stein, and Apostolos Tsiachristas. 2020. "Cost and Effects of Integrated Care: A Systematic Literature Review and Meta-Analysis." *The European Journal of Health Economics* 21 (8): 1211–21. https://doi.org/10.1007/s10198-020-01217-5.
140. Rungreangkulkij, Somporn, Ingkata Kotnara, Nilubol Rujiraprasert, and Napaphat Khuandee. 2019. "Gender Inequality Identified as an Underlying Cause of Depression in Thai Women." *Journal of International Women's Studies* 20 (7): 395–408. https://vc.bridgew.edu/jiws/vol20/iss7/25/.
141. Sanjose, Silvia de, and Vivien Tsu. 2019. "Prevention of Cervical and Breast Cancer Mortality in Low- and Middle-Income Countries: A Window of Opportunity." *International Journal of Women's Health* Volume 11 (July): 381–86. https://doi.org/10.2147/ijwh.s197115.
142. Scheil-Adlung, Xenia. 2015. "Long-term Care Protection for Older Persons: A Review of Coverage Deficits in 46 countries." ILO Working Papers. Geneva, Switzerland: International Labour Organization. https://ideas.repec.org/p/ilo/ilowps/994886493402676.html.
143. Schmitz, Hendrik, and Matthias Westphal. 2017. "Informal Care and Long-Term Labor Market Outcomes." *Journal of Health Economics*, 56 (December): 1–18. https://doi.org/10.1016/j.jhealeco.2017.09.002.
144. Song, Yan, and Ying Bian. 2014. "Gender Differences in the Use of Health Care in China: Cross-Sectional Analysis." *International Journal for Equity in Health* 13 (1): 8. https://doi.org/10.1186/1475-9276-13-8.
145. Srivastava, Shobhit, Paramita Debnath, Neha Shri, and T. Muhammad. 2021. "The Association of Widowhood and Living Alone with Depression among Older Adults in India." *Scientific Reports* 11 (1). https://doi.org/10.1038/s41598-021-01238-x.
146. Stankuniene, Aurima, Mindaugas Stankunas, Mark Avery, Jutta Lindert, Rita Mikalauskiene, Maria Gabriella Melchiorre, Francisco Torres-Gonzalez, et al. 2015. "The Prevalence of Self-Reported Underuse of Medications due to Cost for the Elderly: Results from Seven European Urban Communities." *BMC Health Services Research* 15 (1). https://doi.org/10.1186/s12913-015-1089-4.
147. Stone, Robyn I., and Steven L. Dawson. 2008. "The Origins of Better Jobs Better Care." *The Gerontologist* 48 (suppl 1): 5–13. https://doi.org/10.1093/geront/48.supplement_1.5.
148. Sun, Tao, Shu-E Zhang, Meng-yao Yan, Ting-hui Lian, Yi-qi Yu, Hong-yan Yin, Chen-xi Zhao, et al. 2022. "Association between Self-Perceived Stigma and Quality of Life among Urban Chinese Older Adults: The Moderating Role of Attitude toward Own Aging and Traditionality." *Frontiers in Public Health* 10 (February). https://doi.org/10.3389/fpubh.2022.767255.
149. Sunwoo, Duk. 2017. "Public Long-Term Care Insurance Program for the Elderly (LTCI) - Performance Evaluation and Policy Implications." Sejong city, Korea: Korea Institute for Health and Social Affairs (KIHASA).
150. Suteau, Valentine, Mathilde Munier, Claire Briet, and Patrice Rodien. 2021. "Sex Bias in Differentiated Thyroid Cancer." *International Journal of Molecular Sciences* 22 (23): 12992. https://doi.org/10.3390/ijms222312992.
151. Syed, Samina T., Ben S. Gerber, and Lisa K. Sharp. 2013. "Traveling towards Disease: Transportation Barriers to Health Care Access." *Journal of Community Health* 38 (5): 976–93. https://doi.org/10.1007/s10900-013-9681-1.
152. Szanton, Sarah L., Jerelyn K. Allen, Roland J. Thorpe, Teresa Seeman, Karen Bandeen-Roche, and Linda P. Fried. 2008. "Effect of Financial Strain on Mortality in Community-Dwelling Older Women." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 63 (6): S369–74. https://doi.org/10.1093/geronb/63.6.s369.
153. Thielke, Stephen, and Paula Diehr. 2012. "Transitions among Health States Using 12 Measures of Successful Aging in Men and Women: Results from the Cardiovascular Health Study." *Journal of Aging Research* 2012: 1–9. https://doi.org/10.1155/2012/243263.
154. Thorpe, Roland James, Judith D. Kasper, Sarah L. Szanton, Kevin D. Frick, Linda P. Fried, and Eleanor M. Simonsick. 2008. "Relationship of Race and Poverty to Lower Extremity Function and Decline: Findings from the Women's Health and Aging Study." *Social Science & Medicine* 66 (4): 811–21. https://doi.org/10.1016/j.socscimed.2007.11.005.
155. U.S. Department of Health and Human Services, Health Resources and Services Administration, National Center for Health Workforce Analysis. 2017. Long-Term Services and

Supports: Direct Care Worker Demand Projections, 2015-2030. Rockville, Maryland.
156. United Nations, Department of Economic and Social Affairs, Population Division (2020). World Population Ageing 2019 (ST/ESA/SER.A/444).
157. Vaccarino, Viola, Lori Parsons, Eric D. Peterson, William J. Rogers, Catarina I. Kiefe, and John Canto. 2009. "Sex Differences in Mortality after Acute Myocardial Infarction." *Archives of Internal Medicine* 169 (19). https://doi.org/10.1001/archinternmed.2009.332.
158. Van Houtven, Courtney Harold, Nicole DePasquale, and Norma B. Coe. 2020. "Essential Long-Term Care Workers Commonly Hold Second Jobs and Double- or Triple-Duty Caregiving Roles." *Journal of the American Geriatrics Society* 68 (8): 1657–60. https://doi.org/10.1111/jgs.16509.
159. Vogel, Birgit, Monica Acevedo, Yolande Appelman, C Noel Bairey Merz, Alaide Chieffo, Gemma A Figtree, Mayra Guerrero, et al. 2021. "The Lancet Women and Cardiovascular Disease Commission: Reducing the Global Burden by 2030." *The Lancet* 397 (10292). https://doi.org/10.1016/s0140-6736(21)00684-x.
160. Wakabayashi, Chizuko, and Katharine M. Donato. 2006. "Does Caregiving Increase Poverty among Women in Later Life? Evidence from the Health and Retirement Survey." *Journal of Health and Social Behavior* 47 (3): 258–74. https://doi.org/10.1177/002214650604700305.
161. Wang, Yingqi, and Tao Liu. 2020. "The 'Silent Reserves' of the Patriarchal Chinese Welfare System: Women as 'Hidden' Contributors to Chinese Social Policy." *International Journal of Environmental Research and Public Health* 17 (15): 5267. https://doi.org/10.3390/ijerph17155267.
162. Wannamethee, S. G., O. Papacosta, D. A. Lawlor, P. H. Whincup, G. D. Lowe, S. Ebrahim, and N. Sattar. 2011. "Do Women Exhibit Greater Differences in Established and Novel Risk Factors between Diabetes and Non-Diabetes than Men? The British Regional Heart Study and British Women's Heart Health Study." *Diabetologia* 55 (1): 80–87. https://doi.org/10.1007/s00125-011-2284-4.
163. Washington, Donna L., Bevanne Bean-Mayberry, Deborah Riopelle, and Elizabeth M. Yano. 2011. "Access to Care for Women Veterans: Delayed Healthcare and Unmet Need." *Journal of General Internal Medicine* 26 (S2): 655–61. https://doi.org/10.1007/s11606-011-1772-z.
164. Weber, Ann M, Beniamino Cislaghi, Valerie Meausoone, Safa Abdalla, Iván Mejía-Guevara, Pooja Loftus, Emma Hallgren, et al. 2019a. "Gender Norms and Health: Insights from Global Survey Data." *The Lancet* 393 (10189): 2455–68. https://doi.org/10.1016/s0140-6736(19)30765-2.
165. Weber, Ann M, Beniamino Cislaghi, Valerie Meausoone, Safa Abdalla, Iván Mejía-Guevara, Pooja Loftus, Emma Hallgren, et al. 2019b. "Gender Norms and Health: Insights from Global Survey Data." *The Lancet* 393 (10189): 2455–68. https://doi.org/10.1016/s0140-6736(19)30765-2.
166. Williams, Allison M. 2018. "Education, Training, and Mentorship of Caregivers of Canadians Experiencing a Life-Limiting Illness." *Journal of Palliative Medicine* 21 (S1): S-45-S-49. https://doi.org/10.1089/jpm.2017.0393.
167. Williams, Fiona. 2011. "Towards a transnational analysis of the political economy of care. Feminist ethics and social policy: Towards a new global political economy of care." The Stockholm University Linnaeus Center for Integration Studies (SULCIS). Working Paper 2011:6. ISSN 1654-1189.
168. Williams, Joni S., Kinfe Bishu, Clara E. Dismuke, and Leonard E. Egede. 2017. "Sex Differences in Healthcare Expenditures among Adults with Diabetes: Evidence from the Medical Expenditure Panel Survey, 2002–2011." *BMC Health Services Research* 17 (1). https://doi.org/10.1186/s12913-017-2178-3.
169. Witters, Dan. 2011. "Caregiving Costs U.S. Economy $25.2 Billion in Lost Productivity." Gallup. July 27, 2011. https://news.gallup.com/poll/148670/caregiving-costs-economy-billion-lost-productivity.aspx.
170. World Bank. 2012. "World Development Report 2012: Gender Equality and Development." Washington, D.C.: World Bank. http://hdl.handle.net/10986/4391.
171. _____. 2015. "World Bank Group Gender Strategy 2016-2023: Gender Equality, Poverty Reduction, and Inclusive Growth." Washington, D.C.: World Bank. http://hdl.handle.net/10986/23425
172. _____. 2016. "Live Long and Prosper: Aging in East Asia and Pacific." World Bank East Asia and Pacific Regional Report. Washington, D.C.: World Bank. http://hdl.handle.net/10986/23133.
173. _____. 2017. "Women, Business, and the Law: Saving for Old Age." Washington, D.C.: World Bank. https://thedocs.worldbank.org/en/doc/121231541445506749-0050022018/original/WBLSavingForOldAgeFINALWEB.pdf.
174. WHO (World Health Organization). 2007. *Women, Ageing and Health: A Framework for Action*. Geneva, Switzerland: World Health Organization. https://www.who.int/publications/i/item/9789241563529.
175. _____. 2015. *World Report on Ageing and Health*. Geneva, Switzerland: World Health Organization. https://www.who.int/publications/i/item/9789241565042.
176. _____. 2017a. *Global Strategy and Action Plan on Ageing and Health*. Geneva, Switzerland: World Health Organization. https://apps.who.int/iris/handle/10665/329960.
177. _____. 2017b. *Health Employment and Economic Growth: An Evidence Base*. Geneva, Switzerland: World Health Organization. https://apps.who.int/iris/handle/10665/326411.
178. _____. 2018. "World Elder Abuse Awareness Day 2018." *World Health Organization*. June 15, 2018. https://www.who.int/campaigns/world-elder-abuse-awareness-day/2018.
179. _____. 2021. "Cardiovascular Diseases (CVDs)." *World Health Organization*, June 11, 2021. https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds).
180. _____. 2022. "Cancer." *World Health Organization*. February 3, 2022. https://www.who.int/news-room/fact-sheets/detail/cancer.
181. Wu, Daphne C., Jeremy Veillard, Victoria Haldane, Seemeen Saadat, and Prabhat Jha. 2024. "Assessing Healthy Longevity in Low- and Middle-Income Countries: A Proposed Healthy Longevity Performance Dashboard for India." in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington D.C.: World Bank.
182. Yamada, Y. (2002) 'Profile of Home Care Aides, Nursing Home Aides, and Hospital Aides: Historical Changes and Data Recommendations', *The Gerontologis*t 42(2), pp. 199–206. https://doi.org/10.1093/geront/42.2.199.
183. Yeh, Shu-Chuan, Shwu-Feng Tsay, Wen Chun Wang, Ying-Ying Lo, and Hon-Yi Shi. 2021. "Determinants of Successful Nursing Home Accreditation." *Inquiry: A Journal of Medical Care Organization, Provision and Financing* 58 (November). https://doi.org/10.1177/00469580211059998.
184. Zeng, Qingjun, Qingqing Wang, Lu Zhang, and Xiaocang Xu. 2020. "Comparison of the Measurement of Long-Term Care Costs between China and Other Countries: A Systematic Re-

view of the Last Decade." *Healthcare* 8 (2): 117. https://doi.org/10.3390/healthcare8020117.

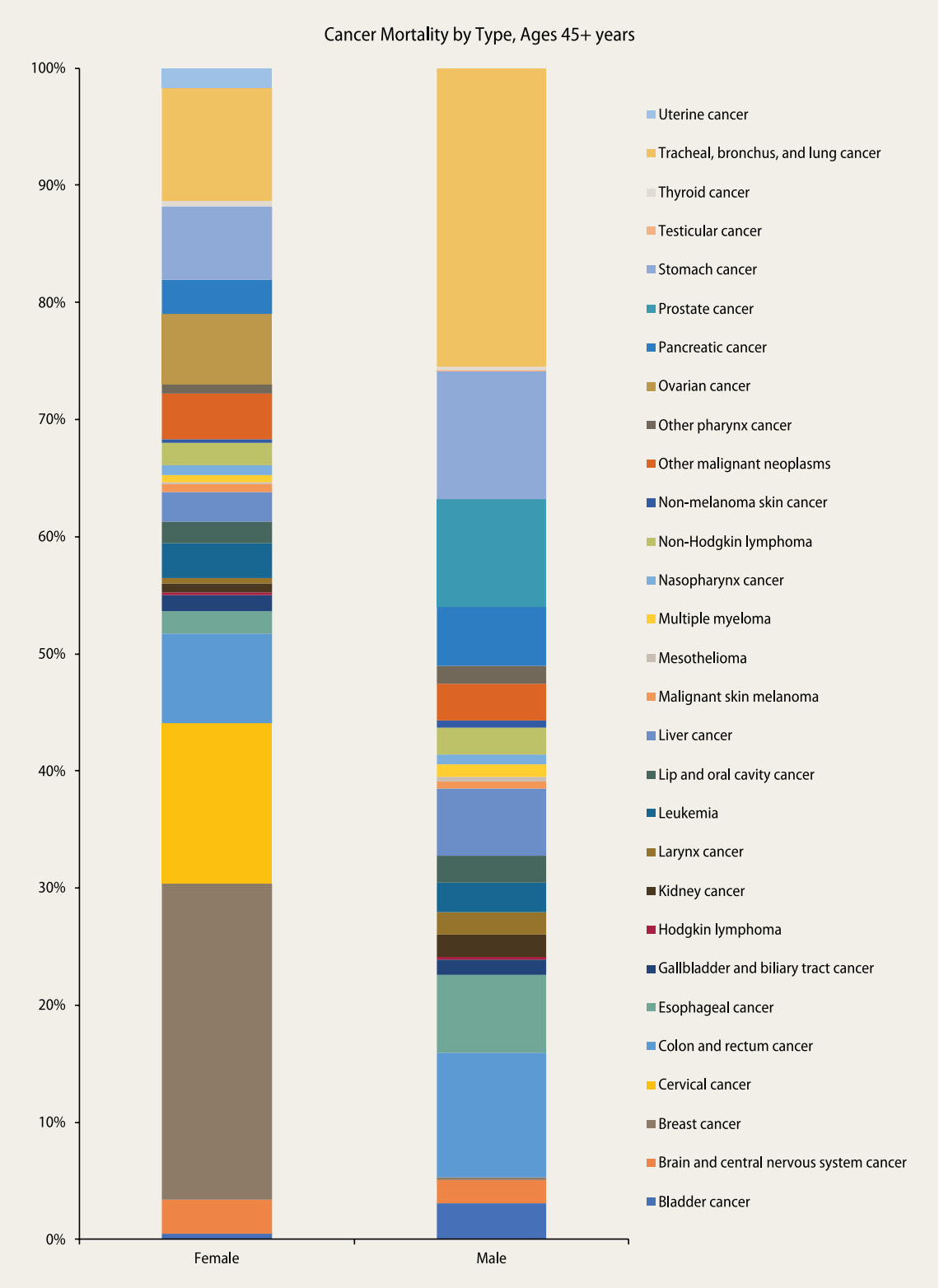
185. Zhan, Heying Jenny. 2005. "Aging, Health Care, and Elder Care: Perpetuation of Gender Inequalities in China." *Health Care for Women International* 26 (8): 693–712. https://doi.org/10.1080/07399330500177196.

186. Zucker, Irving, and Brian J. Prendergast. 2020. "Sex Differences in Pharmacokinetics Predict Adverse Drug Reactions in Women." *Biology of Sex Differences* 11 (1). https://doi.org/10.1186/s13293-020-00308-5.

ANNEX 8.1

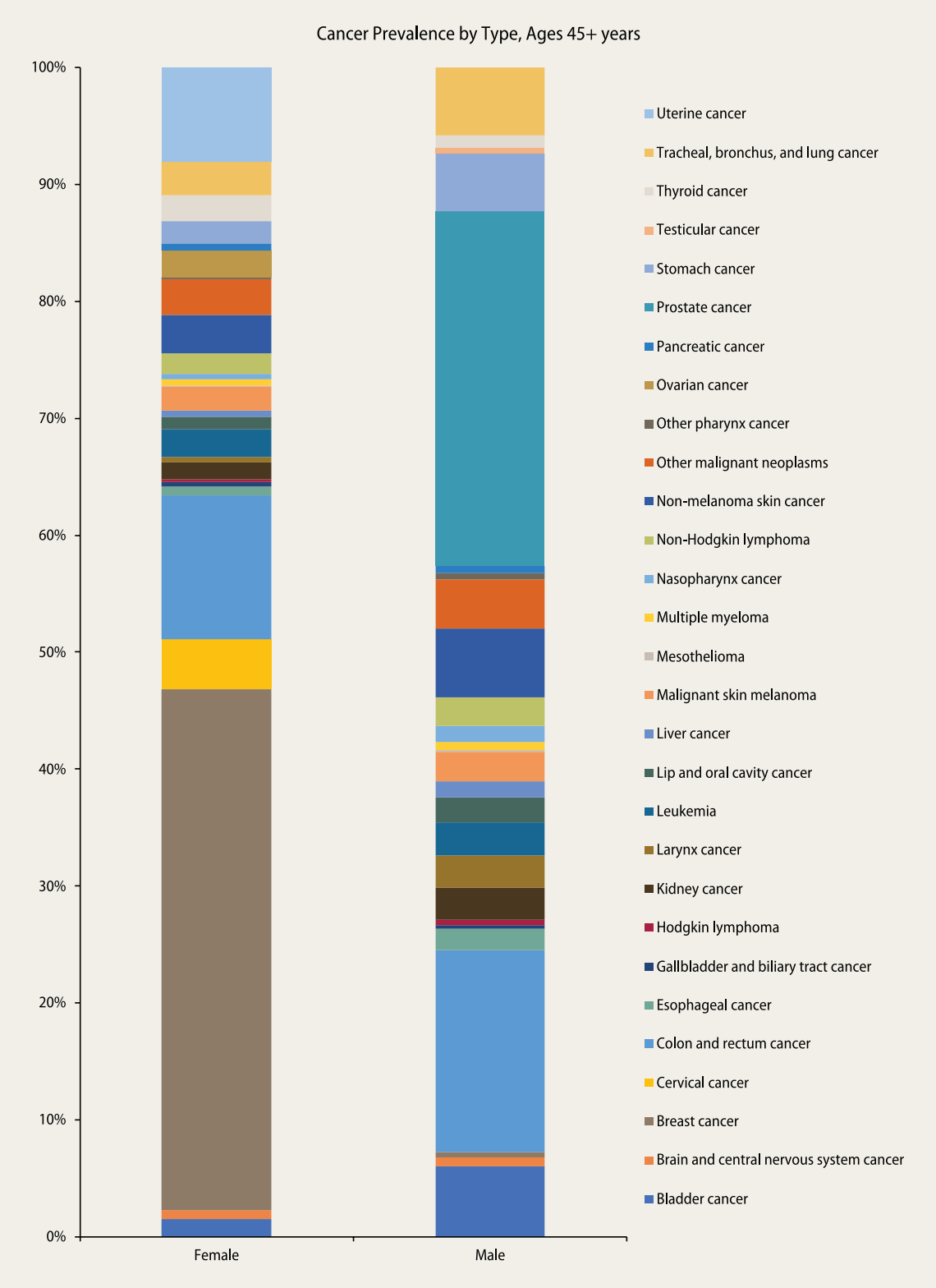
Cancer mortality and prevalence by type for older women and men

FIGURE 8A.1 Cancer Mortality by Type, Ages 45+ years



Source: IHME 2020

FIGURE 8A.2 Prevalence of Cancer by Type, Ages 45+ years



Source: IHME 2020

9

Gendered Responsibilities, Elderly Care, and Labor Supply

Evidence from four middle-income countries

Roberta Gatti [a], Daniel Halim [b,c], Allen Hardiman [d], and Shuqiao Sun [e]

[a] Office of the Chief Economist, Middle East and North Africa, World Bank
[b] Global Gender Unit, World Bank
[c] Poverty and Equity, Middle East and North Africa, World Bank
[d] Department of Economics, University of Illinois
[e] Human Development Practice Group, World Bank

INTRODUCTION

The world's population is aging. The World Health Organization (WHO) predicts that, in 2030, 1 in 6 persons worldwide will be aged 60 years or over (WHO 2021). The developing world is aging especially fast. Fifty-seven percent of the world's population ages 75 and above—more than 138 million people—lived in developing regions in 2015. By 2050, these regions are expected to be home to nearly 8 in 10 older adults globally (UN Women 2017). This trend suggests that there will be an increase in the demand for long-term care (LTC) for older persons. The International Labor Organization (ILO) estimates that the number of older persons needing care worldwide will increase by 50 percent—from 0.2 billion in 2015 to 0.3 billion in 2030. This is faster than the rise in care needs among young children (ILO 2018).

Care for older parents has traditionally been provided by adult children through an "implicit social contract," whereby adult children return the care they received in their childhood (Folbre 2014). This implicit contract continues to operate in many societies. The marketization of care work can be perceived as devaluing the "sacredness" of care and diminishing the quality and authenticity of the care provided (England and Folbre 1999; Himmelweit 1999). However, traditional family-based care arrangements may not be sustainable as populations age: falling fertility rates imply that older parents will depend on fewer adult children. Meanwhile, the market for formal LTC services is underdeveloped in many countries, with limited supply and/or unaffordable costs (Spillman et al. 2014; Agree & Glaser 2009).

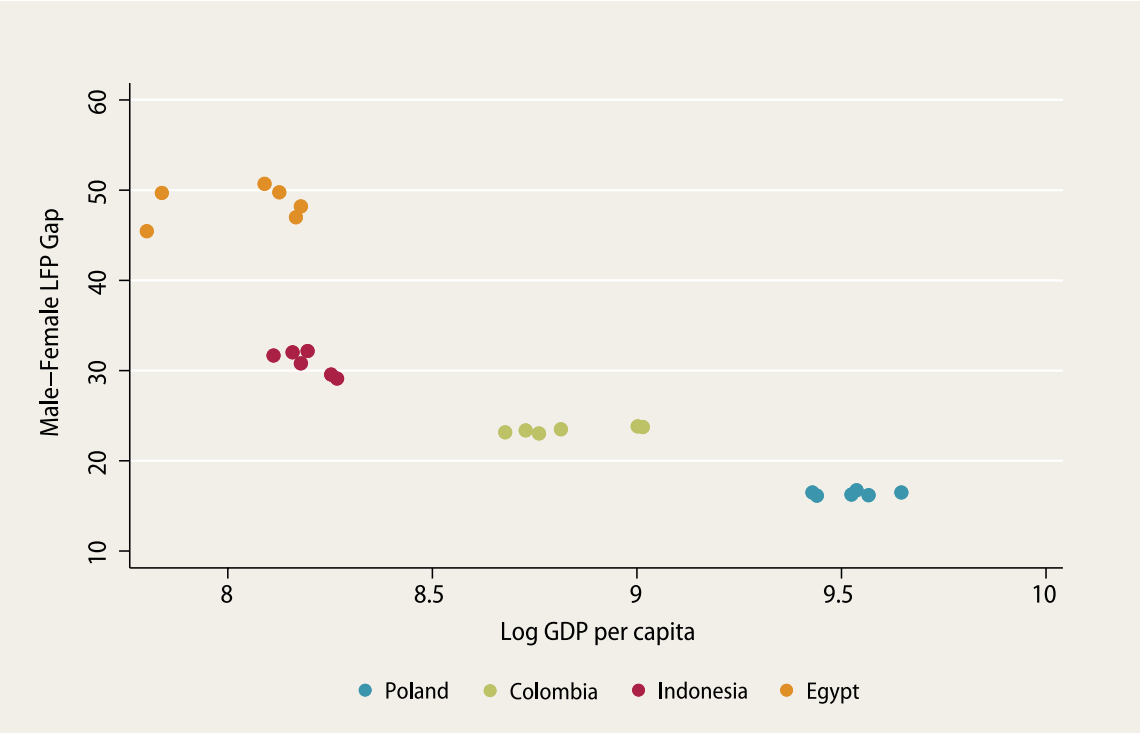
Due to gender stereotypes, much of the responsibility for informal care is shouldered by women (UN Women 2017). Time-use surveys from 64 countries suggest that women bear 76.2 percent of the total time spent on unpaid care work, 3.2 times more than men (ILO 2018). Often in their prime working years, care providers can experience various negative effects on their labor supply caused by the care burden (Connelly et al. 2018; Fahle & McGarry 2017). One global estimate suggests that 647 million working-age individuals are outside of the labor force due to family responsibilities, 606 million of them women (ILO 2018). Because of this, it is imperative to examine whether the growing older-adult care burden imposes a disproportionate toll on labor supply among women.

This study explores the relationship between providing care to older parents/parents-in-law and labor supply for men and women in Colombia, Egypt, Indonesia, and Poland, four middle-income countries in different regions. Due to data limitations in Egypt, our investigation there looks at the relationship between an individual's parents' disability status and labor supply. To conduct our analysis, we utilize a combination of rich time-use surveys and longitudinal household survey data among individuals ages 40 to 59. Overall, for older working-age adults in all four countries, we find that there is a significant negative correlation between labor supply and providing care to parents. This negative impact spans both the extensive and intensive margins of employment for both men and women. However, the negative effect on labor supply is stronger among women than men, consistent with other findings in the literature. Also consistent with the literature, our results show a stronger labor supply effect among those who provide intensive caregiving of more than 10 hours per week, compared to those who provide less than 10 hours of care per week.

It is useful to contextualize our findings against the backdrop of different labor market landscapes in the four countries. As depicted in Figure 9.1, there is a negative correlation between a country's gender gap in labor force participation and its per capita GDP. Looking in detail at each country, we find that, in Colombia and Poland, both men and women who provide parental care[1] are significantly less likely to be employed. Specifically, in Poland we see a 17 percentage-point decline from the mean in employment among women and a 16 percentage-point decline among men, associated with having to provide care to parents. Colombia shows a 20 percentage-point decline among women and a 16 percentage-point decline among men. In Poland, the reduction in employment is driven by a fall in formal wage employment, whereas in

1 Throughout this chapter, the term "parental care" refers to care provided to older parents/parents-in-law within a household.

FIGURE 9.1 Gross domestic product (GDP) per capita and male-female labor force participation gap, four countries, 2013-2018



Note: This graph visualizes the relationship between gross domestic product (GDP) per capita and the male-female labor force participation (LFP) gap in the four study countries between 2013 and 2018, among individuals ages 15+. Data are from the World Bank Gender Data Portal. COL= Colombia, EGY=Egypt, IDN=Indonesia, POL=Poland.

Colombia the decline is driven by both wage employment and casual employment. In Indonesia, while there is no overall change in the extensive margin of labor supply for either gender, we see a significant decline in formal employment among both men and women who provide care. However, while men transition from formal to informal employment when they provide care for their parents, we do not see this transition among female workers. When looking at the intensive margin, we observe a reduction in weekly work hours and annual earnings among men and women in Poland, whereas a similar decline is seen only among men in Indonesia. In Colombia, the reduction in work hours is only observed among female workers. On the other hand, our evidence from Egypt shows that, in that country, there is no significant correlation between an individual's parents' disability status and overall labor supply for either men or women.

In addition to the extensive margin of providing parental care, we also investigate how the intensity of parental care (as measured by the number of hours spent providing care per week) relates to labor supply. Similar to the extensive margin, we find that there is a negative relationship between care hours per week and labor supply, conditional on providing care. We observe a slightly larger estimated change among men than women, which may be driven by the higher propensity for men than women to be employed in the formal sector, where work schedules are less flexible.

To look at how parental care interacts with individual characteristics, we also investigate how our results change among individuals with different educational levels. Among men, we find that there is no differential impact on employment based on educational level. On the other hand, we observe a larger negative impact among women who are highly educated. This may be driven by the significantly higher base employment rate among highly educated women. Because of this, care responsibilities toward parents would likely have more effect on this particular group of female individuals.

Responsibilities for childcare and parental care are often intertwined. When investigating the broader family structure, the presence of children can either help alleviate the burden of caring for parents or, on the contrary, exacerbate the employ-

ment impacts of care responsibilities toward older adults in the household. We find evidence for the former among men. The presence of older children ages 13-18 and above seems to act as a facilitator for men in the household to provide care to older parents. Among women, we find similar evidence concerning the presence of young children (ages 0-6) in the household.

This study builds on a growing literature on the relationship between caring for older parents and labor supply and how gender may be associated with this relationship. While a vast literature shows a negative relationship between parental care and labor force participation, most of the analysis has been done in developed countries, particularly the United States and European countries. Ettner (1995) was one of the first papers to find that co-residence with disabled parents leads to a significant reduction in work hours among female individuals ages 35 to 64 in the United States. More recent literature also finds reduced labor supply due to parental care among individuals aged 50+ (Johnson & Lo Sasso 2006; Johnson & Lo Sasso 2000; Van Houtven et al. 2013; Fahle & McGarry 2017; Heger & Korfhage 2020). In Europe, similar results are reported among elderly individuals (Bolin et al. 2008; Carmichael & Charles 2003; Ciccarelli & Van Soest 2018; Kotsadam 2011). In Australia, Nguyen & Connely (2014) and Bittman et al. (2007) find a similar negative relationship between caregiving and labor supply. Some findings indicate a larger impact on women's labor supply compared to men. While Carmichael & Charles (2003) find that both men and women carers are less likely to be in paid work, conditional on working, women earn significantly less than men. Fevang et al. (2012) find an almost four times larger impact on a daughter's labor supply, compared to a son's, during the years before a parent's death. Van Houtven et al. (2013) likewise find reduced hours worked among caregiving women, conditional on working, while they find no such effect on men. Our analysis contributes to this literature by exploring the relationship between parental care and labor supply in middle-income countries in regions (East Asia and Pacific, Middle East and North Africa, Latin America and Caribbean, and Europe and Central Asia) that are aging faster than other parts of the world.

While the majority of the aging population lives in low- and middle-income countries (LMICs), LTC has yet to be recognized as an urgent policy issue in most LMICs (UN Women 2017). Moreover, evidence from LMICs is more limited than from high-income settings, and much of the available LMIC evidence stems from a single country, China. Among Chinese studies, Liu et al. (2010) find that, while caring for her own parents does not typically affect a woman's labor market outcomes, caring for a parent-in-law harms a woman's labor supply in terms of paid work and work hours. Chai et al. (2021) report an inverse relationship between caregiving and labor force participation among Chinese men, while the results are mixed for women. Huang et al. (2021) find that providing care to parents/parents-in-law at home exerts a negative effect on female caregivers' well-being. Chen et al. (2017) also show that married women who spend more than 15 hours per week providing elder care are less likely to participate in the labor force. They find that intensive caregivers (defined as those providing more than 15 hours of older-adult care per week) work significantly fewer hours of paid work each week when they remain employed. Papers from China that find no negative impact of elder care on labor supply include Mao et al. (2018) and Wang & Zhang (2018). Meanwhile, in Türkiye, Terkoglu & Memis (2022) find that providing care to older adults has a statistically significantly negative impact on the labor force participation of women ages 30 to 49. In Nepal, Sinha & Sedai (2022) find that both men and women caregivers experience a decline in labor supply, with a larger impact in women.

The current study is most closely related to Stampini et al. (2020), who focus their analysis on Chile, Colombia, Costa Rica, and Mexico. Across these countries, they find that women who provide LTC are less likely to work. Additionally, condition-al on working, women who provide parental care work fewer hours per week than those who do not provide such care.

The rest of this chapter is structured as follows. The next section describes the data and the two treatment variables used. The study's methodology is explained in the following section. The following section discusses the results from our main analysis using long-term parental care as our variable of interest. The next section follows up with heterogeneity analysis, while the proceeding section provides a sensitivity analysis with various control groups. The final section concludes.

DATA

Our analysis focuses on four countries: Colombia, Egypt, Indonesia, and Poland. For Colombia and Poland, we take advantage of rich time-use data from the 2017 National Survey of Time Use (Colombia) and the 2013 Poland Time Budget Survey. Due to the lack of time-use surveys in Indonesia, we utilize a rich panel household survey from the 2014 wave of the Indonesia Family Life Survey (IFLS). For Egypt, we utilize the 2018 Egypt Labor Market Panel Survey (ELMPS) to construct our proxy treatment variable, which is defined below. Since the Egypt data does not have information on parental care, we use the individual's parents' disability status as a proxy for the provision of long-term care.

Due to the differences in the sources of data used, there is a slight difference in how our long-term care variable is defined across countries. The time-use surveys from Poland and Colombia directly ask survey respondents (adult children) whether they provide care for their parents. In Indonesia, IFLS instead asks each older parent whether their children often provide help in conducting their daily activities. In all three countries, in addition to the extensive margin, we also extract information on the number of hours spent per week on providing parental LTC. Since Egypt does not have information on providing long-term care, we utilize the information on whether an individual parent reports having some degree of difficulty in conducting some aspect of their daily activities. We use this information as a proxy for our main treatment variable for Egypt. Details on the construction of the variables for all four countries are presented in Table 9.1.

Our main outcome variable is individuals' labor supply. For the extensive margin, we look into the association between our main treatment variables and whether an individual is currently working. We also disaggregate our results based on informal/formal sector. The formal sector includes wage workers, such as private/government employees. The informal sector includes all those who are self-employed or who work as casual family workers. We also investigate the impact of parental care on the intensive margin, including conditional hours worked and annual earnings among those who continue working. For annual earnings, we transform earnings from each individual in each country to the equivalent in 2018 US dollars.

TABLE 9.1 Definition of long-term care by country

Country (Year)	Definition of Treatment Variables
Poland (2013)[1]	Provide care to older parents who are ill/disabled
Indonesia (2014)[2]	Older parents report receiving help with activities of daily living (ADL) or instrumental activities of daily living (IADL)
Colombia (2016)[3]	Provide help to older parents with activities such as: 1) Feeding/bathing 2) Medical appointments 3) Taking medication
Egypt (2018)[4]	Individual's parent report having some difficulty with or being unable to: 1) Walk/climb stairs 2) Perform self-care such as washing all over or dressing

[1] Poland Population Time Budget Survey 2013
[2] Indonesia Family Life Survey 2014-2015
[3] Colombia *Encuesta Nacional De Uso Del Tiempo (ENUT)* 2016-2017
[4] Egypt Labor Market Panel Survey 2018

METHODOLOGY

To estimate the relationship between provision of parental long-term care/presence of a disabled parent and labor supply in Colombia, Indonesia, Poland, and Egypt, we estimate the following equations for each individual *i*:

$$L_i = \beta_0 + \beta_1 LTC_i + \beta_2 X_i + \mu_i \qquad [1]$$

To fully understand how gender interacts with the provision of long-term care and labor supply, we separate our estimation results for males and females. In addition to running the harmonized estimates, we also run our estimates separately for each country. *L* represents our dependent variables: a dummy variable that indicates whether an individual is currently working, types of employment, conditional hours worked per week, and annual earnings conditional on working. *LTC* is our main treatment variable and indicates whether an individual is providing care to their parents/parents-in-law who are 60 years old or above. In the case of Egypt, LTC refers to an individual's parent's disability status. *X* is a vector of individual and household characteristics such as individual age, age-squared, highest educational level, number of children ages 0-6, 7-12, and 13-18 in the household, marital status, and country fixed effects in our harmonized analysis.

Additionally, in order to observe whether the differential impact of LTC on men's and women's labor supply is significant, we also run our analysis interacting LTC dummy and gender dummy. Specifically, we will run:

$$L_i = \beta_0 + \beta_1 LTC_i + \beta_2 Male_i + \beta_3 LTC_i \cdot Male_i + \beta_4 X_i + \mu_i \qquad [2]$$

In our main analysis, we focus on midlife individuals ages 40 to 59, because these individuals are the subpopulation most likely to provide care to aging parents/parents-in-law (Moussa et al. 2019). Our data also confirm that the majority of persons providing care for elderly parents are aged 40 to 59 (Annex Figure 9A.1). Meanwhile, individuals ages 60 and above are excluded, because there is a high probability that the parents of these individuals are deceased and that they themselves may be in need of care. Since the decision to provide parental LTC is endogenous, we do not claim causality in our analysis. For example, there is a potential for reverse causality, where the lack of labor market opportunities may imply lower opportunity costs for those becoming caregivers.

RESULTS

Co-residency and care needs

Table 9.2 shows the basic summary statistics for co-residency and care needs among men and women. It also shows whether there is a significant difference in these statistics between men and women. Table 9.2 shows that, in all four countries, the share of co-residency with parents is generally higher among men than women. However, we also see a higher proportion of women who are spouses of older adults. We observe a higher proportion of men who live with a disabled parent in Poland, while the proportion is equal between genders in Indonesia, Egypt, and Colombia. Despite this, women bear the majority of the responsibility to provide care for their parents. In general, women are at least twice as likely as men to provide care to their older parents. We also observe that, among the three countries, Indonesia has the largest proportion of women who provide LTC to their parents, while Poland has the smallest proportion of women providing such care. In addition, in Indonesia, women spend a significantly longer time caring for their parents, conditional on providing care, while in Colombia men spend a slightly longer time than women.

Figure 9.2 shows how the basic co-residency and care needs analyzed in Table 9.2 change as individuals age in all four countries. In these figures, we include individuals ages 25 to 59 to see a more complete picture of this evolution. Among the four countries, Egypt has the highest fertility rates for both men and women. We also observe that men experience the peak of biological reproduction at a much older age than women. We see a downward trend in co-residency with age, which is not surprising given the increasing number of deceased older parents as individuals age.

TABLE 9.2 Co-residency and long-term care provision among individuals ages 40 to 59

	Poland (2013)		Indonesia (2014)		Colombia (2016)		Egypt (2018)	
	Male (1)	Female (2)	Male (3)	Female (4)	Male (5)	Female (6)	Male (7)	Female (8)
Coreside with an older parent	0.134	0.108***	0.142	0.124**	0.164	0.141***	0.083	0.081
	(0.341)	(0.311)	(0.349)	(0.330)	(0.370)	(0.348)	(0.277)	(0.274)
Relationship to the older adult:								
Spouse	0.047	0.145***	0.005	0.186***	0.030	0.212***	0.007	0.269***
	(0.211)	(0.352)	(0.067)	(0.389)	(0.171)	(0.409)	(0.086)	(0.443)
Child	0.101	0.080***	0.076	0.097***	0.129	0.131	0.079	0.044***
	(0.301)	(0.271)	(0.265)	(0.295)	(0.335)	(0.337)	(0.270)	(0.205)
Child-in-law	0.034	0.028	0.066	0.028***	0.035	0.011***	0.004	0.037***
	(0.181)	(0.166)	(0.249)	(0.165)	(0.184)	(0.105)	(0.066)	(0.190)
# of coresident parents in the household	1.200	1.158*	1.224	1.145***	1.233	1.224	1.124	1.174*
	(0.400)	(0.364)	(0.417)	(0.353)	(0.423)	(0.420)	(0.356)	(0.380)
# of elderly parents in the household	1.201	1.158*	1.174	1.141	1.222	1.219	1.101	1.141
	(0.401)	(0.365)	(0.379)	(0.349)	(0.415)	(0.413)	(0.302)	(0.349)
Older parent(s) have a chronic illness			0.068	0.069	0.120	0.108***	0.052	0.038**
			(0.252)	(0.253)	(0.325)	(0.311)	(0.221)	(0.191)
Share of disabled older parent	0.023	0.018*	0.076	0.079	0.029	0.031	0.048	0.050
	(0.149)	(0.132)	(0.265)	(0.270)	(0.167)	(0.173)	(0.214)	(0.218)
Provide parental care to older parent	0.008	0.014**	0.020	0.076***	0.004	0.015***		
	(0.090)	(0.119)	(0.142)	(0.265)	(0.065)	(0.123)		
Time spent providing care to older parents (hours/week)	9.079	9.567	14.666	19.221	11.268	8.194*		
	(8.273)	(8.159)	(20.880)	(26.760)	(17.151)	(9.197)		
# of children aged … in the household:								
0-6	1.230	1.197	1.208	1.226	1.226	1.259*	1.429	1.409
	(0.470)	(0.451)	(0.460)	(0.508)	(0.520)	(0.573)	(0.692)	(0.750)
7-12	1.215	1.172*	1.224	1.214	1.247	1.213**	1.497	1.352***
	(0.473)	(0.419)	(0.492)	(0.476)	(0.534)	(0.500)	(0.656)	(0.599)
13-18	1.265	1.250	1.221	1.214	1.281	1.250**	1.501	1.432***
	(0.530)	(0.515)	(0.469)	(0.453)	(0.538)	(0.517)	(0.628)	(0.627)
Observations	4,769	8,656	4,906	5,077	15,925	19,453	4,841	4,860

Notes: The columns show means and standard deviations for each variable in different countries, separately for men and women. Standard deviations are shown in parentheses. *, **, *** in "Female" columns indicate that the null hypothesis for similarity of means between male and female samples within each country is rejected at the 10%, 5%, and 1% level, respectively.

FIGURE 9.2 **Share of individuals (ages 25 to 59) with a coresident parent and young children in the household**



Determinants of parental care

Before investigating the relationship between labor supply and parental care, we try to investigate factors that determine parental care. To do this, we regress our explanatory variable (parental care) on individual and household characteristics. The results are presented in Table 9.3. We observe that more highly educated women are less likely to provide parental care. This negative relationship might be driven by increasing opportunity costs of providing care among women who enjoy higher education and who are more likely to be in a higher-paying job. This implies that there is a selection of parental care providers among women, whereby less educated women are more likely to provide care to an elderly parent. We also observe that being married reduces the likelihood of providing parental care. As women age, they are more likely to provide care to their parents, while this relationship is not significant among men. When looking at household composition, we observe that the number of children ages 0 to 18 is associated with an increase in the propensity for providing parental care among men.

TABLE 9.3 Determinants of parental care, three-country pooled sample

	Parental care	
	Male (1)	Female (2)
Primary or less	0.000	0.000
	(.)	(.)
Secondary	0.000	-0.009***
	(0.002)	(0.002)
Tertiary	0.001	-0.010***
	(0.002)	(0.002)
Married	-0.018***	-0.021***
	(0.002)	(0.002)
Age	0.003	0.008***
	(0.002)	(0.003)
Age-sq	-0.000	-0.000***
	(0.000)	(0.000)
# children 0-6	0.004**	-0.002
	(0.002)	(0.002)
# children 7-12	0.004***	-0.001
	(0.001)	(0.001)
# children 13-18	0.002**	-0.002*
	(0.001)	(0.001)
Constant	-0.054	-0.125*
	(0.055)	(0.069)
Observations	29727	36520
Mean	0.014	0.026

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individuals ages 40-59 from Poland, Indonesia, and Colombia.

Labor supply

Next, we investigate the difference in labor supply between men and women. We also observe the gender difference between LTC providers and non-providers (or persons with disabled parents versus non-disabled parents for Egypt). As is well documented in the literature, we see a large disparity in labor supply between men and women in all four countries. In general, men are more likely to be employed, work longer hours conditional on working, and receive higher annual earnings than women. Men are in general more likely to be employed in wage employment and self-employment but are less likely to be employed as casual/family workers.

Unsurprisingly, this gender disparity in labor supply is even more pronounced among persons who do not provide care for parents (or, in Egypt, who do not have disabled parents) across all four countries. For example, the difference in hours worked between men and women is smaller and not significant among persons providing care to parents in Poland and Indonesia. We observe a similar trend in the gender difference in wage employment, self-employment, and casual/family work. Since the decision to provide care to older parents is endogenous, there will be selection into becoming a care provider that plays a role in muting the gender disparity in labor supply.

It is also interesting to note the different labor market landscapes in the four countries. Looking at non-carers as the baseline, around 90 percent or more of males ages 40 to 59 in Indonesia, Colombia, and Egypt are employed; the share is lowest in Poland, at 76 percent. There is more variation in the employment of females ages 40 to 59; the highest share is in Indonesia, with 73 percent of women in this age group employed, compared with around 60 percent in Poland and Colombia and just 24 percent in Egypt. There are also different degrees of formality in the labor market. Roughly half of the employment in Poland (for both women and men) is in wage work. Meanwhile, employment in Colombia and Indonesia is dominated by casual and self-employment. While there is a greater share of wage workers among males in Egypt (67 percent), many fewer women work as wage workers (16 percent). These are important contextual factors, considering that there are different social norms around women's work in these four countries and that casual and self-employment may offer more flexibility to combine paid market work and unpaid care work.

TABLE 9.4 Labor supply among individuals ages 40 to 59

	Carer			Non-carer			
	Male (1)	Female (2)	M – F (3)	Male (4)	Female (5)	M – F (6)	(3) – (6) (7)
Panel A: Poland							
Employed	0.462	0.432	0.0295	0.759	0.636	0.123***	-0.094
	(0.505)	(0.497)		(0.428)	(0.481)		
Hours worked / week	36.111	35.000	1.111	43.125	38.594	4.531***	-3.42
	(11.146)	(12.232)		(10.038)	(9.992)		
Wage worker	0.179	0.296	-0.117	0.528	0.492	0.036***	-0.153*
	(0.389)	(0.458)		(0.499)	(0.500)		
Self-employed	0.282	0.120	0.162*	0.227	0.122	0.105***	0.057
	(0.456)	(0.326)		(0.419)	(0.327)		
Casual/family worker	0.000	0.016	-0.016	0.004	0.022	-0.018***	0.002
	(0.000)	(0.126)		(0.063)	(0.148)		
Annual earnings (USD)	3893.03	4331.42	-438.4	5431.29	4758.31	673.0***	-1111.3*
	(2513.70)	(1769.45)		(2078.07)	(1875.48)		
Primary educated or less	0.154	0.128	0.026	0.109	0.106	0.003	0.022
	(0.366)	(0.335)		(0.312)	(0.307)		
Secondary educated	0.769	0.672	0.097	0.719	0.657	0.061***	0.036
	(0.427)	(0.471)		(0.450)	(0.475)		

	Carer			Non-carer			
	Male (1)	Female (2)	M – F (3)	Male (4)	Female (5)	M – F (6)	(3) – (6) (7)
Panel A: Poland *(continued)*							
Tertiary educated	0.077	0.200	-0.123	0.172	0.237	-0.065***	-0.058
	(0.270)	(0.402)		(0.378)	(0.425)		
Observations	39	125		4730	8531		
Panel B: Indonesia							
Employed	0.945	0.713	0.232***	0.956	0.726	0.231***	0.002
	(0.229)	(0.453)		(0.204)	(0.446)		
Hours worked / week	33.372	33.306	0.0659	39.195	34.230	4.965***	-4.899*
	(21.009)	(22.820)		(21.265)	(23.811)		
Wage worker	0.319	0.169	0.15***	0.369	0.196	0.173***	-0.023
	(0.469)	(0.375)		(0.483)	(0.397)		
Self-employed	0.462	0.321	0.141*	0.445	0.317	0.128***	0.013
	(0.501)	(0.468)		(0.497)	(0.465)		
Casual/family worker	0.165	0.220	-0.0548	0.140	0.208	-0.068***	-0.013
	(0.373)	(0.415)		(0.347)	(0.406)		
Annual earnings (USD)	1278.01	803.90	474.1**	1394.50	799.05	595.5***	-121.35
	(1374.15)	(1264.89)		(1288.81)	(1165.54)		
Primary educated or less	0.330	0.557	-0.228***	0.427	0.570	-0.143***	-0.085
	(0.473)	(0.498)		(0.495)	(0.495)		
Secondary educated	0.462	0.334	0.127*	0.438	0.332	0.107***	0.02
	(0.501)	(0.473)		(0.496)	(0.471)		
Tertiary educated	0.209	0.108	0.101*	0.135	0.099	-0.036***	0.065
	(0.409)	(0.311)		(0.341)	(0.298)		
Observations	91	296		4,351	3,601		
Panel C: Colombia							
Employed	0.687	0.416	0.270***	0.885	0.569	0.316***	-0.046
	(0.467)	(0.494)		(0.319)	(0.495)		
Hours worked / week	45.457	36.258	9.198***	49.696	41.748	7.948***	1.250
	(14.725)	(16.310)		(14.384)	(16.537)		
Wage worker	0.254	0.141	0.113*	0.328	0.230	0.098***	0.015
	(0.438)	(0.349)		(0.469)	(0.421)		
Self-employed	0.418	0.245	0.173**	0.520	0.285	0.235***	-0.062
	(0.497)	(0.431)		(0.500)	(0.451)		
Casual/family worker	0.015	0.030	-0.015	0.038	0.054	-0.016***	0.001
	(0.122)	(0.171)		(0.191)	(0.227)		
Annual earnings (USD)	4606.89	3488.75	1118.1	3733.00	3330.56	403.4***	714.7
	(2872.13)	(2828.99)		(2489.28)	(2564.28)		
Primary educated or less	0.284	0.333	-0.05	0.377	0.358	0.019***	-0.069
	(0.454)	(0.472)		(0.485)	(0.480)		
Secondary educated	0.403	0.404	-0.001	0.411	0.409	0.002	-0.003
	(0.494)	(0.492)		(0.492)	(0.492)		

	Carer			Non-carer			
	Male (1)	Female (2)	M – F (3)	Male (4)	Female (5)	M – F (6)	(3) – (6) (7)
Panel C: Colombia *(continued)*							
Tertiary educated	0.313	0.263	0.051	0.211	0.232	-0.021***	0.072
	(0.467)	(0.441)		(0.408)	(0.422)		
Observations	67	298		15,856	19,139		
Panel D: Egypt							
Employed	0.854	0.306	0.548***	0.896	0.244	0.652***	-0.103***
	(0.321)	(0.470)		(0.281)	(0.434)		
Hours worked / week	45.143	36.605	8.538***	47.011	36.260	10.75***	-2.212
	(18.701)	(13.151)		(17.746)	(14.980)		
Wage worker	0.644	0.207	0.437***	0.665	0.162	0.503***	-0.066
	(0.480)	(0.406)		(0.472)	(0.369)		
Self-employed	0.202	0.041	0.16***	0.225	0.041	0.184***	-0.024
	(0.402)	(0.199)		(0.418)	(0.198)		
Casual/family worker	0.009	0.074	-0.065*	0.008	0.046	-0.038***	-0.028*
	(0.092)	(0.263)		(0.091)	(0.209)		
Annual earnings (USD)	1468.32	1292.61	175.7	1588.65	1483.99	104.7**	71.057
	(937.08)	(649.23)		(908.68)	(785.07)		
Primary educated or less	0.412	0.541	-0.129**	0.406	0.601	-0.195***	0.065
	(0.493)	(0.499)		(0.491)	(0.490)		
Secondary educated	0.403	0.281	0.122**	0.396	0.275	0.121***	0.002
	(0.492)	(0.450)		(0.489)	(0.447)		
Tertiary educated	0.185	0.178	0.007	0.198	0.124	0.074***	-0.067*
	(0.389)	(0.383)		(0.398)	(0.330)		
Observations	233	242		4,567	4,592		

Notes: Columns 1, 2, 4, and 5 show means and standard deviations for each variable for male and female samples, as indicated. Standard deviations shown in parentheses. Columns 3, 6, and 7 test the statistical significance of difference in means. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively.

How does parental care differentially affect male and female labor supply?

We begin by looking at the relationship between parental care and labor supply for men and women ages 40 to 59 in all four countries combined. Panel A in Table 9.5 presents the results for males, while panel B presents the results for females. We find that providing care to older parents is associated with a significant reduction in labor supply for both men and women. This reduction applies not only to the probability of employment but also to intensive margins such as conditional hours worked and log annual earnings. Both men and women carers work on average about three hours less per week and earn less, conditional on working. In almost all cases except conditional hours worked, the point estimates for women are in general higher than for men. While men are 5.6 percentage points (p.p.) less likely to be employed when they provide care to their parents, the decline for women is almost twice as large, with a 10 p.p. decline in the employment rate among female carers. We observe a similarly sharper decline in women's probability of wage employment (7.9 p.p. versus 5.3 p.p. for men) and annual earnings (22 percent versus 17 percent for men). In contrast, we observe zero impact on the probability of self/casual employment for men and women. This result highlights the importance of flexible work hours in the informal sector.

TABLE 9.5 Correlational effect on employment of providing long-term care to parents, by gender, four-country pooled sample

	Employed (1)	Wage Employment (2)	Casual/Self Employment (3)	Weekly Hours Worked (4)	Log Earnings (USD) (5)
Panel A: Male					
Parental Care	-0.056***	-0.053**	-0.001	-3.108***	-0.171**
	(0.018)	(0.022)	(0.022)	(0.996)	(0.084)
Observations	29725	29725	29725	25908	14758
Dep. Var Mean	0.876	0.418	0.458	46.627	7.319
Share of Parent Carer	0.014	0.014	0.014	0.013	0.017
Panel B: Female					
Parental Care	-0.099***	-0.079***	-0.020	-2.709***	-0.228*
	(0.016)	(0.012)	(0.014)	(0.890)	(0.130)
Observations	36519	36519	36519	20284	12067
Dep. Var Mean	0.556	0.276	0.279	39.501	6.994
Share of Parent Carer	0.026	0.026	0.026	0.023	0.028

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, country fixed effect, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, and marital status. Sample includes all individuals aged 40-59 in Poland, Egypt, Indonesia, and Colombia. Log earnings indicate log annual earnings (in USD) conditional on being employed.

Before diving into the results for each specific country, we investigate whether the worse outcomes we observe among women in Table 9.5 are significant. Table 9.6 provides the estimates from equation (2) for all four countries combined where we interact our main explanatory variable (LTC) with the gender indicator to investigate whether there is a significant impact difference between men and women. Columns (1) through (5) confirm what we already observe in Table 9.5: there is a larger negative impact on labor supply among women than among men who provide long-term care for their parents. More notably, we observe a statistically significant differential effect of long-term care on employment, wage employment, and annual earnings between men and women, where the negative effect is less pronounced among males. LTC is associated with a 5.7 percentage points gender employment gap and a 31.5 percent gender earnings gap to women's disadvantage. In contrast, we do not observe meaningful gender differences in the impact on hours worked and self-employment. These results underscore women's disproportionate responsibility to provide LTC and their associated disadvantage in paid employment relative to men. Men's advantage in wage employment also highlights the well-documented observation that women often turn to casual/self-employment, which offers more time flexibility to shoulder the double responsibilities of unpaid care and paid market work.

TABLE 9.6 Gender difference in the effect on employment of providing long-term care to parents, four-country pooled sample

	Employed (1)	Wage Employment (2)	Casual/Self Employment (3)	Weekly Hours Worked (4)	Log Earnings (USD) (5)
Parental Care	-0.087***	-0.087***	0.000	-2.076**	-0.476***
	(0.015)	(0.012)	(0.014)	(0.888)	(0.131)
Male	0.317***	0.150***	0.167***	7.030***	0.676***
	(0.003)	(0.004)	(0.004)	(0.161)	(0.027)
Parental Care * Male	0.057**	0.082***	-0.024	-1.324	0.315**
	(0.025)	(0.026)	(0.025)	(1.332)	(0.155)
Observations	66244	66244	66244	46192	26825
Dep. Var Mean	0.700	0.340	0.359	43.498	7.173
Share of Parent Carer	0.021	0.021	0.021	0.018	0.022

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, country fixed effect, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, and marital status. Sample includes all individuals aged 40-59 in Poland, Egypt, Indonesia, and Colombia. Log earnings indicate log annual earnings (in USD) conditional on being employed.

While the harmonized results are informative, we recognize that there are vast differences among the study countries in culture, social norms, and gender gaps in labor force participation, as shown in Figure 9.1. To investigate how the relationship between parental LTC and labor market outcomes differs across countries, we run equations (1) and (2) separately for each country. Column (1) to (3) in Table 9.7 present the results for men for each country, while columns (4) to (6) present the results for women. LTC has a negative relationship with labor market outcomes for both men and women in Poland and Colombia. However, the difference in impact on women and men is unclear.

TABLE 9.7 Correlational effect of providing long-term care to parents on employment, by country

	Male			Female		
	Employed (1)	Wage Employment (2)	Casual/Self Employment (3)	Employed (4)	Wage Employment (5)	Casual/Self Employment (6)
Panel A: Poland						
Long-term care	-0.158**	-0.223***	0.065	-0.174***	-0.169***	-0.005
	(0.076)	(0.062)	(0.067)	(0.041)	(0.038)	(0.030)
Observations	4768	4768	4768	8653	8653	8653
Dep. Var. mean	0.757	0.525	0.232	0.633	0.489	0.144
Share of parent carer	0.008	0.008	0.008	0.014	0.014	0.014
Panel B: Indonesia						
Long-term care	0.010	-0.077	0.089*	-0.032	-0.038*	0.008
	(0.023)	(0.048)	(0.050)	(0.027)	(0.020)	(0.029)
Observations	4438	4438	4438	3894	3894	3894
Dep. Var. mean	0.956	0.368	0.586	0.725	0.194	0.527
Share of parent carer	0.021	0.021	0.021	0.076	0.076	0.076
Panel C: Colombia						
Long-term care	-0.156***	-0.064	-0.092	-0.195***	-0.110***	-0.085***
	(0.055)	(0.052)	(0.060)	(0.029)	(0.020)	(0.026)

	Male			Female		
	Employed	Wage Employment	Casual/Self Employment	Employed	Wage Employment	Casual/Self Employment
	(1)	(2)	(3)	(4)	(5)	(6)
Panel C: Colombia *(continued)*						
Observations	15727	15727	15727	19153	19153	19153
Dep. Var. mean	0.885	0.324	0.560	0.565	0.225	0.339
Share of parent carer	0.004	0.004	0.004	0.016	0.016	0.016
Panel D: Egypt						
Long-term care	-0.017	-0.005	-0.010	0.035	0.013	0.023
	(0.023)	(0.032)	(0.028)	(0.028)	(0.022)	(0.020)
Observations	4792	4792	4792	4819	4819	4819
Dep. Var. mean	0.894	0.664	0.228	0.247	0.165	0.082
Share of parent carer	0.049	0.049	0.049	0.050	0.050	0.050

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, country fixed effect, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, and marital status. Sample includes all individuals aged 40-59 in Poland, Egypt, Indonesia, and Colombia.

In Poland, providing LTC is associated with 15.8 percentage points and 17.6 percentage points declines in employment for men and women, respectively. This decline seems to be driven entirely by the drop in wage employment, which in general has more rigid hours and schedules. The decline in wage employment is also significantly larger among men. In Colombia, both men and women drop out of employment when they provide LTC to their parents, and, in contrast to Poland, we observe a larger decline in all types of employment among women compared to men. This larger decline in Colombia than Poland might be attributed to the more egalitarian society in Poland, as shown by the smaller gap in labor force participation from Figure 9.1. In Indonesia, we observe a transition from wage employment to informal employment among men when they provide LTC, suggesting the role of more flexibility in the casual employment sector. However, this transition is not observed among Indonesian women who drop out of the wage employment sector. Meanwhile, the result from Egypt shows that the mere presence of a disabled parent in the household does not have any meaningful impact on labor market outcomes for men and women in that country. The null effect may partly be explained by the fact that having parents who need help with daily activities does not necessarily translate to care provided by adult children. For example, in Indonesia, 7.6 percent of males living with older parents need help with daily activities, but only 2 percent provide care to the parents. Similarly, in Colombia, 3.1 percent of women live with disabled parents but less than half of them provide care to the parents (Table 9.2). We also provide evidence of correlations in terms of hours worked and earnings for each country. Those results are presented in Annex Table 9A.1.

How does the intensity of parental care affect labor supply among men and women?

In the previous section, we investigated how the decision to provide long-term parental care affects labor supply among men and women. However, a substantial heterogeneity exists across individuals in the intensity/number of hours spent caring for parents per week. In Table 9.8, we take a closer look into the relationship between labor supply and the hours spent per week on providing parental care. We exclude Egypt in this harmonized sample, as the Egyptian data do not provide information on the intensity of parental care. In general, we observe that, conditional on providing parental care, women on average devote 0.5 to 1 hour more per week to care compared to men. Similar to the previous findings, both men and women experienced a significant decline in both the extensive margin of work and weekly hours worked. In general, a 10 percent increase in hours of providing parental care is associated with a 0.4 percentage points and a 0.6 percentage points decline in the probability of employment for men and women, respectively. Both men and women also experience fewer hours worked, conditional on being employed. In Panel C, we test whether the differ-

ence between men and women in the impact of care intensity on labor supply is significant. Contrary to our hypothesis, we find that the impact on men is slightly higher, indicating that additional time for providing parental care reduces the labor supply of men more than women. One possible explanation for this is the higher proportion of men who are in formal employment, where there is less flexibility in work schedules. The added responsibility of parental care might drive men in this situation to be more likely to leave their employment.

TABLE 9.8 Correlational effect on employment of care hours devoted to parents, pooled sample from three countries

	Employed (1)	Wage Employment (2)	Casual/Self Employment (3)	Weekly Hours Worked (4)	Log Earnings (USD) (5)
Panel A: Male					
Log Care Hours	-0.039***	-0.050***	0.012	-1.754***	-0.122*
	(0.012)	(0.013)	(0.015)	(0.673)	(0.070)
Observations	25396	25396	25396	22161	12468
Dep. Var Mean	0.875	0.369	0.505	46.356	7.311
Mean Hours Cared	13.496	13.496	13.496	13.386	14.671
Panel B: Female					
Care Hours	-0.055***	-0.041***	-0.014*	-1.348***	-0.112*
	(0.008)	(0.006)	(0.007)	(0.453)	(0.061)
Observations	32890	32890	32890	19955	12265
Dep. Var Mean	0.608	0.289	0.318	39.397	6.845
Mean Hours Cared	14.086	14.086	14.086	14.474	15.886
Panel C: Interaction					
Care Hours	-0.044***	-0.038***	-0.005	-0.965**	-0.217***
	(0.008)	(0.006)	(0.007)	(0.454)	(0.061)
Male	0.265***	0.102***	0.164***	6.679***	0.764***
	(0.003)	(0.004)	(0.004)	(0.167)	(0.028)
Care Hours*Male	-0.026*	-0.025*	-0.000	-1.300	0.132
	(0.015)	(0.014)	(0.016)	(0.815)	(0.092)
Observations	58286	58286	58286	42116	24733
Dep. Var Mean	0.724	0.324	0.399	43.059	7.080
Mean Hours Cared	13.959	13.959	13.959	14.169	15.537

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, country fixed effects, and marital status. The regression includes individuals aged 40-59 from Poland, Colombia, and Indonesia. Individuals from Egypt are excluded because there is no information on amount of time devoted to parental care. Log earnings indicate log annual earnings (in USD) conditional on being employed.

HETEROGENEITY

Educational level

We proceed to observe how educational level interacts with the relationship between labor supply and older parental care. The feminization-U hypothesis suggests that the relationship between female labor supply and education is U-shaped, where it is higher for low- and high-skilled women and lower for middle-skilled women (Goldin 1995). Women with less education are driven by the necessity to be employed. But as women gain more education, the income effect starts to dominate the substitution effect. Women then tend to demand more leisure and drop out of the labor force. As women become highly educated, however, the substitution effect begins to dominate again, with increased opportunity costs of staying out of the labor force.

In Table 9.9, we observe how an individual's highest educational level interacts with the relationship between long-term care provision/disabled parent and labor supply. The omitted educational level category here includes those whose highest level of education is primary school or less. Indeed, we do see that the coefficients make a U-shape for women, where the negative effect is greater in magnitude among women with a "middle" educational level (secondary) than among those with low (primary or less) or high (tertiary) levels. Meanwhile, there is no differential impact on employment based on education level among men. Conditional on working, we do not see a differential effect of LTC on hours worked by education level for either men or women. For women, the results suggest that the impact of LTC on earnings is alleviated among women with tertiary education.

TABLE 9.9 Heterogeneous effect of long-term care provision by education level, pooled sample from four countries

	Male			Female		
	Employed (1)	Hours worked/week (2)	Log earnings (USD) (3)	Employed (4)	Hours worked/week (5)	Log earnings (USD) (6)
Parental Care	-0.044	-3.569*	-0.142	-0.040*	-2.582*	-0.582***
	(0.029)	(1.919)	(0.112)	(0.023)	(1.516)	(0.220)
Parental Care * Secondary educated	-0.026	2.107	-0.239	-0.116***	-0.166	0.285
	(0.040)	(2.365)	(0.177)	(0.034)	(2.218)	(0.302)
Parental Care * Tertiary educated	-0.005	-2.104	0.345	-0.077*	-0.272	0.950***
	(0.046)	(2.590)	(0.217)	(0.043)	(1.903)	(0.315)
Observations	29725	25908	14758	36519	20284	12067
Dep. var. mean	0.876	46.627	7.319	0.556	39.501	6.994
Share of parent carer	0.014	0.013	0.017	0.026	0.023	0.028

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, country fixed effects, and marital status. The regression includes individuals from Poland, Colombia, Indonesia, and Egypt. Log earnings indicate log annual earnings (in USD) conditional on being employed.

Presence of children

This section tests how the presence of children in the household may affect the relationship between labor supply and providing parental care. Specifically, we test whether there is a differential impact on labor supply in the "sandwich" generation, where individuals have to take care of both young children and older parents in the household. On the one hand, the double care responsibility can impose an extra burden on employed adults and encourage a decline in labor supply. On the other hand, older children (ages 13 to 18) may help employed adults provide parental care in the household.

Table 9.10 shows that the presence of older children in the household, especially children ages 13 to 18, helps male adults stay in their jobs when there is a parental care responsibility. However, we also observe that this presence of older children exacerbates the negative impact on work hours among male adults, conditional on working. In contrast, the presence of older children does not affect women's already-heavy parental care burden. Further, we observe a positive interaction between care provision for aged parents and the number of young children ages 0 to 6. While it is not definitive, one possible explanation for this is that older adults might be able to help out with supervising young children. Another possible explanation is that the care burden may exhibit economies of scale, meaning that additional dependents affect women's labor force participation decision to a lesser degree than the first dependent in need of care.

TABLE 9.10 Heterogeneous effect of long-term care provision by presence of children in household, pooled sample from four countries

	Male			Female		
	Employed (1)	Hours worked/week (2)	Log earnings (USD) (3)	Employed (4)	Hours worked/week (5)	Log earnings (USD) (6)
Parental Care	-0.092***	-2.027	-0.215	-0.120***	-2.900***	-0.106
	(0.026)	(1.360)	(0.142)	(0.020)	(1.081)	(0.157)
Parental Care * # children age 0-6	-0.009	-0.792	0.056	0.077**	0.019	-0.282
	(0.018)	(1.403)	(0.090)	(0.030)	(1.466)	(0.232)
Parental Care * # children age 7-12	0.028	1.539	-0.032	0.019	1.028	0.059
	(0.018)	(1.307)	(0.093)	(0.027)	(1.753)	(0.251)
Parental Care * # children age 13-18	0.046**	-2.687**	0.063	-0.003	-0.271	-0.167
	(0.021)	(1.342)	(0.094)	(0.024)	(1.538)	(0.225)
Observations	29725	25908	14758	36519	20284	12067
Dep. var. mean	0.876	46.627	7.319	0.556	39.501	6.994
Share of parent carer	0.014	0.013	0.017	0.026	0.023	0.028

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, country fixed effects, and marital status. The regression includes individuals aged 40-59 from Poland, Colombia, Indonesia, and Egypt. Log earnings indicate log annual earnings (in USD) conditional on being employed.

ROBUSTNESS CHECK

The presence of adult household members

In this section, we test sensitivity of our results by examining whether and how the relationship between LTC and labor supply will change with the presence of adult men/women in the household. Specifically, the hypothesis here is that the presence of adult women in the household may help other women participate in the labor market by mitigating the care burden, while the presence of adult men may reduce that probability due to gender stereotypes whereby men are expected to preferentially join the labor force. In this section, we test whether including the number of adult males and adult females in the household would change the relationship between LTC and labor supply for men and women.

Table 9.11 presents our results. Columns (1) and (3) show results from the original specification for males and females, respectively. Columns (2) and (4) show the results when including the number of adult males and females in the household in the main specification control variables. The results show that, in general, controlling for the number of adult males and adult females does not signifi-

cantly change our results. However, this table also confirms our previous hypothesis. Among female individuals, the presence of other adult women in the household seems to increase the probability of employment. We also observe that the presence of male adults seems to diminish the probability of employment among female individuals. This result may be driven by gender-cultural norms, where male adults are more likely than women to enter the labor force.

TABLE 9.11 Sensitivity check: including the number of adult females/males in households

	Employed			
	Male		Female	
	(1)	(2)	(3)	(4)
Parental Care	-0.056***	-0.056***	-0.099***	-0.099***
	(0.018)	(0.018)	(0.016)	(0.016)
Number of Adult Male in HH		-0.006**		-0.010***
		(0.003)		(0.003)
Number of Adult Female in HH		-0.003		0.007**
		(0.003)		(0.004)
Observations	29725	29725	36519	36519
Mean	0.876	0.876	0.556	0.556
Share of Parent Carer	0.014	0.014	0.026	0.026

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, country fixed effects, and marital status. The regression includes individuals aged 40-59 from Poland, Colombia, Indonesia, and Egypt. HH=household.

Intensity of parental care

Past literature has indicated that the length of caregiving that adults provide has a non-trivial impact on labor supply. Chai et al. (2021) find that only women who provide more than eight hours of care per week experience negative associated changes in labor force participation. Walsh & Murphy (2018) provide similar evidence among those who provide more than 15 hours of care per week in Ireland. To investigate further, we conduct additional analysis looking into how labor supply is differentially affected by the intensity of parental care. To do this, we divide our sample into three categories. First, some individuals do not provide care for their older parents. The second category consists of individuals who provide parental care, but do so for less than 10 hours per week. The third category includes those who provide lengthy parental care of more than 10 hours per week.

Table 9.12 presents our results. In general, these align with findings in the previous literature. We find that, while there is a negative effect on employment among men and women who provide less than 10 hours of care per week, the effect is substantially larger among those who provide more than 10 hours of care per week. Moreover, individuals who provide more than 10 hours of care per week also work fewer hours and earn significantly less, while this reduction is not observed among those who are not intensive caregivers. These results indicate that the relationship between parental care and labor supply might not be linear; as the responsibility of caregiving gets larger, the effect on labor supply will be amplified.

TABLE 9.12 Correlational effect on employment of the intensity of long-term care provision to parents, pooled sample from three countries

	Employed (1)	Wage Employment (2)	Casual/Self Employment (3)	Weekly Hours Worked (4)	Log Earnings (USD) (5)
Panel A: Male					
Care Hours (1-10 Hrs)	-0.086**	-0.066	-0.019	-3.642	-0.136
	(0.039)	(0.047)	(0.049)	(2.359)	(0.253)
Care Hours (>10 Hrs)	-0.117**	-0.190***	0.075	-5.634**	-0.500*
	(0.047)	(0.045)	(0.056)	(2.199)	(0.265)
Observations	25368	25368	25368	22137	12450
Dep. Var Mean	0.875	0.369	0.505	46.367	7.312
Mean Hours Cared	15.506	15.506	15.506	15.684	17.085
Panel B: Female					
Care Hours (1-10 Hrs)	-0.127***	-0.092***	-0.033	-1.503	-0.100
	(0.025)	(0.018)	(0.023)	(1.329)	(0.202)
Care Hours (>10 Hrs)	-0.151***	-0.118***	-0.034	-4.835***	-0.532**
	(0.029)	(0.022)	(0.027)	(1.720)	(0.230)
Observations	32890	32890	32890	19955	12265
Dep. Var Mean	0.608	0.289	0.318	39.397	6.845
Mean Hours Cared	14.086	14.086	14.086	14.474	15.886

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, country fixed effects, and marital status. The regression includes individuals aged 40-59 from Poland, Colombia, and Indonesia. Individuals from Egypt are excluded because there is no information on the intensity of parental care. Log earnings indicate log annual earnings (in USD) conditional on being employed.

CONCLUSION

The population of older adults worldwide is projected to increase significantly in the coming years. This surge is expected to be accompanied by an increase in demand for informal care, the bulk of which will be borne by women. Because of this, analyzing how parental care differentially affects the labor supply between men and women is imperative in designing policies that may alleviate the forgone labor market opportunities that come with additional care responsibility.

Our main analysis from all four countries confirms that women provide the large majority of care for aging parents. We also observe a negative relationship between parental caregiving and labor supply, with a larger correlation among women. Further analysis also shows a significantly larger effect among intensive caregivers: those who provide parental care for more than 10 hours per week. When looking at specific countries, the results from Poland and Colombia suggest that both men and women who provide parental care are significantly less likely to be employed. In cases where there is no employment change, as in Indonesia, men may transition from formal work to informal work, while the same transition is not observed in women. In Egypt, this study shows that the mere presence of a disabled parent in the household is not accompanied by a significant change in labor supply for either gender.

We observe some degree of heterogeneity in the relationship between long-term care and labor supply, based on individuals' educational levels and the presence of young children in the household. This provides us with a glimpse into the evidence of the increasing opportunity cost of parental care

among those who are highly educated and suggests how the presence of children affects the relationship between care provision and labor supply.

With this study's focus on developing countries, we add to the vast literature on the relationship between informal care and labor supply, much of which has foregrounded developed countries. While the evidence presented in this study is not causal, our results can contribute to future policy dialogue to reduce the gender imbalance in LTC burdens, particularly in rapidly aging regions where the gender gap in labor market participation is large.

REFERENCES

1. Agree, Emily, and Karen Glaser. 2009. "Demography of Informal Caregiving." In *International Handbook of Population Aging*, edited by Peter Uhlenberg. Springer Dordrecht. https://link.springer.com/book/10.1007/978-1-4020-8356-3.
2. Bittman, Michael, Trish Hill, and Cathy Thomson. 2007. "The Impact of Caring on Informal Carers' Employment, Income and Earnings: A Longitudinal Approach." *Australian Journal of Social Issues* 42 (2): 255–72. https://doi.org/10.1002/j.1839-4655.2007.tb00053.x.
3. Bolin, Kristian, Bjorn Lindgren, and Petter Lundborg. 2008. "Your next of Kin or Your Own Career?" *Journal of Health Economics* 27 (3): 718–38. https://doi.org/10.1016/j.jhealeco.2007.10.004.
4. Carmichael, Fiona, and Susan Charles. 2003. "The Opportunity Costs of Informal Care: Does Gender Matter?" *Journal of Health Economics* 22 (5): 781–803. https://doi.org/10.1016/s0167-6296(03)00044-4.
5. Chai, Huamin, Rui Fu, and Peter C. Coyte. 2021. "Unpaid Caregiving and Labor Force Participation among Chinese Middle-Aged Adults." *International Journal of Environmental Research and Public Health* 18 (2): 641. https://doi.org/10.3390/ijerph18020641.
6. Chen, Lu, Na Zhao, Hongli Fan, and Peter C. Coyte. 2016. "Informal Care and Labor Market Outcomes: Evidence from Chinese Married Women." *Research on Aging* 39 (2): 345–71. https://doi.org/10.1177/0164027515611184.
7. Ciccarelli, Nicola, and Arthur Van Soest. 2018. "Informal Caregiving, Employment Status and Work Hours of the 50+ Population in Europe." *De Economist* 166 (3): 363–96. https://doi.org/10.1007/s10645-018-9323-1.
8. Connelly, Rachel, Xiao-yuan Dong, Joyce Jacobsen, and Yaohui Zhao. 2018. "The Care Economy in Post-Reform China: Feminist Research on Unpaid and Paid Work and Well-Being." *Feminist Economics* 24 (2): 1–30. https://doi.org/10.1080/13545701.2018.1441534.
9. Crespo, Laura, and Pedro Mira. 2014. "Caregiving to Elderly Parents and Employment Status of European Mature Women." *Review of Economics and Statistics* 96 (4): 693–709. https://doi.org/10.1162/rest_a_00426.
10. England, Paula, and Nancy Folbre. 1999. "The Cost of Caring." *The Annals of the American Academy of Political and Social Science* 561 (1): 39–51. https://doi.org/10.1177/000271629956100103.
11. Ettner, Susan L. 1995. "The Impact of 'Parent Care' on Female Labor Supply Decisions." *Demography* 32 (1): 63. https://doi.org/10.2307/2061897.
12. Fahle, Sean, and Kathleen McGarry. 2018. "Caregiving and Work: The Relationship between Labor Market Attachment and Parental Caregiving." *Innovation in Aging* 2 (suppl_1): 580–80. https://doi.org/10.1093/geroni/igy023.2150.
13. Fevang, Elisabeth, Snorre Kverndokk, and Knut Røed. 2012. "Labor Supply in the Terminal Stages of Lone Parents' Lives." *Journal of Population Economics* 25 (4): 1399–1422. https://doi.org/10.1007/s00148-012-0402-3.
14. Folbre, Nancy. 2014. "Who Cares? A Feminist Critique of the Care Economy." New York, NY: Rosa Luxemburg Stiftung. https://rosalux.nyc/a-feminist-critique-of-the-care-economy/.
15. Goldin, Claudia. 2004. "The U-Shaped Female Labor Force Function in Economic Development and Economic History." In *Investment in Women's Human Capital and Economic Development*, edited by T. Paul Schultz. University of Chicago Press. https://scholar.harvard.edu/goldin/publications/u-shaped-female-labor-force-function-economic-development-and-economic-history.
16. Heger, Dörte, and Thorben Korfhage. 2020. "Short- and Medium-Term Effects of Informal Eldercare on Labor Market Outcomes." *Feminist Economics* 26 (4): 205–27. https://doi.org/10.1080/13545701.2020.1786594.
17. Himmelweit, Susan. 1999. "Caring Labor." *The Annals of the American Academy of Political and Social Science* 561 (1): 27–38. https://doi.org/10.1177/000271629956100102.
18. Huang, Guogui, Fei Guo, and Gong Chen. 2021. "The Role and Wellbeing of Female Family Caregivers in the Provision of Aged Care in China." *Social Indicators Research* 159 (2): 707–31. https://doi.org/10.1007/s11205-021-02769-6.
19. International Labour Organisation (ILO). 2018. "Care Work and Care Jobs for the Future of Decent Work." Geneva, Switzerland: International Labour Office. https://www.ilo.org/global/publications/books/WCMS_633135/lang--en/index.htm.
20. Johnson, Richard W., and Anthony T. Lo Sasso. 2000. "The Trade-off between Hours of Paid Employment and Time Assistance to Elderly Parents at Midlife." Washington, D.C. : The Urban Institute.
21. ———. 2006. "The Impact of Elder Care on Women's Labor Supply." *INQUIRY: The Journal of Health Care Organization, Provision, and Financing* 43 (3): 195–210. https://doi.org/10.5034/inquiryjrnl_43.3.195.
22. Kotsadam, Andreas. 2011. "Does Informal Eldercare Impede Women's Employment? The Case of European Welfare States." *Feminist Economics* 17 (2): 121–44. https://doi.org/10.1080/13545701.2010.543384.
23. Liu, Huan, and Meng Wang. 2022. "Socioeconomic Status and ADL Disability of the Older Adults: Cumulative Health Effects, Social Outcomes and Impact Mechanisms." Edited by Petri Böckerman. *PLOS ONE* 17 (2): e0262808. https://doi.org/10.1371/journal.pone.0262808.
24. Liu, Lan, Xiao-yuan Dong, and Xiaoying Zheng. 2010. "Parental Care and Married Women's Labor Supply in Urban China." *Feminist Economics* 16 (3): 169–92. https://doi.org/10.1080/13545701.2010.493717.

25. Mao, Shangyi, Rachel Connelly, and Xinxin Chen. 2017. "Stuck in the Middle: Off-Farm Employment and Caregiving among Middle-Aged Rural Chinese." *Feminist Economics* 24 (2): 100–121. https://doi.org/10.1080/13545701.2017.1387670.
26. Moussa, Margaret Malke. 2018. "The Relationship between Elder Care-Giving and Labour Force Participation in the Context of Policies Addressing Population Ageing: A Review of Empirical Studies Published between 2006 and 2016." *Ageing and Society* 39 (06): 1281–1310. https://doi.org/10.1017/s0144686x18000053.
27. Nguyen, Ha Trong, and Luke Brian Connelly. 2014. "The Effect of Unpaid Caregiving Intensity on Labour Force Participation: Results from a Multinomial Endogenous Treatment Model." *Social Science & Medicine* 100 (January): 115–22. https://doi.org/10.1016/j.socscimed.2013.10.031.
28. Sinha, Aashima, and Ashish Kumar Sedai. 2022. "Why Care for the Care Economy: Empirical Evidence from Nepal." Centre for Applied Macroeconomic Analysis (CAMA) Working Paper 31/2022. The Australian National University. https://doi.org/10.2139/ssrn.4078353.
29. Stampini, Marco, María Laura Oliveri, Pablo Ibarrarán, Diana Londoño, Ho June Sean) Rhee, and Gillinda M. James. 2020. "Working Less to Take Care of Parents?: Labor Market Effects of Family Long-Term Care in Latin America." IDB Working Paper Series No. 1105. Inter-American Development Bank (IDB). https://doi.org/10.18235/0002738.
30. Terkoğlu, Özge İzdeş, and Emel Memiş. 2022. "Impact of Elderly Care on 'Sandwiched-Generation' Women in Turkey." *New Perspectives on Turkey* 66 (May): 88–121. https://doi.org/10.1017/npt.2022.12.
31. UN Women. 2017. "Long-Term Care for Older People: A New Global Gender Priority." Policy Brief No. 9. UN Women. https://www.unwomen.org/en/digital-library/publications/2017/12/long-term-care-for-older-people.
32. Van Houtven, Courtney H., Norma B. Coe, and Meghan M. Skira. 2013. "The Effect of Informal Care on Work and Wages." *Journal of Health Economics* 32 (1): 240–52. https://doi.org/10.1016/j.jhealeco.2012.10.006.
33. Wang, Yafeng, and Chuanchuan Zhang. 2017. "Gender Inequalities in Labor Market Outcomes of Informal Caregivers near Retirement Age in Urban China." *Feminist Economics* 24 (2): 147–70. https://doi.org/10.1080/13545701.2017.1383618.
34. World Health Organization (WHO). 2022. "Ageing and Health." Fact Sheet. World Health Organization. October 1, 2022. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health.

ANNEX 9.1

TABLE 9A.1 Correlational effect on employment of providing long-term care to parents

	Male		Female	
	Hours worked/ week	Log earnings (USD)	Hours worked/ week	Log earnings (USD)
	(1)	(2)	(3)	(4)
Panel A: Poland				
Long-term care	-6.589***	-0.351**	-3.436**	-0.113*
	(2.541)	(0.144)	(1.637)	(0.064)
Observations	3608	2164	5477	3521
Dep. var. mean	43.091	8.514	38.558	8.381
Share of parent carer	0.005	0.007	0.010	0.010
Panel B: Indonesia				
Long-term care	-5.209**	-0.379**	-0.572	-0.265
	(2.267)	(0.190)	(1.625)	(0.181)
Observations	4194	4207	2799	2792
Dep. var. mean	39.070	6.580	34.158	4.878
Share of parent carer	0.017	0.017	0.055	0.055
Panel C: Colombia				
Long-term care	-3.317	0.394	-5.838***	-0.017
	(2.181)	(0.489)	(1.460)	(0.348)
Observations	13912	5650	10816	5094
Dep. var. mean	49.733	7.469	41.714	7.174
Share of parent carer	0.003	0.003	0.011	0.010

	Male		Female	
	Hours worked/ week	Log earnings (USD)	Hours worked/ week	Log earnings (USD)
	(1)	(2)	(3)	(4)
Panel D: Egypt				
Long-term care	-2.045	-0.084	-0.843	-0.071
	(1.345)	(0.058)	(1.581)	(0.082)
Observations	4194	2737	1192	660
Dep. var. mean	46.921	7.201	36.301	7.147
Share of parent carer	0.047	0.047	0.073	0.078

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, country fixed effect, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, and marital status. Sample includes all individuals aged 40-59 in Poland, Egypt, Indonesia, and Colombia.

TABLE 9A.2 Gender difference in the effect on employment of providing long-term care to parents

	Employed	Wage Employment	Casual/Self Employment	Weekly Hours Worked	Log Earnings (USD)
	(1)	(2)	(3)	(4)	(5)
Panel A: Poland					
Parental Care	-0.159***	-0.150***	-0.009	-3.544**	-0.099
	(0.041)	(0.037)	(0.030)	(1.652)	(0.065)
Male	0.140***	0.059***	0.081***	4.530***	0.192***
	(0.008)	(0.009)	(0.007)	(0.220)	(0.011)
Parental Care * Male	-0.065	-0.150**	0.086	-3.495	-0.306*
	(0.086)	(0.073)	(0.073)	(3.054)	(0.161)
Observations	13421	13421	13421	9085	5685
Dep. Var Mean	0.677	0.502	0.175	40.358	8.432
Share of Parent Carer	0.012	0.012	0.012	0.008	0.009
Panel B: Indonesia					
Parental Care	-0.022	-0.034*	0.013	-0.599	-0.246
	(0.027)	(0.021)	(0.029)	(1.621)	(0.184)
Male	0.229***	0.151***	0.081***	4.113***	1.589***
	(0.009)	(0.009)	(0.011)	(0.595)	(0.058)
Parental Care * Male	0.005	-0.060	0.066	-4.876*	-0.302
	(0.036)	(0.052)	(0.058)	(2.774)	(0.273)
Observations	8332	8332	8332	6993	6999
Dep. Var Mean	0.848	0.286	0.558	37.104	5.901
Share of Parent Carer	0.046	0.046	0.046	0.042	0.042
Panel C: Colombia					
Parental Care	-0.167***	-0.093***	-0.073***	-5.289***	0.011
	(0.029)	(0.020)	(0.026)	(1.475)	(0.351)
Male	0.329***	0.106***	0.223***	8.179***	0.353***
	(0.004)	(0.005)	(0.005)	(0.212)	(0.049)
Parental Care * Male	-0.068	-0.014	-0.054	0.819	0.296
	(0.064)	(0.056)	(0.065)	(2.620)	(0.598)
Observations	34880	34880	34880	24728	10744

Panel C: Colombia *(continued)*					
Mean	0.709	0.270	0.439	46.226	7.329
Share of Parent Carer	0.010	0.010	0.010	0.007	0.006
Panel D: Egypt					
Parental Care	0.049*	0.020	0.030	-0.529	-0.109
	(0.029)	(0.023)	(0.020)	(1.566)	(0.077)
Male	0.610***	0.450***	0.158***	10.902***	0.186***
	(0.009)	(0.010)	(0.008)	(0.574)	(0.027)
Parental Care * Male	-0.087**	-0.039	-0.047	-1.810	0.024
	(0.037)	(0.039)	(0.033)	(2.051)	(0.096)
Observations	9611	9611	9611	5386	3397
Dep. Var Mean	0.570	0.414	0.155	44.571	7.191
Share of Parent Carer	0.049	0.049	0.049	0.051	0.050

Notes: Robust standard errors in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1%, respectively. Each regression includes individual and household-level characteristics: individual age, age-squared, highest educational level, number of children aged 0-6, 7-12, and 13-18 in the household, country fixed effects, and marital status. The regression includes individuals aged 40-59 from Poland, Colombia, and Indonesia.

FIGURE 9A.1 Kernel density of long-term care provision by age and country

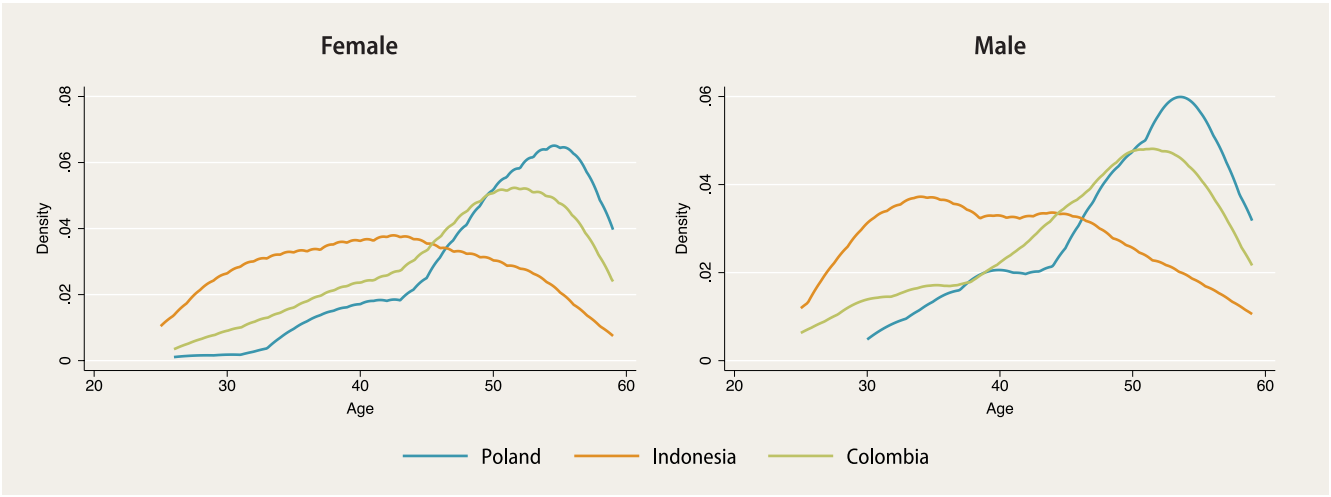


FIGURE 9A.2 Work hours and care hours gradient

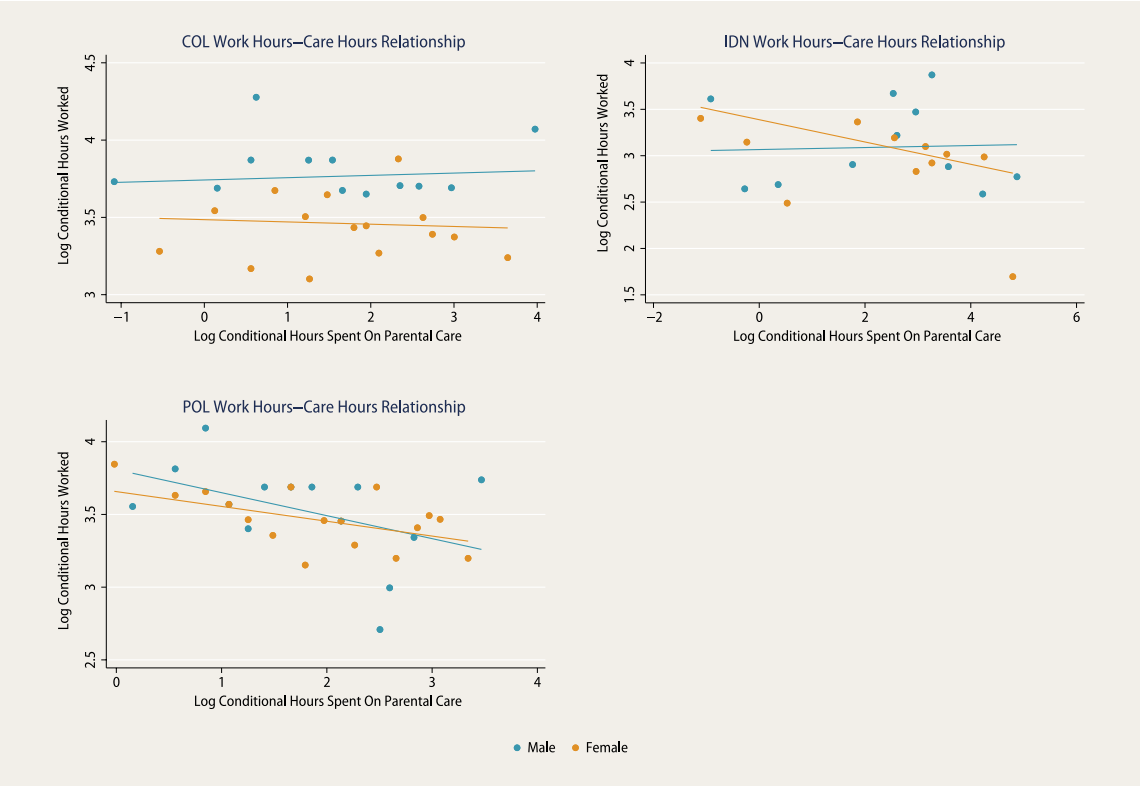


FIGURE 9A.3 Correlation between time spent on long-term care and employment



FIGURE 9A.4 Correlational effect of providing long-term care on individual employment by choice of control group

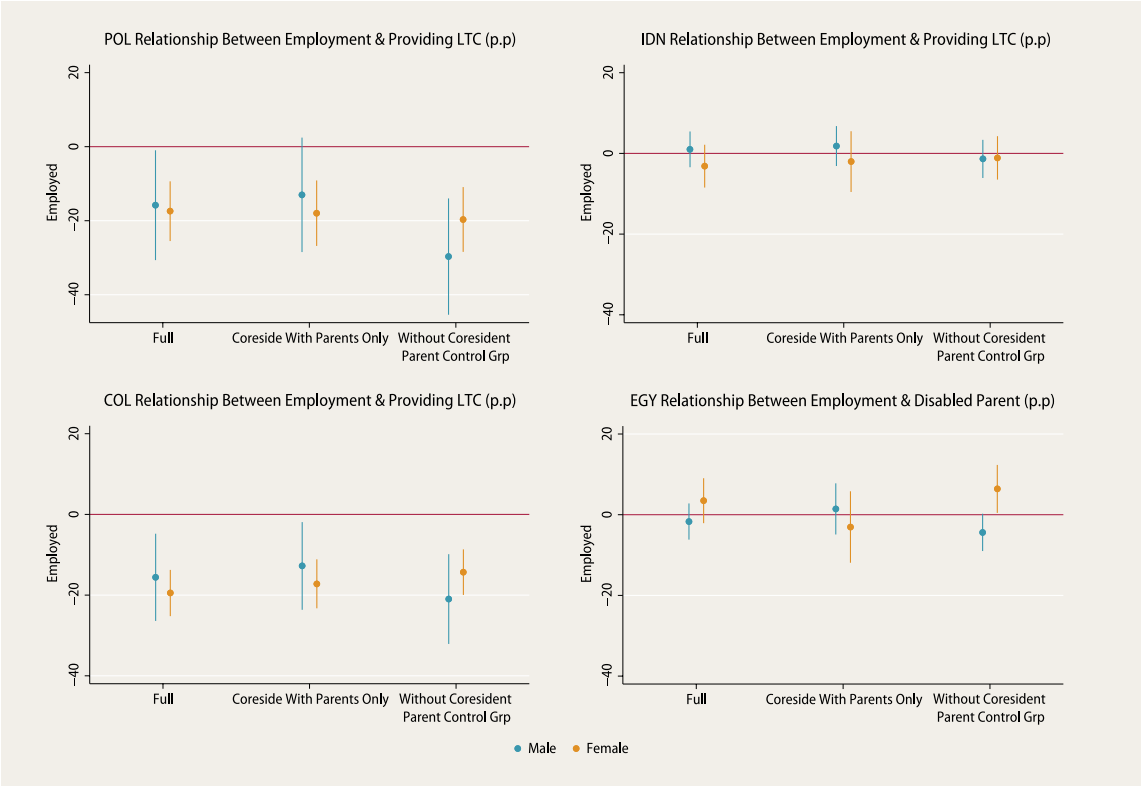


FIGURE 9A.5 Correlational effect of providing long-term care on annual earnings by choice of control group

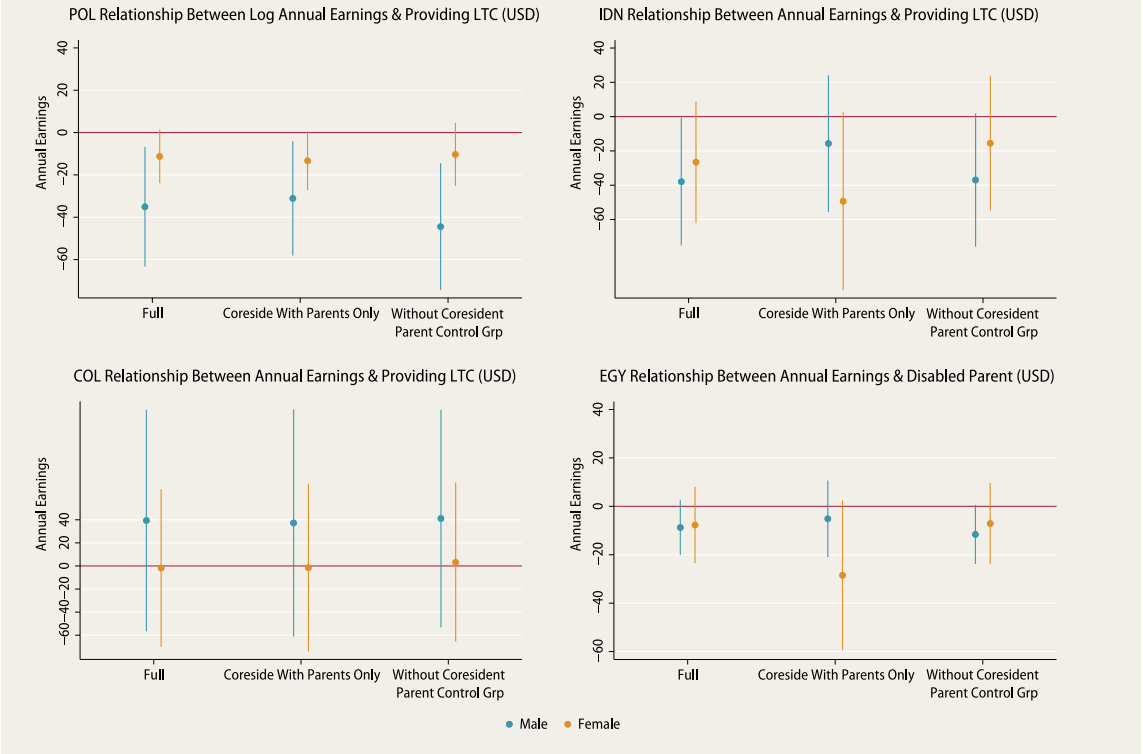
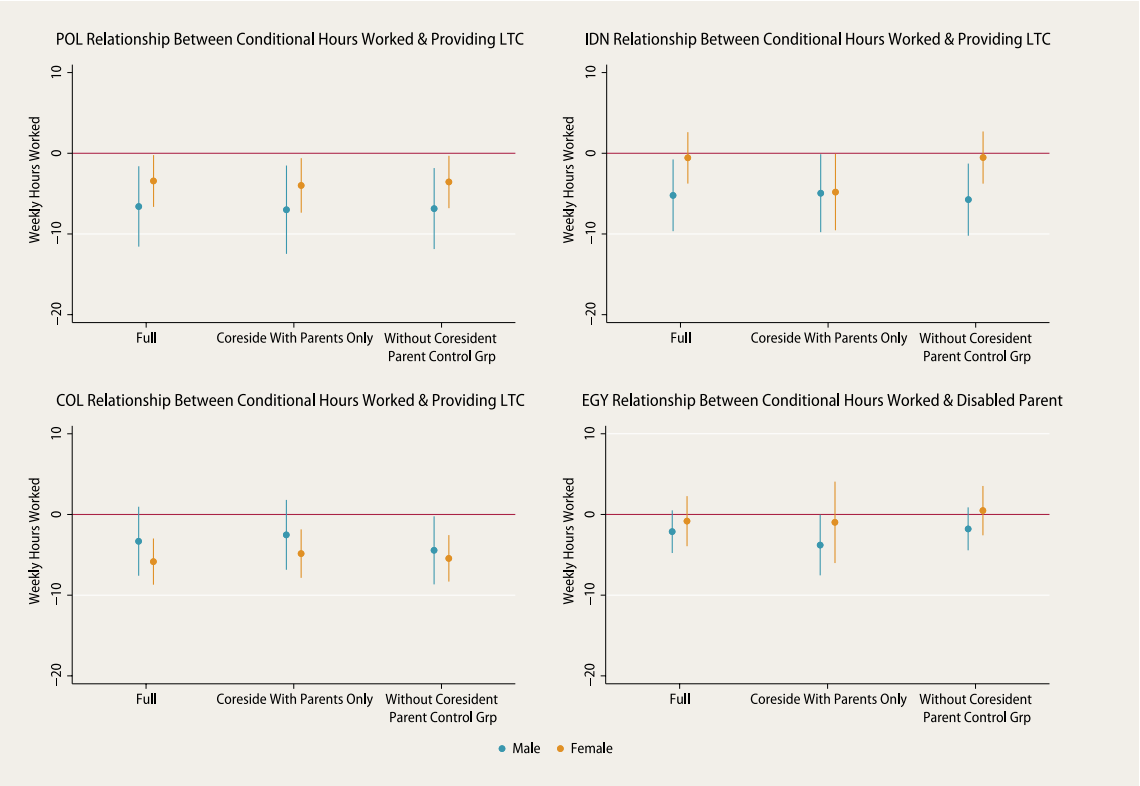


FIGURE 9A.6 Correlational effect of providing long-term care on work hours by choice of control group



Long-term Care

Chapter 10
Health and Long-term Care Needs in a Context of Rapid Population Aging

Chapter 11
Demand for and Supply of Long-Term Care for Older Persons in Low- and Middle-Income Countries



10

Health and Long-Term Care Needs in a Context of Rapid Population Aging

Natalia Aranco Araújo [a] *and Gisela M. Garcia* [b]

[a] Independent Consultant
[b] IEG Human Development and Corporate Program, World Bank

INTRODUCTION

Population aging is a global phenomenon: people all over the world are living longer. Undoubtedly, this is good news. Extended longevity reflects the social and economic progress of societies; it is the result of innumerable advancements in medicine, nutrition, education, and technology, bringing increased opportunities for both individuals and countries alike.

One of the consequences of this aging process has to do with the challenges that an aging population poses for countries' health care and long-term care arrangements. A longer life increases the probability of disease, disability, and the loss of functional autonomy (WHO 2015). Thus, an increase in the share of older individuals put pressures on health care and long-term care systems, which need to adapt to a new pattern of demand, characterized by growth in the prevalence of chronic diseases and in the rates of functional dependency.

These pressures are even more critical in developing countries, given the unprecedented speed of their demographic transition and the resource constraints, limited-service coverage, barriers to access to services, and low-quality services that characterize many of these countries. Yet the predictability of the demographic and epidemiological changes provides governments with an unprecedented opportunity to intervene proactively to find effective and innovative solutions to address the needs of the elderly (UN 2015a, 2017a).

Ensuring that the elderly enjoy the best possible health is not only an aim in its own right but is also justified on economic grounds. Older people's contributions to societies, in the form of financial support to younger generations, help with childcare, participation in labor markets, and volunteerism, among others, can only materialize if gains in longevity are translated into years lived in good health (UN 2017a).[1]

This literature review identifies key challenges in health care and long-term care as populations age and provides relevant examples of how countries are responding. The study was developed as a background report for the Independent Evaluation Group evaluation "World Bank Support to Aging Countries." It focuses on developing countries that are aging fast, where anticipation and action are important, highlighting steps and policies that some countries have been adopting to address the challenges.

A comprehensive review of all health and long-term care policies and actions taken by countries is outside the scope of the study. Instead, we aim to highlight selected examples that illustrate diverse country responses to the different challenges posed by population aging.

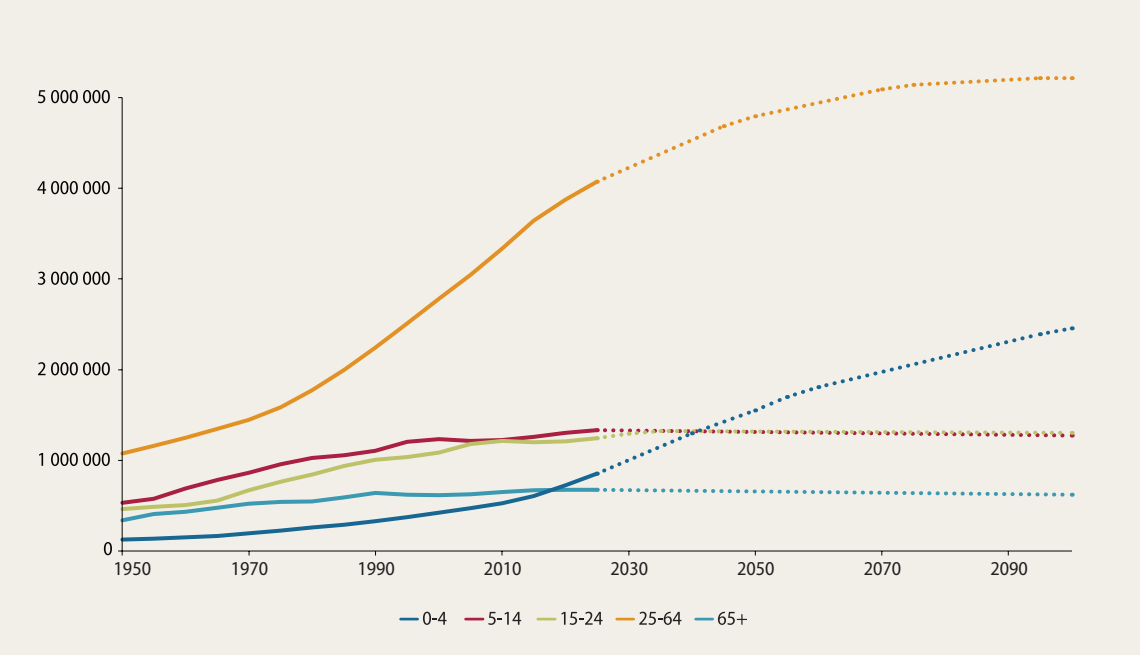
The chapter is organized as follows. The Main Trends in Longevity section provides a brief overview of the trends in increasing longevity observed in countries in different stages of the demographic transition over the last decades; it also shows where the gains in life expectancy have been translated into gains in healthy life expectancy. The Aging, Health, and the Challenges for Health Care Systems section focuses on the consequences of the demographic transition for the epidemiological profile of aging countries and the implications for health care systems; this section also provides some examples of how countries are responding to the challenges. Increasing Risk of Functional Dependency and Challenges for Long-Term Care Systems section discusses the implications of an aging population for long-term care services; this section also presents examples of countries' efforts to address rising long-term care needs in a context of shrinking families. The Final Remarks and Key Policy Consideration section concludes.

1 The need to promote the health and wellbeing of older people, and to make sure that they are considered in the development process, ensuring supportive environments that allow them to contribute fully to society, was recognized in the 2002 *Madrid International Plan of Action on Aging* (MIPAA), adopted at the Second World Assembly on Aging (UN 2002), and was further reinforced in the United Nations 2030 Sustainable Development Goals (Zaidi 2016).

MAIN TRENDS IN LONGEVITY

All over the world, people are living longer. As a result, the proportion of older people in the global population is increasing. Global average life expectancy at birth has risen from 47 years in 1950 to 72.6 years in 2019 (UN-WPP 2019). According to the United Nations medium variant projections,[2] average life expectancy at birth is expected to reach 77.1 years by 2050 and the share of people aged 65 years or more worldwide to rise from 9 percent in 2019 to 12 percent in 2030 and 16 percent in 2050. In 2018, for the first time in history, the number of individuals 65 years old or more surpassed that of children younger than five years old (UN 2019) (Figure 10.1).

FIGURE 10.1 Population by broad age group (thousands), estimates 1950-2020 and projections 2025-2100



Source: United Nations Population Highlights 2019, Figure 12.
Note: 2050 projections are based on the United Nations "medium variant" assumptions.

Life expectancy is also increasing at older ages. Thanks to progress made in disease management and control, global average life expectancy at age 60 increased almost three years between 1990-1995 and 2015-2020, rising from 18.1 to 20.7 (UNWPP 2019). Thus, the share of the "oldest old" is also increasing, and individuals aged 80 years or more went from representing 1 percent of the world's total population in 1990, to 1.9 percent in 2019, and an estimated 4.4 percent in 2050 (UNWPP 2019).

This trend is seen in all regions of the world, and it is expected to continue, albeit at different levels and rates, depending on the stage of the demographic transition in each country (see Box 10.1 for a definition of an aging country). Overall, the number of people 65 years old or more is projected to increase by almost 2 billion from 2020 to 2050; more than 60 percent of this increase will happen in middle-income countries (particularly lower-middle income). The population share of people older than 65 in middle-income countries is expected to double (from 8 percent to 16 percent). Countries in Latin America and the Caribbean, South Asia, and East Asia are expected to see the largest increases, more than doubling the percentage of people older than 65 in their populations from 2020 to 2050. In these three regions, that population share will rise from 9 percent to 19 percent, from 6.2 percent to 13.2 percent, and from 13.4 percent to 27.2

2 The medium variant projection is a probabilistic method that considers not only the historical fertility rates of each country but also the uncertainty regarding future trajectories, based on countries with similar past rates. For more details, see: "Definition of projection variants. World Population Prospects 2019," United Nations Department of Economic and Social Affairs, Population Dynamics. Available at: https://population.un.org/wpp/DefinitionOfProjectionVariants/#:~:text=Medium%2Dvariant%20projection%3A%20in%20projecting,of%20changes%20in%20each%20variable.

BOX 10.1 When is a country "aging"?

A country is usually defined as "aging" when the share of people ages 65+ is above 7 percent, "aged" when it is 14 percent or more, and "super-aged" when it exceeds 20 percent. Other definitions are also used, such as the median age, or the old-age dependency ratio, which is the ratio of older dependents (people older than 64) to the working-age population (people ages 15–64). Cut-offs are arbitrary, however, because they do not consider how healthy and functional the "elderly" under such definitions are. The Prospective Old Age Dependency Ratio (Sanderson and Scherbov, 2005, 2007, 2010) measures population aging based on remaining life expectancy instead of the number of years lived. This measure reflects improvements in life expectancy over time, instead of anchoring old age to a fixed threshold, and suggests a slower increase in dependency than the traditional old-age dependency ratio.

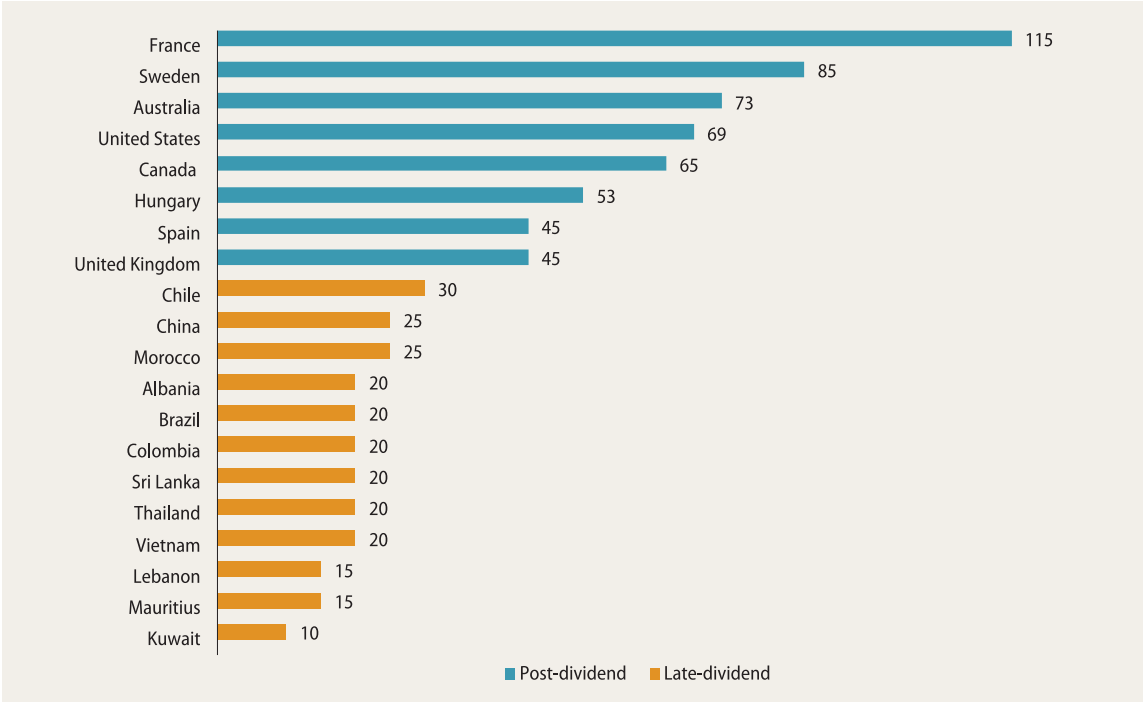
The 2015/16 Global Monitoring Report (GMR) (World Bank and IMF 2016) proposes a definition that combines trends in fertility and in the size of the working-age population. Based on these trends, countries are classified into four stages of the "demographic transition": pre-dividend countries (where fertility is greater than 4 births/woman); early-dividend countries (where fertility is lower than 4 births/woman, but the working-age population is still increasing); late-dividend countries (with a shrinking working-age population, but where fertility fell only recently); and post-dividend countries (with a shrinking working-age population and where fertility fell below replacement level, or 2.1 births/woman, three decades earlier). The last two stages characterize aging countries. This chapter adopts the GMR definition to select aging countries, although it may refer to other definitions when appropriate.

Source: World Bank (2021).

percent, respectively (UNWPP 2019).

In fact, the demographic change in developing countries is taking place at an unprecedented speed. While in some developed countries like France, Sweden, and the United States, it took 115, 85, and 69 years, respectively, for the share of people aged 65+ to rise from 7 to 14 percent, in some late-dividend countries, the same change is taking place at a considerably faster pace (in some cases, less than 20 years) (Figure 10.2).

FIGURE 10.2 Years required or expected for the population share aged 65+ to rise from 7 percent to 14 percent



Source: United Nations World Population Prospects 2019

Note: The graph shows the number of years needed for a country to transition from "young" to "old" (as measured by a rise in the share of its 65+ population from 7 percent to 14 percent of the total). For late-dividend countries, calculations are based on the "medium-variant" UN projections; it should be noted that UN estimations are published at five-year intervals.

The figures and trends shown so far lead to questions about the quality of the years of life expectancy gained in the past decades. In other words, are we living healthier or just longer? The extent to which gains in life expectancy translate into new opportunities for both individuals and countries depends largely on the quality of these additional years. The concept of healthy life expectancy, which reflects the number of years that a person can expect to live in good health, free of disease or disability, can shed some light on this question. From 1990 to 2019, globally, 83 percent of the years of life gained were years free of disability and disease, with the largest increases seen in countries that are less advanced in the demographic transition, as seen in Table 10.1 (GBD 2019).

At older ages, the gap between life expectancy and healthy life expectancy widens, indicating that most of the years lived in bad health or disability are concentrated later in life. On average, life expectancy at 65 years old is 17.6 years; 73 percent of those years are expected to be lived in good health. This proportion has remained stable since 1990, and does not show much variation across country groups, as depicted in Figure 10.3.

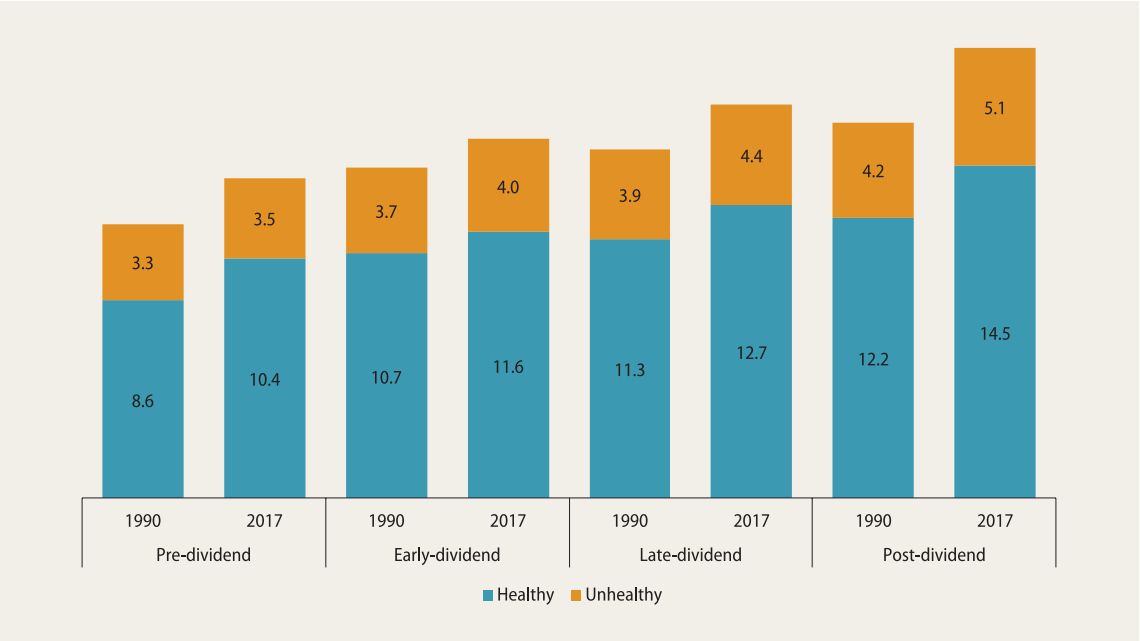
Women live longer than men in all regions of the world, but they also spend more years in poor health due to differences in risk factors and disease patterns. Women are more vulnerable than men to disabling non-fatal afflictions, while men are more affected by conditions that have high death rates (Luy and Minagawa 2014). Gender differences,

TABLE 10.1 Years gained in life expectancy and healthy life expectancy at birth, 1990-2017. Both sexes, by demographic group

	1990		2019		Variation 1990-2019		
	LE0	HALE0	LE0	HALE0	Years gained in LE0	Years gained in HALE0	(%) Years gained in good health
Pre-dividend	53.0	45.5	64.5	56.3	11.5	10.8	94.1%
Early-dividend	65.1	56.5	71.2	61.9	6.1	5.3	88.1%
Late-dividend	70.8	61.7	75.8	66.1	5.0	4.4	88.2%
Post-dividend	75.0	65.1	80.4	69.4	5.4	4.3	79.9%

Source: Authors' analysis based on GBD and collaborators Results Tool 2019.
Note: LE0: life expectancy at birth; HALE0: healthy life expectancy at birth. Values were computed as the unweighted average for the countries in each group.

FIGURE 10.3 Healthy and unhealthy life expectancy at age 65 years, 1990 and 2017



Source: Original analysis based on the Global Burden of DIsease (GBD) Results Tool 2019.

both in life expectancy and healthy life expectancy, are narrower in younger countries. This discrepancy could be explained by a higher risk of mortality in both sexes, a high prevalence of infectious diseases at old ages (such as tuberculosis), a recent increase in the prevalence of behavioral risk factors (especially tobacco consumption), and low levels of health care coverage (GBD Collaborators 2017; Mathers et al. 2015). Over time, gender differences are expected to widen in developing countries as well (He, Goodkind, and Kowal 2016).

Some researchers argue that the definition of "old age" should not be based on a universal threshold, but instead should consider health status measures and, more generally, whether the aging of the population is achieved because of health improvements or not. When indicators of life expectancy and indicators of morbidity and mortality are combined, it is shown that, although older people's health is improving worldwide, as the fatality and severity of age-related diseases decreases, the onset of age-related diseases occurs at younger ages in relatively less-developed countries (Chang et al. 2019). This is reflected in the fact that, despite having lower levels of life expectancy, less-developed countries still experience a high burden of age-related diseases. For example, a 76-year-old individual in Japan is equivalent to a 46-year-old individual in Papua New Guinea, and in both cases, they show the same age-related burden of disease as the global average 65-year-old individual (Chang et al. 2019).

The discussion as to whether increasing longevity has been accompanied by increases in healthy life expectancy is closely linked to the debate on the compression or expansion of morbidity. In this sense, if, on the one hand, increments in life expectancy are led by a delay in the onset of illnesses, then, unhealthy years would be concentrated at the end of the life cycle, and we would be witnessing a compression of morbidity and an improvement in the health indicators of older people (Fries 1980). If, on the other hand, the rise in life expectancy is mainly led by a drop in death rates from fatal diseases, but the age-specific pattern of incidence remains stable, then we may witness an expansion of morbidity, as the average duration of disability increases (Gruenberg 1977; Olshansky 1991). A third alternative, the so-called dynamic equilibrium theory, posits that it is neither the postponement of the onset of disease nor the postponement of death from diseases, but the delay in the progression of disease, that characterizes the increases in life expectancy, so that people are living longer with mild/non-fatal conditions, but rates from fatal diseases remain stable (Manton 1982).

Evidence in this regard is not conclusive. Research in high-income countries seems to favor the hypothesis of a compression of morbidity when looking at severe disability rates, but results are contradictory when looking at mild disability and chronic disease prevalence among older people, with some studies pointing to an expansion of morbidity due to the improvements in secondary and tertiary prevention treatments that allow people with disabilities to live longer (Howse 2006; Chatterji et al. 2015; Rechel et al. 2009). Research for low- and middle-income countries is much scarcer and difficult to reconcile, as results vary depending on the methods and data used (Chatterji et al. 2015).

Last but not least, policy responses to population aging should consider the important distributional issues that come with population aging (World Bank 2021). These include gender gaps; intergenerational disparities; spatial (e.g., rural versus urban) differences; and socioeconomic inequalities. Gender inequalities that can be exacerbated by population aging are rooted not only in gender differences in life expectancy, but in differences in care responsibilities and their implications for women's own health and wellbeing, women's participation in the labor market and, ultimately, their income security in old age. As care demands increase in aging societies, care responsibilities usually fall to women. When unpaid, such demands further limit women's labor market participation or impose a double work burden, when women are responsible for both paid and domestic labor (World Bank 2015). Similarly, policies should consider that younger generations will face greater risks of inequality in old age than current retirees (OECD 2017). Spatial disparities are already reflected in large inequalities in access to health and social care between old people living in urban and rural areas. These gaps are expected to widen, as younger generations leave rural areas looking for better opportunities. Important socioeconomic inequalities are found among adults aged 50+ years in low- and middle-income countries when it comes to medical frailty. This has been measured using the Study on global AGEing and adult health (SAGE) data from China, Ghana, India, Mexico, Russia, and South Africa (Hoogendijk 2018). Such inequalities may widen further with changing gender norms and cohabitation patterns and increasing informality in these countries.

AGING, HEALTH, AND THE CHALLENGES FOR HEALTH CARE SYSTEMS

Highlights

- *Population aging inevitably comes with rising prevalence of chronic diseases, as well as geriatric neurological conditions, such as dementia and Alzheimer's disease. Depression and musculoskeletal disorders in older people are also major causes of disability.*

- *Several characteristics of the epidemiological transition in developing countries complicate the picture, including the double burden of communicable and non-communicable diseases; the increased risk of multimorbidity; under-diagnosis and lack of affordable, timely, and effective treatments; and the increased adoption of harmful habits such as smoking, alcohol use, lack of physical activity, and unhealthy diets.*

- *Thus, population aging comes with at least three main challenges for health care systems in developing countries: (i) guaranteeing coverage, access, and affordability of services in a context of increasing demand; (ii) shifting the service model from a curative-based approach towards a person-centered, holistic, and integrated approach that encourages a continuum of care through the life course, with greater emphasis on primary health care, including health promotion and prevention activities; and (iii) keeping costs under control without losing attention to quality.*

- *Health care systems need to adapt and prepare. How people age is, to a large extent, determined by their health earlier in life, and the choices they made when young. Countries should therefore promote healthy lifestyles throughout the entire life course and work towards better management of chronic diseases. Universal health coverage in countries with aging populations should consider that older adults not only have different health care needs than the younger population but are often also less able to afford care.*

Changing patterns of disease: the increase in chronic conditions and the importance of multimorbidity

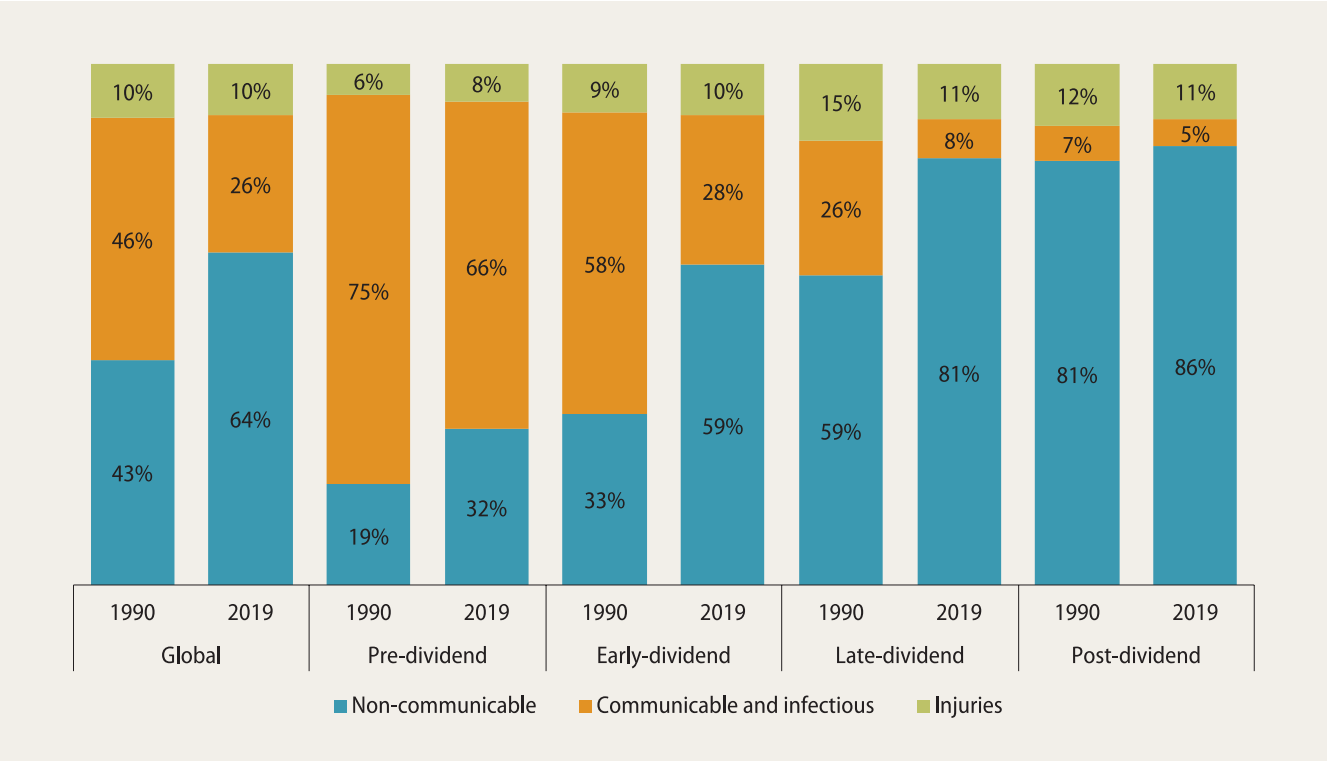
As people live longer, the main causes of mortality and morbidity shift from communicable or infectious diseases to chronic diseases,[3] in a process that is known as the *epidemiological transition* (Omran 1971). It is estimated that 15 percent of the increase in the global burden of mortality and disability from 1990 to 2016 could be explained by population aging (Gakidou et al. 2017). In 2019, chronic diseases explained 64 percent of the burden of disease, measured by Disability Adjusted Life Years (DALYs),[4] and are the first cause of disability globally (GBD 2019). As seen in Figure 10.4, while the burden of chronic diseases in 1990 was already high in post-dividend countries, in the last two decades the increase has been pronounced in late- and early-dividend countries. In late-dividend countries, chronic diseases already represent more than 80 percent of the total burden of disease, almost as much as in post-dividend countries.

Following current demographic projections, these trends are expected to accelerate during the coming decades. Among people aged 70 years or more, chronic diseases already explain more than 90 percent of the burden of disease in post- and late-dividend countries. The World Health Organization (WHO) estimates that, by 2060, 83 percent of global deaths will be caused by chronic diseases, an increase of more than 10 percentage points compared to 71 percent in 2016. This means an increase of almost 44 million people dying from chronic diseases in 44 years. More than 75 percent of that increase will take place in middle-income countries (WHO Global Health Estimates 2018).

3 In this chapter, the term chronic disease refers to conditions that are non-communicable, long in duration, and generally progress slowly.

4 The Disability Adjusted Life Years metric is used to measure the current health status of a population with respect to an ideal health situation, where everyone lives free of illness and disability to an old age. It is calculated as the sum of the Years of Life Lost due to Premature Mortality and the Years of Life Lost Due to Disability. A more detailed explanation can be found at: https://www.who.int/healthinfo/global_burden_disease/metrics_daly/en/

FIGURE 10.4 **Burden of disease, by disease type, 1990-2017 (% of total DALYs)**



Source: Original analysis based on GBD Results Tool 2019.
Note: Country classification is based on the World Bank typology presented in Box 10.1.

The prevalence of behavioral risk factors for chronic conditions increases with age. Evidence shows that this is true for obesity, hypertension, insufficient vegetable and fruit intake, and insufficient physical activity (Wu et al. 2015; Rampal et al. 2007). The only risk factors that show a negative gradient with age are alcohol and tobacco consumption (Wu et al. 2015). In part, this might be a consequence of higher mortality among smokers (Storr et al. 2010). However, tobacco use affects disproportionately more older adults in developing countries, with prevalence higher among middle-aged persons than among the youngest (Storr et al. 2010).

The link between population aging and the rising prevalence of chronic diseases becomes more evident in those countries that are aging rapidly, as evidenced by the observed trends in conditions that are known to be strongly age-dependent, such as cardiovascular diseases, diabetes, dementia, or chronic obstructive pulmonary disease (Prince et al. 2015). Mortality and morbidity due to cardiovascular diseases has increased in China, India, and Russia in the latest years, due to an increase in the prevalence of elevated cholesterol, diabetes, and obesity (Prince et al. 2015). In Middle Eastern and North African countries, chronic diseases accounted for 69 percent of the total burden of disease and 78 percent of total deaths in 2019, due to the combination of rapid population aging and the evolution of chronic disease risk factors, such as rising obesity and the persistence of elevated rates of hypertension, which are among the highest in the world (GBD 2019; Sibai et al. 2017). The prevalence of hypertension among older adults increased 20 percent between 1995 and 2004 in Tunisia and almost tripled in Lebanon during the period 2000-2010 (Sibai et al. 2017). Similar trends are seen in other aging countries; in Malaysia, for example, the prevalence of hypertension among individuals aged 30 or more increased from 32.9 percent in 1996 to 40.5 percent in 2004 (Ramli and Taher 2008).

Rising prevalence rates of diabetes and chronic obstructive pulmonary disease are also associated with population aging. In the case of diabetes, the number of people living with the condition is projected to increase 51 percent from 2019 to 2045. Although in absolute terms most people with diabetes are concentrated in middle-income countries, the

largest relative increase is expected to take place in low-income countries, where the number of people living with the disease is expected to increase by 150 percent (International Diabetes Federation 2019).

In the case of chronic obstructive pulmonary disease, it is projected that the burden of disease will increase by 89 percent from 2004 to 2030 (Prince et al. 2015). The problem is particularly serious in South Asian countries, where chronic respiratory diseases rank second as cause of morbidity and premature mortality among older people, representing 17 percent of total DALYs. Population aging, deterioration of environmental conditions, and increased pollution due to rapid urbanization in some countries, as well as high rates of smoking, are behind these large figures (Bishwajit et al. 2017).

As the share of the older population rises, the importance of geriatric neurological conditions, such as dementia and Alzheimer's disease, also increases. While in 2017, neurological conditions explained only 4 percent of DALYs for the world population of all ages, the figure reaches 6 percent among those older than 70 years, and 9 percent among those older than 80 (GBD 2019). With the projected increases in the share of older adults in the population, the burden of dementia is expected to rise. In 2015, 58 percent of those with dementia lived in low- and middle-income countries, and it is expected that by 2050 this figure will reach almost 70 percent (ADI 2015).

Due to their debilitating effects and their contribution to disability, musculoskeletal disorders deserve special consideration. Even though their mortality rates are low, musculoskeletal diseases are one of the main causes of chronic pain and functional impairment, hence having important detrimental effects on quality of life among the elderly (Woolf et al. 2012). In fact, although they represent only 6 percent of DALYs, these diseases account for 17 percent of Years Lost due to Disability (YLDs) (GBD 2019).

Depression in older adults is a major cause of disability, although highly underdiagnosed and, as a result, left untreated. In fact, evidence shows that depression symptoms are more difficult to recognize in older adults, as they usually manifest in concurrence with other physical and neurological factors that are thought to be "part of the normal aging process", such as loss of mobility, chronic pain, or dementia (Rodda, Walker, and Carter 2011). In particular, the link between dementia and depression is well recognized, although the direction of causality and the mechanisms behind it are not yet fully understood (Byers and Yaffe 2011).

Older people are more likely to experience multiple health conditions at once (Afshar et al. 2015; He, Goodkind, and Kowal 2016). The epidemiological transition not only leads to an increasing burden of chronic diseases as causes of death and disability, but also to an increased prevalence of multimorbidity. In Colombia, a 2018 study found multimorbidity present in approximately half of patients of all ages with chronic diseases. This means that between 4. 5 and 6 million of the approximately 11 million patients per year who accessed health services in Colombia for at least one chronic disease were patients with multimorbidity. Yet programs for an integrated approach to multimorbidity are incipient or exist only as pilots (Alfonso-Sierra et al. 2018).

Comparable patterns appear to hold, irrespective of the region and the stage of demographic transition of the country. In Uruguay, 43 percent of adults 60 years old or more suffer from more than one chronic condition (Aranco and Sorio 2019); in Mexico the figure is 33 percent (Lopez-Ortega and Aranco 2019). Data for Asia show rates of multi-morbidity of more than 30 percent in India (for those aged 70 years or more), 40 percent in Viet Nam, and 58 percent in Bangladesh (for those aged 60 or more) (Khanam et al. 2011; Ha et al. 2015; Pati et al. 2014). Data for China show that the so-called metabolic risk syndrome, which is a combination of cardiovascular risk factors including abdominal obesity, high blood pressure, increased glucose level, and dyslipidemia rises from 14 percent among middle-aged adults to 46 percent among older people (He et al. 2009). Evidence for Kuwait also shows an increase in multimorbidity with age: the proportion of individuals who suffer from diabetes, hypertension, and heart disease simultaneously rises from 3.6 percent among those aged 50–59 to 9.4 percent among those 60–69, then surges to 20.9 percent among persons older than 70 (Boutayeb, Boutayeb, and Boutayeb 2013).

Common clinical practice and guidelines that focus on managing a single disease can negatively impact the quality of life and health of people suffering from multiple chronic conditions. The interactions, not only between the biological impacts of different conditions, but also among their recommended treatments and/or medications, can represent important health risks for individuals suffering them (WHO 2015). Different medications prescribed by different providers could trigger adverse drug reactions that are harmful for patients (van der Heide et al. 2015). The fragmented approach of multiple specialists treating single diseases separately not only increases the risk of drug inter-

actions but also reduces adherence to crucial treatments and impairs the percep-tion of safety.

The epidemiological transition in developing countries

Some characteristics of the epidemiological transition in developing countries could worsen the aging challenges ahead. First, many of today's older adults in developing countries were exposed to infectious diseases in their early childhood and survived thanks to medical advances that were not necessarily related to an improvement in their socio-economic conditions, a circumstance that may have unknown effects on older people's health during the coming years (Palloni, Pinto-Aguirre, and Pelaez 2002). Indeed, poor health conditions in early life have been shown to be linked to an increased risk of diabetes, obesity, and heart disease in adulthood (He, Goodkind, and Kowal 2016). This is especially true for older adults who were born in the 1930s and 1940s in countries that experienced rapid mortality reductions at that time (such as Brazil, Chile, Costa Rica, and Mexico, among others) (McEniry 2014; McEniry and McDermott 2015).

Second, although chronic diseases are the leading causes of mortality and disability among older people, the importance of infectious diseases should not be underestimated. This double burden of disease increases the risk of multimorbidity, with consequences for the morbidity and mortality patterns of older adults that are not yet fully understood (WHO 2015). Older people suffering from chronic diseases are more exposed to infectious diseases; type 2 diabetes, for example, is a known risk factor for the onset of tuberculosis, leading to serious health consequences (WHO 2011a). The recent pandemic generated by the spread of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has highlighted the vulnerability of older adults, particularly those with previous chronic conditions, in the face of the surge of new infectious diseases (or the upsurge of older ones).

Third, under-diagnosis of key medical conditions and the lack of affordable, timely, and effective treatments are still common problems in many developing countries (He, Goodkind, and Kowal 2016). Around half of the people with type 2 diabetes are unaware of their condition (International Diabetes Federation 2019). Rates of underdiagnosis show a clear income gradient across countries, ranging from 38.3 percent in high-income countries to 52.6 percent in middle-income countries and reaching 66.8 percent in low-income countries (International Diabetes Federation 2019). Data for Argentina, Brazil, Chile, Colombia, and Mexico show that 40 percent of hypertensive individuals are not diagnosed (OPS 2017; Arredondo and Recaman 2018). Similar figures have been found for Egypt and Viet Nam (37.5 percent and 48.4 percent, respectively) (Ibrahim and Damasceno 2012). International evidence shows that, even among those who are diagnosed with key chronic diseases, a very small fraction of people follows an appropriate treatment and have the condition under control (Ibrahim and Damasceno 2012). Data from China show that more than half of diabetes cases are undiagnosed and that, among those who are diagnosed, less than 40 percent have the recommended glycemic controls (Chen et al. 2018). In the case of high blood pressure, figures are even more worrisome: only 8 percent of diagnosed individuals in Egypt and 10.7 percent in Viet Nam have the disease under control with adequate theraapies (Ibrahim and Damasceno 2012).

Fourth, globalization and modernization, which have prompted widespread adoption of harmful habits such as smoking, alcohol use, lack of physical activity, and unhealthy diets, have unfolded faster in developing than in developed countries. This has fueled the increase in chronic diseases and epidemiological change (Miranda et al. 2009). Obesity, for instance, is an increasing global phenomenon, with 39 percent of adults aged 18 and over being overweight or obese in 2016, an almost three-fold increase from 1975. The World Bank estimates that more than three-quarters of obese or overweight individuals live in middle-income countries (Shekar and Popkin 2020). The percentage of deaths from all causes attributable to a high body mass index rose from 4.7 percent in 1990 to 8.9 percent in 2019 (GBD 2019). In upper-middle-income countries the reported increase was from 5.8 percent to 10.4 percent, and from 2.4 percent to 7.9 percent in lower-middle-income countries. The problem is particularly acute in Asia Pacific and in countries in the Middle East and North African region (Prentice 2006), where public policies have stimulated the consumption of highly energy-dense foods. This has led to a change in dietary habits that, in conjunction with increasingly sedentary lifestyles, has contributed to worrying levels of overweight and obesity in populations (Kilpi et al. 2013). Papua New Guinea, for instance, has an overweight/obesity prevalence of 60 percent (Shekar and Popkin 2020).

Prevalence rates of obesity among adults older than 18 years reach almost 30 percent in Egypt and Libya, 24 percent in Tunisia, and more than 20 percent in Algeria and Morocco (WHO 2018a).

Tobacco consumption, the single most important avoidable risk for chronic diseases, had been increasing in developing countries, particularly among men, until 2018, in stark contrast to the observed trends in developed countries. However, the most recent report on tobacco use estimates that tobacco consumption rates reached their peak in 2018, and projects a decreasing trend up to 2025 through all country income groups (WHO 2019). Only five countries globally are currently experiencing increasing trends in tobacco use: Congo, Lesotho, and Niger, in Africa, and Egypt and Oman in the Middle Eastern region (WHO 2019).

Yet disaggregating the data by sex shows quite a different picture, as in some places women are increasingly taking up smoking. For example, in Croatia, the share of women who smoke has increased by 9 percentage points in the past 20 years, from 27 percent in year 2000 to 36 percent in 2020; an increase of almost 5 percentage points was seen in the Slovak Republic and in Türkiye.[5] In Latin America, tobacco use prevalence was very similar among male and female adolescents aged between 13 and 15 years old (15 percent and 12 percent for young men and women respectively), with Chile showing the highest tobacco use among young women (26 percent), followed by Argentina (25 percent) and Mexico (18 percent) (OECD and WHO 2020).

Challenges for health care systems and countries' responses

The increasing number of people with chronic health conditions exerts pressures on health systems, which will need to adapt to satisfy not only a growing demand but also a different type of demand. In this section, we discuss what these challenges mean for health systems in rapidly aging countries and present some of the steps taken by developing countries to overcome them.

Population aging brings about at least three main challenges for health care systems in developing countries: (i) first, guaranteeing coverage, access, and affordability of services in a context of increasing demand; (ii) second, shifting their care model from a curative-based approach, designed to deal mainly with acute and infectious diseases, towards a holistic and integrated approach that encourages a continuum of care throughout the life course, with a greater emphasis on primary health care and health promotion and prevention activities; and (iii) last, but not least, keeping costs under control without losing attention to quality.

Effective health care coverage for older individuals in low- and middle-income countries is far from universal, signaling the existence of critical unmet needs and important gaps in access to and availability of health care services (Goeppel et al. 2014). Despite significant progress made during recent years, important inequalities still exist both between and within nations when it comes to timely and effective access to care (Bloom et al. 2019) (Box 10.2). Older people belonging to the lowest socioeconomic strata in Latin America and the Caribbean, for instance, are more likely to have difficulties accessing the health care services they need (Huenchan 2010).

Inequalities in coverage and access, and poor performance in terms of effectiveness and quality of care, are critically salient when looking at chronic disease management. Effective coverage rates among older people with chronic conditions range from 21 percent in Mexico to 48 percent in South Africa (Atun et al. 2015; Glassman et al. 2010). Similar results have been found elsewhere (see for example, Tham et al. 2 018 for Asia-Pacific; Atun et al. 2015; and Glassman et al. 2010 for Latin America; and Kujawska 2017 and Rechel et al. 2012 for Europe and Central Asia). Barriers to access in the form of unaffordability of services or lack of transportation are often cited by older adults in low- and middle-in-come countries as the main reasons for not being able to access health care when needed (Table 10.2).

The lack of formal coverage leads to the neglect of health or to high out-of-pocket expenditures when care is needed, imposing a heavy financial burden on individuals and households. In low- and lower-middle-income countries in Asia-Pacific, out-of-pocket expenditures in 2015 accounted for almost 50 per-cent of total health expenditures, increasing the risk of household impoverishment in the face of chronic and long-term illness (WHO 2018b; OECD and WHO 2018a). For example, in Viet Nam, more than one-quarter of older people are not insured, and more than half refrain from seeking medical treatment due to high costs (Hoang and Duong 2018).

5 See World Bank Open Data website, retrieved from: https://data.worldbank.org/

BOX 10.2 Health and socioeconomic status

The patterns of diseases and risk factors vary, not only across countries at different stages of development, but also across individuals in different socioeconomic strata within countries. Individuals from lower socioeconomic levels are usually exposed to a larger number of risk factors and have limited access to health care and to the resources that could allow them to follow a healthier lifestyle (Blas and Kurup 2010). These disadvantages develop in early childhood (sometimes, even in utero) and accumulate throughout the life course, widening the health gap between individuals from different socioeconomic strata (Blas and Kurup 2010; Wilkinson and Marmot 2003). This positive association between socioeconomic status and individual health has been widely documented in the literature and has been proved to hold for different countries and periods, regardless of the measures of health and socioeconomic status used (Goldman 2001).*

However, given differences in the access to and quality of health care, as well as in social, cultural, and economic environments, the degree (and in some cases even the sign) of the association may differ between developed and developing countries (Blas and Kurup 2010). In developed countries, individuals in higher socioeconomic groups were the first to adopt harmful behaviors such as smoking or unhealthy eating; soon lower socioeconomic groups followed their behavior, while prevalence among the higher socioeconomic groups started to drop as educated individuals learned the health consequences of these habits. The evidence for low- and middle-income countries is less clear, although recent evidence suggests that tobacco and alcohol consumption decrease with socioeconomic status while the reverse is true for physical inactivity. Results for dietary pattern are more mixed: individuals in higher socioeconomic groups tend to consume more fruits, vegetables, fish, and fiber but also more fats, salts, and processed foods (Allen et al. 2017). Yet the evidence suggests that, as country income increases, the burden of overweight/obesity shifts from the wealthy to the poor (Jones-Smith et al. 2011, 2012b; Shekar and Popkin 2020).

Differences in risky behaviors lead to differences in disease prevalence. Various studies in developing countries have shown a higher prevalence of cardiovascular diseases among lower socioeconomic groups (Vathesatogkit, Batty and Woodward 2014; Lustigova et al. 2018), and a study for Latin America shows that individuals with no education are twice as likely to suffer from Alzheimer's disease as individuals with some education (Nitrini et al. 2009). Similar results have been shown for Brazil, China, and India (Scazufca et al. 2008; Libre Rodriguez et al. 2008). The evidence for type 2 diabetes is not as clear: some studies find that, in developing countries, higher prevalence is associated with higher socioeconomic status, in stark contrast to the evidence in developed regions (Xu et al. 2017); however, other studies point in the direction of a negative socioeconomic gradient (see for example Sandoya 2016 for Uruguay and Suwannaphant et al. 2017 for Thailand). Multimorbidity prevalence is also shown to be negatively associated with education in the multi-country study from Afshar et al. (2015), even when adjusted for age and gender.

Note: Grossman (2015) provides an extensive review of recent studies carried out in this field.

Table 10.2 Reasons given by adults aged 60 years or older for not accessing health care services, by country income category

	High income	Upper-middle income	Lower-middle income	Lower income
Could not afford the visit	15.7	30.9	60.9	60.2
No transport	12.1	19.3	20.7	29.1
Could not afford transport	8.7	12.9	28.1	33.0
Health care provider's equipment inadequate	11.2	10.5	14.1	16.7
Health care provider's skills inadequate	19.0	8.3	7.8	13.1
Previously treated badly	23.8	8.7	7.9	8.3
Did not know where to go	12.2	9.7	9.8	7.8
Was not sick enough	21.5	31.8	27.3	25.8
Tried but was denied health care	20.0	16.2	8.3	8.5
Other	43.8	22.5	23.5	13.9

Source: WHO 2015, based on WHO World Health Surveys 2002-2004 (http://www.who.int/healthinfo/survey/en/)

Chronic diseases, common in old age, can result in catastrophic health expenditures. Older people with diagnosed chronic diseases face catastrophic health expenditure even in some of the wealthiest countries in Europe (Arsenijevic et al 2016). In developing countries, data from WHO's SAGE surveys shows that households with at least one member aged 50 years or more have a higher probability than those with only younger members of facing catastrophic health care expenditures, having to borrow money from relatives to afford health care services, or being impoverished by health care costs (He, Goodkind, and Kowal 2016). Similar results were found in Latin American and Caribbean countries (Knaul et al. 2011), in Asia (Somkotra and Lagrada 2009), and in a more recent global stocktake (Hoang-Vu Eozenou et al. 2021).

The path towards universal health care coverage should take distinctive characteristics in countries with aging populations, as older adults not only have different health care needs than the younger population but are often less able to afford care (Sadana, Soucat, and Beard 2018). The Universal Health Coverage Political Declaration from 2019 includes clear commitments to promoting healthy ageing. Specifically, it commits governments to *"scale up efforts to promote healthy and active ageing, maintain and improve quality of life of older persons and to respond to the needs of the rapidly ageing population, especially the need for promotive, preventive, curative, rehabilitative and palliative care as well as specialized care and the sustainable provision of long-term care."*[6] This implies adapting health care systems to a different and increasing demand through: (i) improving timely access to and affordability of health care services and medicines for conditions that are common in old age; (ii) delivering person-centered services that address older people's health needs, with an emphasis on primary and community care; (iii) improving the management of chronic conditions (including cognitive conditions, such as dementia) and multimorbidity; and (iv) the development of a trained workforce that responds to the needs of aging populations. Additionally, it will require efforts to ensure the financial sustainability of services, as well as adequate financial protection for older adults, especially the poorest and most vulnerable, without compromising the quality of services.

Within this context, countries have taken steps to improve the coverage, accessibility, and affordability of health care services for the older population. Some examples are presented below.

Improving coverage and effective access

a. Extended coverage or subsidized health care contributions

In most countries, health care coverage has been traditionally linked to formal employment, leaving those outside the formal workforce and who cannot afford private insurance (including informal workers but also pensioners and retirees) unprotected. During recent decades, countries have taken actions to correct this situation, improving population coverage, either as part of overall system reforms, or focusing on specific vulnerable groups.

Health care reforms in Latin American and Caribbean countries in the early 2000s were motivated by the need to address the institutional and financial fragmentation of systems that led to important gaps in coverage (Atun et al. 2015). For example, in Uruguay, the health care reform of 2007 extended insurance coverage to previously uncovered population groups, including retirees. By 2018, 83.5 percent of pensioners and retirees were covered by the system.[7] The reform also increased coverage to other population groups, including the children and spouses of formal workers, who were previously excluded from insurance. In Bolivia, special provisions to improve older people's coverage were adopted: in 2006, the country created the Health Insurance for the Older Adult (SSPAM), which covers adults 60 years old or more who have no other health insurance. Similarly, in Costa Rica, health care provision is free for older individuals (among other vulnerable groups), regardless of formal coverage (PHCPI Costa Rica n.d.; Montenegro Torres 2013).

In Asia, China has also taken steps to increase

6 United Nations General Assembly (UNGA), Political Declaration of the High-level Meeting on Universal Health Coverage "Universal health coverage: moving together to build a healthier world", September 2019. Retrieved from: https://www.un.org/pga/73/wp-content/uploads/sites/53/2019/07/FINAL-draft-UHC-Political-Declaration.pdf

7 Original calculations based on data from the Ministry of Public Health (2019) (retrieved from: https://www.gub.uy/ministerio-salud-publica/datos-y-estadisticas/datos/evolucion-afiliados-fonasa-2007-mayo-2019), and statistics from the Uruguayan Social Security Bank (retrieved from: https://www.bps.gub.uy/2692/principales-indicadores.html).

coverage for older people, with the establishment of two new health insurance schemes for urban and rural populations (Smith and Majmundar 2012). Subsidized or exempted contributions for the el-derly have been another instrument to facilitate their access to health care in the region. In Thailand, for example, before the introduction of free health care coverage for the entire population in 2006, vulnerable groups, including older individuals, were exempted from copayments for health services (Hughes and Leethongdee 2007). Viet Nam, a country that has made important efforts to achieve universal health care coverage through the creation of a social health insurance program, has compulsory affiliation but fully subsidized premiums for vulnerable groups, including older populations (Somanathan et al. 2014).

Examples in Eastern Europe can be found in Bulgaria, where older adults - among other vulne-rable groups - are covered for free by the national mandatory health insurance, or in Serbia, where individuals aged 65 years or above have free access to the public health care services (Pitheckoff 2017; Stokic and Bajec 2018).

In spite of these efforts, the lack of public re-sources can be a barrier for implementation of well-intended policies, as in the case of Lebanon, which had to block enrolment in its optional health care plan for older people (launched in the year 2000), due to underfunding (UN 2017b). In most Eastern European countries, health care systems are characterized by constrained resources, inadequate infrastructure, large out-of-pocket expenditures, and insufficient coordination between local and na-tional authorities, resulting in fragmented systems (Kujawska 2017; Rechel et al. 2012).

b. Improving affordability and accessibility

Regardless of coverage, evidence shows that a large share of older individuals faces affordability and access restrictions when it comes to the actual use of services. For example, in Peru, data from 2012 show that almost 14 percent of people over 80 years old say they do not have access to the health care they need due to cost or transport barriers (*Encuesta de Salud y Bienestar del Adulto Mayor de Perú 2012*); in El Salvador, 44 percent of individuals aged 80 or more face barriers related to the quality and timing of services, such as not getting an appointment in due time, lack of personnel, or being poorly treated at the institution (*Encuesta de Hogares de Propositos Múltiples de El Salvador 2018*). Increasing coverage is not a guarantee of effective access to services, particularly when health care systems are fragmented (Guanais et al. 2018).

Aiming at improving older people's access to health care services and medicines, some countries have established free or subsidized consultation and medicines for older adults, giving them priority in access and treatments, and even providing free transportation to health care facilities. Free or subsidized consultation and medicines for older people are provided both in countries that are advanced in the demographic transition, such as in Azerbaijan, Bermuda, the Czech Republic, Hungary, Jamaica, Kazakhstan, Oman, Tunisia, and Uruguay, but also in countries where the transition is less advanced, for example Iraq, Sudan, or Uzbekistan (UN ECE 2017; UN ECWA 2017; Bonilla-Chacín et al. 2018). In Uruguay, the 2007 reform sought to improve older people's access to services and medications through the subsidization of service fees and medications and the right to one or two free checkups per year (depending on the age of the older person) (UN and HelpAge International 2012). In Bermuda, hospitalization services are publicly covered for individuals older than 75, and in Jamaica user fees were eliminated at public health facilities (UN ECLAC 2017). Programs that provide free medications, checkups, and other benefits for senior citizens living with chronic disease are in place in many Latin American and Caribbean countries, such as Argentina, The Bahamas, Barbados, Belize, Bermuda, Brazil, Costa Rica, Cuba, Mexico, Paraguay, Saint Maarten, and Trinidad and Tobago (WHO 2015; UN ECLAC 2017; UN and HelpAge International 2012).

Since 2005, Chile has in place the Universal Access to Explicit Guaranteed Entitlements plan (AUGE as per its name in Spanish), that guarantees timely and quality access to treatment for 85 conditions and prevents beneficiaries from incurring catastrophic expenses (Aguilera et al. 2015; Superintendencia de Salud de Chile 2019). Many of these conditions relate directly or indirectly to older adults. The Seguro Popular in Mexico also has a special fund that covers catastrophic expenditures for complex illness (Atun et al. 2015). Similarly, the Catastrophic Medical Insurance scheme in China, implemented at the national level in 2015, provides extra reimbursement for individuals who incur excessive out-of-pocket medical expenses, providing extra financial protection to those who are at risk of catastrophic expenditure, including older people (Fang et al. 2019). The National Resources Fund

(*Fondo Nacional de Recursos*) in Uruguay has a similar aim, although its application is more restricted, covering health care expenses for high-complexity procedures and very expensive medicines.[8]

In many Asian countries, such as aging Viet Nam, but also relatively younger countries, such as Bhutan or Nepal, senior citizens are given priority in treatment, which allows them to shorten waiting times, and they have access to subsidized care (Williamson 2015). In 2012, Kuwait issued a "priority pass" card that gives preference to older citizens and reduces waiting periods for them at primary health centers (WHO 2015; UN ESCWA 2017). Bangladesh, Cambodia, China, India, Malaysia, Maldives, Mongolia, Nepal, Solomon Islands, and Tuvalu are among the countries that have provisions to ensure that older people in remote areas can access health care through, for example, providing free transportation to facilities (Williamson 2015).

However, and despite the efforts described above, older people in many settings still face barriers in seeking to access timely and quality health care. For instance, Armenia has offered free primary health care since 2006, and vulnerable groups in the country - including the elderly - are entitled to a package of basic health care benefits free of charge. However, the lack of resources means that sometimes these benefits cannot be provided; this has led to the development of a "shadow market" of paid medical services (WHO 2009; Tonoyan and Muradyan 2012). In other settings, such as Latvia, the administrative procedures required to be exempted from medical co-payments and to obtain other benefits could act as a barrier for older adults (European Commission 2019). Evidence for the Asia Pacific region also shows that access and affordability restrictions persist in many countries there (Lagomarsino et al. 2012; Van Minh et al. 2014; Zaidi et al. 2017).

Adapting health care systems to an older population and a new epidemiological profile without losing focus on quality

Improvement in health care delivery requires a deliberate focus on the quality of health services, which involves providing effective, safe, person-centered care that is timely, equitable, integrated, and efficient (Kieni et al 2018). In most developing countries, health care systems were designed to deal with acute and infectious diseases and hence focus on "finding the problem and fixing it" (WHO 2015, p.93). With the upsurge of chronic diseases, this approach is rapidly becoming obsolete. For people with chronic diseases, the ultimate goal of care should be to improve the quality of life and to enhance functional status through secondary prevention (Grumbach 2003).

Many health care systems around the world have failed to incorporate into their model of care the typical problems that matter to older people, such as frailty, chronic pain, and the loss of functional and sensory capacity. This leads to the onset of many health problems that could be prevented or reversed if they were identified in a timely manner (WHO 2018a). This is closely linked to the quality of services, which is defined by the WHO as *"the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with evidence-based professional knowledge."*[9] Although this problem is common worldwide, it is more pronounced in middle- and lower-income countries (WHO 2015). For example, it is estimated that the low quality of services (and not the lack of access) is responsible for almost 60 percent of amenable deaths in low- and middle-income countries (Kruk et al. 2018)

Few and poorly trained human resources, inadequate infrastructure, outdated technology and treatments, and insufficient material resources are common characteristics of health care systems in most developing settings, and these factors impact older people's access to effective, quality, and timely healthcare. This is reflected, for example, in long waiting lines, lack of affordable transportation options to health care centers, and physical barriers to access, among other obstacles (WHO 2018a).

The management of chronic diseases, a key component of any health care system that deals with an aging population, encounters many obstacles in low- and middle-income contexts. Best-practice recommendations that work in more developed countries usually fail in developing nations, due to: (i) little support for self-management of chronic conditions derived from a

8 See Fondo Nacional de Recursos Uruguay webpage at http://www.fnr.gub.uy/quienes_son_beneficiarios

9 World Health Organization Fact Sheet. "Quality Health Services". July 20th, 2020. Retrieved from: https://www.who.int/news-room/fact-sheets/detail/quality-health-services

poor communication relationship between providers and patients, which in turn is often rooted in a lack of time, willingness, and appropriate training among providers and is exacerbated by patients' lack of health education, confidence, and motivation to change; (ii) the inability of providers to follow guidelines due to lack of awareness, time constraints, or practical considerations; (iii) poor follow-up care and information-recording protocols; (iv) absence of community support; (v) patients' inability to afford the costs and cover the distance to health care facilities; (vi) lack of resources, including medicines, equipment, laboratory supplies, and human resources; and (vii) lack of coordination across public, private, and alternative providers in contexts where patients seek care from multiple providers, according to their beliefs, their ability to pay, and the seriousness of their condition (Lall et al. 2018).

Within this context, health care systems need to adapt. Taking a person-centered, holistic approach that focuses on prevention, as well as on the integration and continuity of care across different services, with a renewed emphasis on primary care services, is paramount (He, Goodkind, and Kowal 2016; WHO 2015; WHO 2018a). Developing countries have taken decisive steps to transform their health care systems to deal with the new morbidity and mortality profiles of their populations. Some examples are presented below.

a. Better management of chronic disease through prevention and timely diagnosis

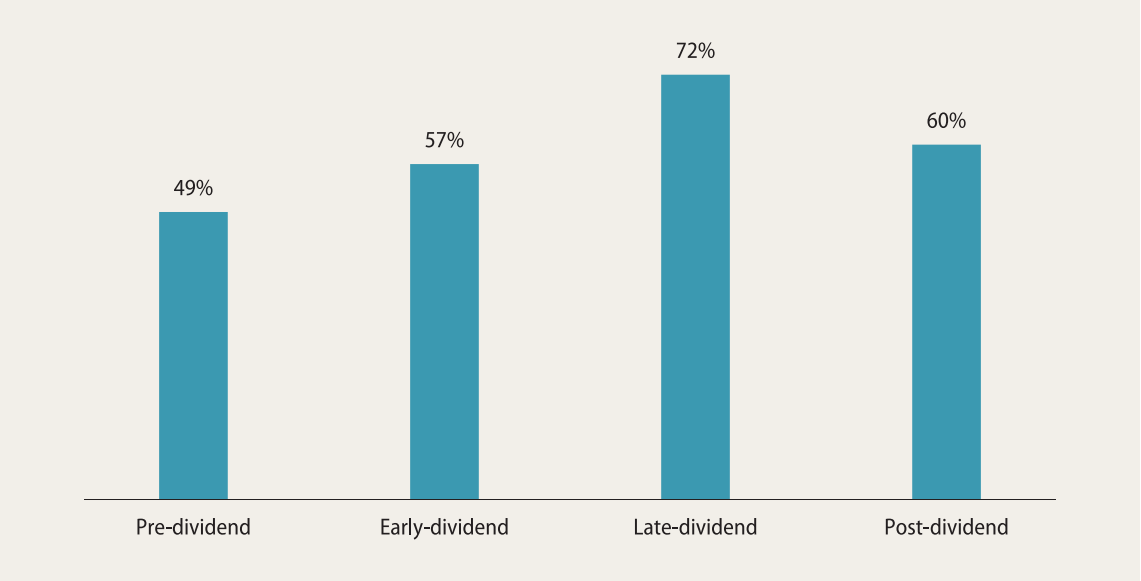
Evidence shows that cost-effective policies, implemented through coordinated and integrated efforts in which health care systems work in coordination with other sectors and actors, taking a comprehensive and horizontal approach, could reduce the mortality and morbidity burden of chronic diseases (Samb et al. 2010). Community, workplace, and school-based programs that encourage physical activity and healthy diets, and individual health care interventions aimed at the population who are at risk of developing chronic diseases (primary prevention) or at those who are already sick in order to prevent complications (secondary prevention) have proved to be effective (WHO 2017a). Up to 80 percent of heart disease, stroke, and type 2 diabetes and 40 percent of cancers could be prevented by eliminating the common risk factors behind these conditions, such as tobacco and excessive alcohol consumption, unhealthy diet, and lack of physical activity (WHO 2008). About 35 percent of dementia cases could also be prevented by tackling nine modifiable risk factors: education, hypertension, obesity, hearing loss, late-life depression, diabetes, physical inactivity, smoking, and social isolation (ADI 2019a).

WHO "best buys" are simple and cost-effective interventions to prevent death and disability brought by chronic diseases. These "best buys" include population-wide interventions, such as tobacco and alcohol consumption control and regulation (through the application of increased taxes, regulation of publicity, and laws that regulate consumption and purchase); the promotion of healthy diets (through, for example, actions to reduce salt and trans-fat consumption); mass media communications campaigns to increase awareness about the importance of healthy diets and physical activity; and timely screening for prevention of cardiovascular diseases, diabetes, and cancer (WEF and WHO 2011).[10] Countries can select cost-effective interventions from the list of best buys, considering affordability, implementation capacity, and feasibility, according to national circumstances, as well as the measures' impact on health equity.

Following these recommendations, countries all over the world are making important efforts to improve early diagnosis and management of chronic diseases and to reduce the costs of treatment. In fact, arguably, part of the observed increase in chronic disease prevalence rates documented in the previous section could be explained by better diagnosis. However, implementation of these type of policies has been uneven across the globe, particularly in developing countries, with recommended policies more prevalent in late-dividend countries (Figure 10.5). While some countries have taken a multisectoral approach (integrating health care systems with other sectors such as education), others have adopted a more compartmentalized approach, focusing on specific measures to improve the situation of those with chronic diseases. Still, 60 percent of countries worldwide have a national multisectoral strategy to manage chronic diseases and their risk factors (WHO Global Health Observatory Data Repository 2020).

10 Most updated information on the list of the "Best Buys" interventions recommended by WHO is available at World Health Organization (2017). "Tackling NCDs: 'Best Buys' and other recommended interventions for the prevention and control of non-communicable diseases". Retrieved from: https://apps.who.int/iris/bitstream/handle/10665/259232/WHO-NMH-NVI-17.9-eng.pdf

FIGURE 10.5 Percentage of countries that have a national strategy for chronic diseases and their risk factors, by demographic stage



Source: Authors' analysis based on data from the Global Health Observatory Data Repository (WHO 2020).
Note: Calculated as "Country has an operational, multisectoral national chronic diseases policy, strategy or action plan that integrates several chronic diseases and their risk factors." For more information on what this entails, see: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4680

As an example of the above, Uruguay reoriented its entire healthcare system to increase coverage and address the increasing prevalence of chronic diseases, strengthening primary care services and encouraging prevention. Broad system reforms that included measures to encourage prevention, timely diagnosis, and access to treatment for chronic diseases were also taken in other countries in Latin America, such as Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Mexico, Peru, or Venezuela (Atun et al. 2015). In 2015, Croatia launched a reorganization of hospitals that consists in reclassifying hospital beds from acute beds to palliative, chronic, prolonged, and day-care beds as part of a system-wide approach (European Commission 2019).

Efforts towards improving diagnosis, treatment, and control targeted at specific chronic diseases have taken place during recent years in all regions. In Europe and Central Asia, some aging countries such as Armenia, Belarus, Latvia, Lithuania, and Slovenia can be highlighted as examples. In some cases, these actions are specifically targeted at the elderly. Belarus, for example, created the so-called *health schools for the third age* to educate older people on common disease treatments and health promotion, while persons older than 40 in Albania are entitled to free annual checkups to identify risk factors and behaviors early (UN ECE 2017). Actions to encourage screening and early diagnosis among the elderly have also been taken in Armenia, Hungary, and Portugal (UN ECE 2017).

In Latin America, medications to control hypertension and diabetes were subjected to discounts and subsidies to guarantee access to adequate treatment in Uruguay (World Bank Independent Evaluation Group 2018). Similarly, in Brazil, medicines for diabetes control are subsidized (Kaselitz, Rana, and Heisler 2019). Among Middle Eastern countries, Morocco has made efforts in the treatment and control of diabetes by implementing a multidisciplinary strategy, in which a team of specialized professionals provides individualized treatments to patients; the program encourages self-management of the disease in collaboration with non-governmental organizations and subsidizes diabetes medication (Salhab et al. 2004).

The case of Sri Lanka, with the establishment of the Well Woman Clinics, is a noteworthy example in Asia. These clinics were introduced in 1996 with the objective of screening perimenopausal women for breast and cervical cancers, as well as other chronic diseases, such as diabetes and hypertension. Yet coverage levels fall short of the initial aim, reaching only 50 percent of women in the 35-year-old cohort, 30 percentage points below the target of 80 percent. A severe shortage of human resources for health, especially midwifes, who are expected to

visit homes and invite women to Well Woman Clinics, explains this result. (UNFPA WWP 2019).

Due to historically high rates of communicable diseases, efforts towards the prevention and treatment of chronic diseases in Africa have been meagre except in a few countries, among which two aging countries, Seychelles and Mauritius, and relatively younger South Africa and Tanzania stand out (Aikins et al. 2010). Management of chronic diseases is a priority in Seychelles, for example, where several initiatives have been adopted such as a multisectoral approach to manage chronic diseases and their risk factors, encouraging a person-centered approach, improving health care quality standards, and investing in the quality of human resources for the long term (WHO 2018c). The budget allocated to NCD prevention activities in the country almost doubled from 2009 to 2015, rising from 6.4 percent to 12.5 percent of general government spending, a clear sign of a shift in the healthcare paradigm from a curative to a health promotion perspective (Waleling et al. 2018). Targeted interventions, such as the approval of a tax on sweetened beverages and a diabetes management pilot program, have also been supported (Waleling et al. 2018). Mauritius has had a national program for the control and prevention of non-communicable diseases in place since 1987 and conducts focused surveys every five years.[11]

Stand-alone population-based interventions targeted at the prevention of the main risk factors for chronic diseases, such as consumption taxes applied to tobacco or unhealthy food products, have also proved to be cost-effective policies instruments to discourage harmful habits. Although there have been claims against their use based on equity reasons and the fact that consumption taxes are regressive in nature (i.e., their impact is proportionately larger on those at the lower end of the income distribution), these arguments are countered by evidence that shows that low-income consumers benefit most from these policies in terms of health gains (Sassi et al. 2018). If revenues stemming from these taxes are earmarked for health-related priority programs and actions targeted at individuals from low-income strata, potential health benefits could be even larger.

According to the latest data from WHO (2020), more than 80 percent of countries globally have policies aimed at discouraging unhealthy dietary habits and encouraging physical activity.[12] Although most of them are late or post-dividend countries, a few countries that are earlier in the demographic transition have taken steps in the same direction (Figure 10.6). Data show that between May 2016 and May 2018, 24 countries or local jurisdictions implemented taxes on artificially sweetened beverages (World Cancer Research Fund International 2018).

In Chile, for example, the Ministry of Health promoted measures that aim at controlling rising levels of obesity (and its related complications) among the population, such as the imposition of a tax on sweetened beverages, changes in food labeling, advertising restrictions, and school-based interventions (OECD 2019a). Uruguay has followed a similar path, restricting the selling of unhealthy foods at schools and salt consumption in restaurants and bars and approving legislation on food labeling, which came into effect in February 2021.[13, 14] Many countries in Asia have also approved taxes on sweetened beverages. Jurisdictions advancing on this front include rapidly aging countries such as Malaysia, Sri Lanka, and Thailand, although Sri Lanka took a step back in 2018 when it ordered a reduction in taxes. South Africa and Seychelles have also recently approved a tax on sweetened beverages.[15] Other regulatory measures used by countries to improve diet quality include the use of front-of-package labeling; nutrient profiling; school-based food regulations and education, market, and retail solutions; and marketing controls and regulations (Shekar and Popkin 2020). In Latin America, for instance, several countries including Chile, Mexico, Peru, and Uruguay have recently implemented

11 See World Health Organization, All Africa at https://allafrica.com/stories/201901070565.html

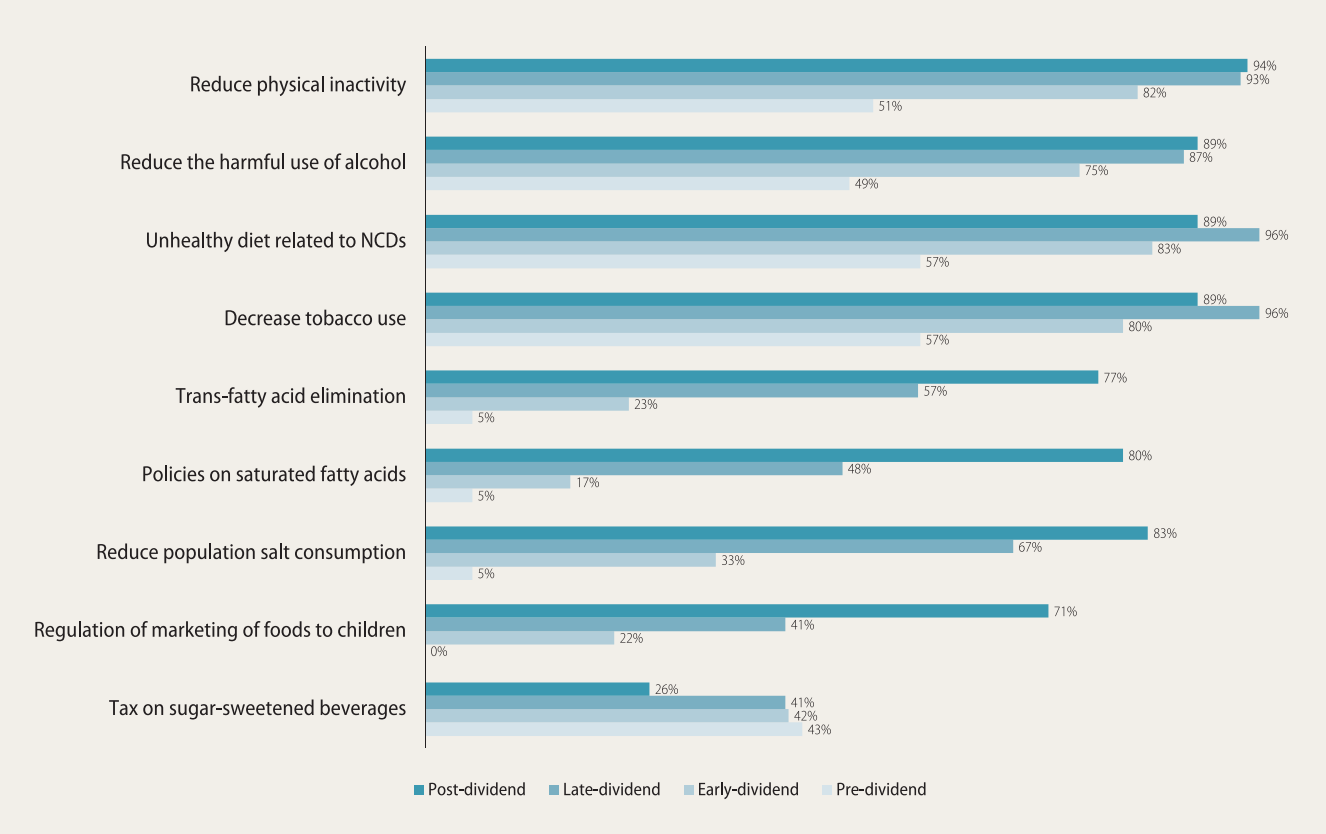
12 See preceding footnote

13 From 2007 to 2015, Uruguay also received the financial and technical assistance of the World Bank to implement a chronic disease prevention project, that focus on strengthening the country's capacities to detect chronic diseases on a timely manner, and to reduce exposure to selected risk factors across the population (World Bank PPA Uruguay).

14 See El País Newspaper. "Etiquetado de alimentos: cambian criterios y suben valores que definen cuándo un contenido es excesivo." January 28th, 2021. Available at: https://www.elpais.com.uy/informacion/salud/etiquetado-alimentos-cambian-criterios-suben-valores-definen-contenido-excesivo.html

15 See World Health Organization, Achievements in Seychelles website at http://open.who.int/2016-17/country/SYC

FIGURE 10.6 Percentage of countries with policies that target main chronic diseases risk factors, by type of policies and country's demographic stage



Source: Original analysis based on data from the Global Health Observatory Data Repository (WHO 2020).
Note: For selected policies.

front-of-package labeling with warning labels for excessive amounts of sugars, total fats, saturated fats, trans fats, and sodium.

Salt-reduction initiatives, ranging from consumer education to taxation on high-salt-content food, were first taken mostly by high-income European countries and have lately become a popular strategy to fight the rise of chronic diseases among countries of all income levels. Initiatives have shifted from voluntary to mandatory or legislative approaches worldwide (Trieu et al. 2015). There are suggestive examples of private sector involvement, as in Uruguay and Iran, where bakeries voluntarily agreed to lower the salt content in their products (Salhab et al. 2004; World Bank Independent Evaluation Group 2018).

Tobacco control policies, like banning smoking in enclosed places, increasing taxes, and requiring health warnings on tobacco packages, have been adopted at different paces and levels and with different results worldwide. Although the WHO recommends tobacco taxes of at least 75 percent of retail price, in 2018 only 32 countries met this criterion, an increase of only 10 countries since 2008; as a result, 90 percent of the global population lives in countries where tobacco taxation is deemed to be insufficient by international standards (WHO 2017b). In Latin America and the Caribbean, Uruguay is regarded as the regional leader in the fight against tobacco, while important advances have also been made in Brazil and Panama (Burki 2017); progress has been somewhat slower in Argentina, Chile, Peru, Guatemala, or Mexico (Burki 2017; Yamaguchi et al. 2017). Earmarked tobacco taxes or at least some strategic reinvestment of tax revenues towards health care and health promotion activities are present in at least 43 countries, most of them low- and middle-income countries.[16] The adoption of tobacco control policies has been sluggish in Eu-

16 See Tobacco-free Kids website at www.tobaccofreekids.org

rope and Central Asia countries, with the exception of Türkiye, and in Arab countries, where although legislation is in place, actual compliance is low; given the alarming rates of tobacco consumption among countries in the region, this lack of political commitment is worrisome (Smith and Nguyen 2013; Maziak et al. 2014).

b. Strengthening primary and community care

The role of primary care as a key strategy to achieve universal coverage and a person-centered and integrated approach to health services has been widely recognized, at least since the WHO and UNICEF Alma Ata Declaration of 1978.[17] Strengthening primary care means giving more prominence to health promotion and prevention, ambulatory and outpatient care, homebased interventions, community participation, and to coordination and integration between primary and higher care levels (WHO 2015).

A good primary care system should show the following characteristics: (i) be accessible and provide the first point of contact for the patient with the health system; (ii) be comprehensive, providing a range of services that extend from prevention and health promotion to timely detection of diseases, while avoiding unnecessary referrals to specialists; (iii) deliver person-, family-, and community-centered care, allowing for continuity of care throughout the life cycle and taking into account the specific characteristics and needs of individuals; (iv) coordinate services not only across different levels, but also across different service providers and different sectors outside the healthcare system; and (v) work longitudinally, in the sense that the relationship between the patient and the health care provider is sustained over time (Guanais et al. 2018).

Successful examples of strengthening primary care initiatives have been implemented in developing countries, often engaging the community. Although many of them concentrate on child and maternal health, initiatives that focus on chronic diseases and mental health management are also found (Kruk et al. 2010). Enhancing the capacity of the first level of care for prevention, risk factor detection, and timely diagnosis of chronic diseases is among the goals of such initiatives (Almeida et al. 2018).

Among developed countries, the case of Israel is probably one of the best-known examples of how an aggressive investment in primary care can improve population health in an efficient way. The country's primary care level is grounded on its large workforce (approximately 7,000 primary care doctors in 2017) and is strongly community-oriented, with an extended geographical network of primary care community clinics which also provide ambulatory specialist care (Rosen, Waitzberg, and Merkur 2015; Clarfield et al. 2017).

Also worth noting is the case of Canada, which has recently implemented an innovative person-centered primary care model in several provinces that focuses on health promotion and chronic disease management, including mental health services. The initiative – called My Health Teams – brings together teams of providers to care for patients with chronic conditions. These teams are comprised of health care workers who have different skills and expertise, usually a physician, a nurse practitioner, and other health professionals who may be in the same clinic, community, or even connected online. The aim of the teams is to be the first point of care for people with chronic conditions, even providing care after hours, while engaging patients in their own care and ensuring accessible, comprehensive, and coordinated person-centered care (Chateau et al. 2017; OECD 2019b).

Developing countries like Sri Lanka, Thai-land, or Viet Nam in Asia; Brazil, Chile, Costa Rica, and Uruguay in Latin American; and Seychelles in Sub-Saharan Africa have undergone a series of health care reforms that built on the expansion of primary care to achieve universal coverage, while at the same time adapting to the new epidemiological profile of the population through a reinforced emphasis on the prevention and management of chronic conditions (Atun et al. 2015; Waleling et al. 2018).

In Sri Lanka, as part of the government's strategy to manage the increase in chronic diseases, in 2011 the Ministry of Health established Healthy Lifestyle Centers. These centers function within the country's primary care units, with a twofold objective: detecting risk factors for chronic diseases through timely screening and improving access to specialized care for those diagnosed or at great risk of developing a chronic condition (Mallawaarachchi at al. 2016). Although initially the target pop-

17 See WHO (1978) "Declaration of Alma-Ata". Retrieved from: https://cdn.who.int/media/docs/default-source/documents/almaata-declaration-en.pdf?sfvrsn=7b3c2167_2

ulation comprised individuals aged 35 to 65 years, the age upper limit was later removed (UN ESCAP 2016), and by 2016 the country's 826 centers had screened 25.5 percent of the population aged 40 to 65 (Mallawaarachchi at al. 2016). Screening of younger people is also important when thinking about an aging population, as the prevention and timely management of chronic conditions earlier in life improve health at older ages.

Countries that are less advanced in the demographic transition, such as Peru and Mexico, have also invested in strengthening the primary care focus on chronic diseases. For example, the public health insurance under Peru's Seguro Integral de Salud includes an extensive primary care package that covers many chronic diseases; in Mexico, the Seguro Popular expanded beneficiaries' access to ambulatory health care services, including a benefits package that covers a set of primary care interventions, making them free at the point of delivery (Han 2012).

An important reliance on the community and the family are at the base of many of these programs. The role of community-driven initiatives is crucial, not only to reduce barriers to access, but also to provide timely and quality care at all levels, to help in the integration of primary, secondary, and tertiary care levels, and to raise awareness and education about the consequences of aging and the best ways to deal with them (HelpAge International 2014a). Because of cultural similarities with the community they care for, community health workers are seen as an important link between the formal health care system and those in need of care (Woldie et al. 2018). Community health workers are as good as, or sometimes even better than, formal health care workers in delivering preventive, promotive, and curative services, particularly when they are integrated with the formal health care system and work in settings that provide in-service training, financial incentives, adequate infrastructure and supplies, regular monitoring, supervision, and evaluation (Woldie et al. 2018).

In Brazil, the *Programa Saude da Familia* serves as a role model for a community approach to primary care. Multidisciplinary primary health teams, composed of a physician, a nurse, and four to six community health agents, are assigned up to 1,000 families each, acting as a point of entry to the health care system for them. The community health agents have a key role in the health delivery system: each of them is assigned up to 150 families and is responsible to visit them once a month to provide basic preventive care, including screening for diabetes and hypertension, health education, and, if needed, to help patients adhere to recommended treatments and stay motivated (Dmytraczenko and Almeida 2015; PHCPI Brazil n.d.). Given their close links to the families, these agents allow for continuity of care; moreover, they can refer families to other social and welfare programs, improving socio-sanitary coordination. Since 2006, the program has increased the attention given to the elderly, training health professionals in matters related to older adults' health, such as the assessment of functional status and frailty, and the establishment of self-help groups in the community that encourage healthy behaviors (WHO 2015).

Also, in Brazil, the example of Rocinha, the biggest slum (*favela)* in Rio de Janeiro, is worth mentioning. In 2012, a pilot project was launched to support the health of older people living in the city's largest slums through the design of individualized health plans and follow-up in close collaboration with three family health clinics in the communities. The evaluation of the program showed good results and was extended to the whole state of Rio de Janeiro (WHO 2015). Family-based models are also the foundation of the primary care delivery system in Costa Rica, El Salvador, and Estonia. In Costa Rica, multidisciplinary health teams (EBAIS as per the Spanish acronym) are responsible for providing care to 1,000 families each and pay home visits to the elderly; in Estonia, family doctors receive special training in the management of chronic diseases in order to reduce specialist care; moreover, any patient with a chronic disease has the right to get an appointment within three days of requesting it (PHCPI Estonia n.d.; PHCPI Costa Rica n.d.).

The role of the community in the delivery of primary care is also highlighted by successful examples in Asia, where the prevention and management of chronic diseases is increasingly gaining attention (HelpAge International 2014a). In Thailand, primary health care, with a prominent role for "village health volunteers," is considered the backbone of the health care system. These workers focus on prevention and health promotion and act as the first point of contact between primary care and the rest of the health care system (Tejativaddhana et al. 2018). As part of a strategic plan to reorient its health care system towards the management of chronic diseases, Malaysia has made an important investment in primary health care that focuses on prevention and screening for major chronic diseases at the community, workplace, and school levels, also relying on voluntary workers (Yiengprugsawan

et al 2017). In Viet Nam, intergenerational self-help clubs for the elderly promote healthy aging activities and provide health checkups and homecare support services, along with other services, such as self-care trainings, information on older people's rights, and help building social networks or generating an income. The project has the support of HelpAge International and works with volunteers, who are trained by paid retired health care professionals. More than 16,000 caregivers provide ongoing care for at least 10,000 people in the 3,000 clubs that exist in the country (AHWAIN 2020).

A few relatively younger countries have started to move in the same direction, in response to the recent increase in the prevalence of chronic conditions and foreseeing the demographic and epidemiological changes to come. In South Africa and rural Ethiopia, for instance, chronic disease clinics run by trained nurses have proved to be effective for the management of chronic diseases (Mamo et al. 2007; Coleman, Gill, and Wilkison 1998). In Bangladesh, the 13,000 community clinics that exist in rural areas have recently incorporated chronic disease screening as part of their functions. In India, chronic diseases and palliative care have become part of the remit of the country's "Accredited Social Health Activists," who serve as community health providers in rural areas (WHO 2018b). Also in India, the state of Kerala has made important advancements in strengthening primary care with a strong focus on community engagement. Although, until recently, efforts were mostly focused on maternal and child health, the state has started to plan for an aging population, with the development of geriatric wards and facilities.[18]

Faith-based organizations are an important part of community initiatives, although more data is needed to estimate their coverage (Kagawa et al. 2012). A 2015 report by The Lancet highlights the role of these organizations in Africa, particularly Christian and Islamic facilities (Olivier et al. 2015). In Asia, a recent study for Viet Nam finds that Catholic and Buddhist organizations are important in providing both short- and long-term support for older adults in need of health and social services, including medical screenings, healthcare counseling, psychological support, and even surgery funding aid (Hun et al. 2023). Anecdotal evidence also points to an important role of thee organizations in Latin America.

Evidence regarding the impacts of primary care approaches to managing chronic diseases in developing countries is scarce but promising (Kruk et al. 2010; Macinko et al. 2009; Macinko et al. 2016). There is evidence that community-based programs are effective for the prevention and control of chronic disease, particularly for tobacco cessation programs and diabetes and blood pressure control (Jeet et al. 2017). In South Africa, after the implementation of a nurse-run chronic disease program, disease control improved by 68 percent in the case of patients with hypertension, 82 percent in the case of patients with diabetes, and 84 percent in asthmatic individuals (Coleman, Gill, and Wilkison 1998). In Latin America, countries that have invested in building a strong primary care sector, like Chile, Costa Rica, and Uruguay, have seen an increase in the use of preventive screening services for breast and cervical cancer (Almeida et al. 2018). A recent study focusing on Brazil, Colombia, El Salvador, Jamaica, Mexico, and Panama shows that, along with multimorbidity rates, the quality of the primary care sector is a key variable in determining people's ability to pay for the medical services they need (Macinko et al. 2019). Community-led initiatives have proved to be effective in the management and control of diabetic patients (Kaselitz, Rana, and Heisler 2019). Different evaluations show that implementation of the *Programa Saude da Familia* program in Brazil has expanded home health care among the elderly, particularly among functionally dependent individuals from lower socioeconomic groups who have been hospitalized in the previous year, hence contributing to reducing health inequalities (Thumé et al. 2011; Honorato dos Santos de Carvalho 2013).

Despite the progress, there is still much to do. In many countries, primary care clinics are regarded by many individuals as low-quality care, leading them to bypass this level and go directly to the second level of care. Different studies have highlighted the public mistrust of primary care in Asian countries, such as China, Malaysia, Sri Lanka, and Viet Nam, for example, but also in richer countries like Japan or the Republic of Korea (Chen et al. 2019; Yiengprug-sawan et al. 2017; Lee et al. 2019; Gaál et al. 2015). Sometimes, particularly in lower-resource contexts, this perception is justified. A study for Viet Nam found that 35 percent of the more than

18 See Improving Primary Health Care Performing Initiative. Country cases and promising Practices. Retrieved from: https://www.improvingphc.org/country-case-studies-promising-practices

100,000 commune health clinics that exist in the country do not have doctors, and many of them suffer from a lack of medicines and equipment, hampering service delivery (Somanathan et al. 2014).

The lack of trust in primary care is also reflected in patients' unwillingness to follow physicians' recommendations about diets, physical activity, and screening (Yiengprugsawan et al. 2017). Improving patients' health literacy, but also the communication skills of providers, is crucial to overcome these problems. For example, a study done in six Latin American and Caribbean countries finds that a large percentage of primary care patients report communication problems with their providers, such as: not being given the opportunity to ask questions (28 percent of respondents), not having things explained clearly enough (26 percent), leaving with health problems unsolved (31 percent), and not receiving help to coordinate care (61 percent) (Macinko et al. 2015).

Another issue is the lack of integration between primary care and other levels of care, which compromises the continuity of care, a crucial aspect of the management and prevention of chronic diseases (Dmytraczenko and Almeida 2015; Singh, Cassels and Travis 2018). Although some efforts have been made in this direction, integration initiatives in low- and middle-income countries generally focus on specific diseases or conditions, evidencing the lack of a horizontal, system-wide vision that considers the multiple health conditions that affect older adults and the need to integrate health and social services (Druetz 2019; Mounier-Jack, Mayhew, and Mays 2017).

c. Managing dementia and mental health

The management and prevention of cognitive and neurological degenerative diseases, like Alzheimer's disease and other dementias, is a priority in the agenda of health systems in most developed countries. However, even in OECD countries, plans and priorities are not always put into practice: there is still a large degree of underdiagnosis, and the quality of life among people with dementia is poor, with higher-than-recommended prescription levels of antipsychotic drugs and a lack of adequately trained medical personnel (OECD 2018b).

The situation is even more acute in developing countries, although some progress has been made during recent years, particularly in rapidly aging countries. In 2017, only 32 countries worldwide had adopted a national dementia plan, most of them high-income countries that are already advanced in the demographic transition, except for Chile, Costa Rica, Indonesia, and Mexico (ADI 2017).[19] By 2019, 30 more countries had national plans in development (ADI 2019) (Figure 10.7). Some countries, such as China, Kuwait, Lebanon, Morocco, Tunisia, and Uruguay, have recently launched national mental health programs that include older people as part of their target populations (UN ESCWA 2017; UN ESCAP 2017; MSP Uruguay 2020).

The lack of a clear commitment regarding public funds sometimes prevents plans from advancing and being put into practice (ADI 2019a). For example, the Uruguayan government approved a Mental Health Plan that includes dementia in 2017, but until 2020 no resources had been allocated, preventing its implementation.[20] Peru approved a national law to develop a national plan for dementia in 2013; while the plan was supposed to be developed in 90 days, six years later it had not been approved.[21] Similar experiences have been reported in Argentina, India, Slovenia, and Türkiye (ADI 2019a).

Relatively younger countries have also made important progress, albeit outside the framework of a National Dementia Policy. In Nepal, for example, Alzheimer treatment is provided at no cost for the elderly (Williamson 2015). Early detection of cognitive decline in adulthood is encouraged in Indonesia as part of a life-course approach to mental health (WHO 2015). In the Middle East and North Africa, some countries that are less advanced in the demographic transition, such as Iraq and Sudan, offer mental health programs for older people in mental institutions or long-term residences, rather than as part of their national health policies (UN ESCWA 2017).

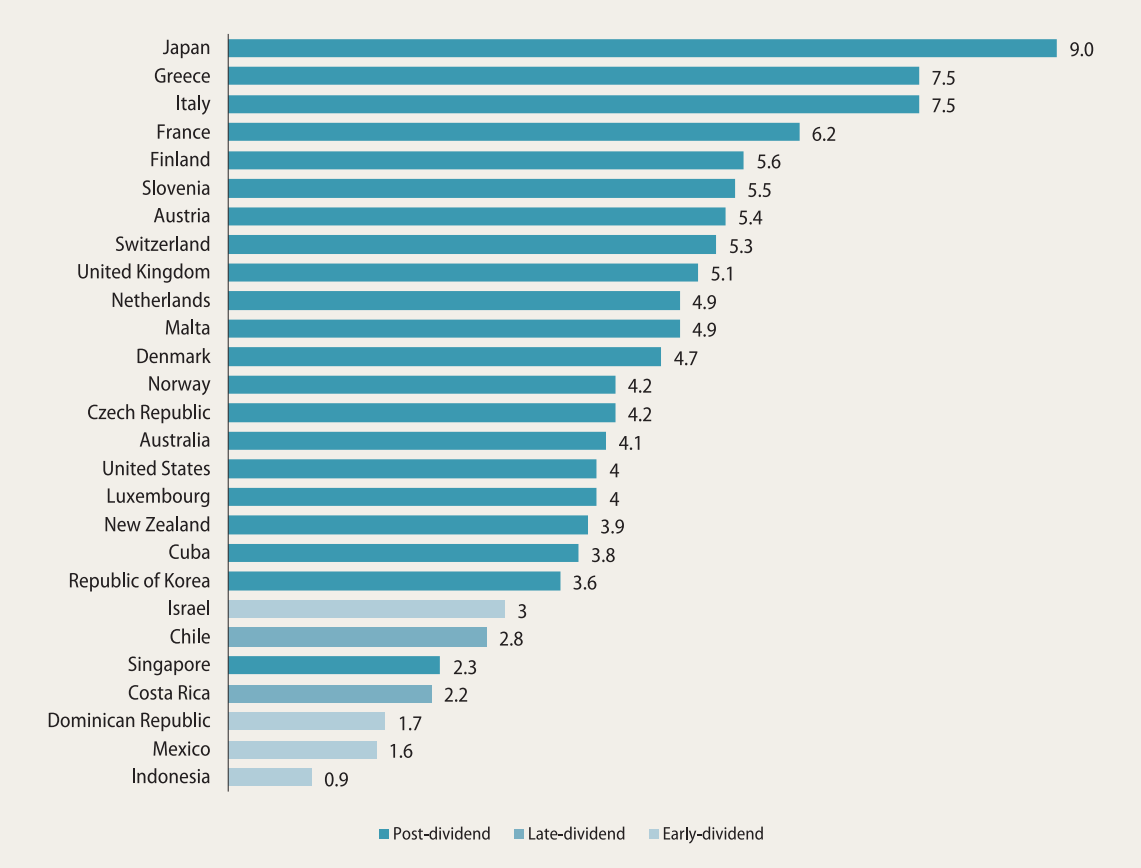
A large degree of misinformation and cultural stigma about dementia still prevails in many countries. For example, 66 percent of people worldwide think that developing dementia is a natural part of the aging process, while 63 percent and 67 percent of people living with dementia in Asia and Africa,

19 See Alzheimer's Disease International website at https://www.alz.co.uk/dementia-plans ;

20 See Uruguay Presidencia. Press Release July 22nd, 2020. Retrieved from: https://www.presidencia.gub.uy/comunicacion/comunicacionnoticias/salud-mental-presupuesto

21 See Alzheimer's Disease International website at https://www.alz.co.uk/news/national-dementia-plan-confirmed-for-peru

FIGURE 10.7 Countries that have national dementia plans in place, and percentage of their populations aged 80 and above



Source: Alzheimer's Disease International (2020) (https://www.alz.co.uk/dementia-plans).

respectively, were targets of jokes (ADI 2019b). Mechanisms to ensure accurate and timely diagnosis are also needed. Even in OECD countries, underdiagnosis reaches almost 50 percent (OECD 2018b). This figure is expected to be much higher in lower- and middle-income countries.

The development of dementia-friendly communities [22] in different parts of the world is a powerful tool to raise awareness about the issue. Among the most successful examples of such initiatives is the Dementia Friends movement that comprises 16 million volunteers in 50 countries, following a model first implemented by the UK and Japan. The model is simple, consisting of face-to-face or online training sessions that educate people about dementia in order to change the way people think about the disease and defeat main misconceptions. The aim is that those who attend the training session become a support for people with dementia within their families and communities.[23] The Alzheimer Café initiative, first developed in the Netherlands and then replicated in 15 countries around the world, is another example of a simple and easy-to-implement approach to a dementia-friendly initiative. The aim is to provide a safe social setting where people with dementia and their caregivers can meet to share their experiences.[24]

Among developing countries that are advanced in the demographic transition, the case of China is worth highlighting as an example of the development of dementia-friendly communities: the campaign "Memory Health in the Community," where

22 These are defined as "a place or culture in which people with dementia and their careers are empowered, supported and included in society, understand their rights and recognize their full potential." See Alzheimer's Disease International. Dementia Friendly Communities webpage at https://www.alz.co.uk/dementia-friendly-communities/principles

23 See preceding footnote

24 See Alzheimer's Disease International. Alzheimer's Cafés webpage a https://www.alz.co.uk/dementia-friendly-communities/alzheimer-cafe

memory specialists, social workers, and community advocates give lectures to increase awareness and understanding of the disease and encourage memory screening, is present in 50 cities. Also, the Yellow Bracelet Project distributes free GPS-guided bracelets to ensure the safety of people with dementia, preventing them from getting lost. The project was implemented in 233 cities, distributing 500,000 bracelets between 2012 and 2016 (ADI 2017).

Although the most common initiatives in developing countries are concentrated on raising awareness about the condition, there are examples of policies in other areas, as well. For example, Bermuda and Jamaica established training programs for formal caregivers of people with dementia (UN ECLAC 2017), while Trinidad and Tobago has set up special provisions for people with dementia in its disaster relief national program (UN ECLAC 2017). The pilot project "Forget Me Not," carried out by HelpAge International and European donors between 2013 to 2015 in Bolivia, Colombia, and Peru, is also worth mentioning. The program aimed to improve diagnosis and care for people with dementia, as well as providing support for caregivers and increasing awareness within the population (HelpAge International 2015a). International consensus exists that this is one of the areas in which countries are further behind when it comes to preparing for an aging population.

Finally, there are few support programs for family members, who usually bear the main responsibility of caring for people with dementia, as discussed below, in paragraphs 4.16 and 4.17 (Manes 2016). The Italian Up-Tech program is a successful initiative that aims at reducing family caregivers' burden through the training and hiring of social workers who provide continuous support to the caregivers of persons with dementia in the form of face-to-face counseling sessions and follow-up telephone calls, among others. The social worker acts as a care manager and can coordinate care between different care settings and between hospitals (Amelung et al. 2014). Some developing countries have taken steps in this direction, but more needs to be done.

For example, in Chile, the Ministry of Health gives financial support to local governments for the implementation of daycare centers for people with dementia, which function as respite services for caregivers. However, as per information from 2016, these centers covered only 0.3 percent of the population with low or moderate dementia in the country (Molina et al. 2020). In China, Dementia Caregiver Support groups, where volunteers previously trained by professionals organize training and recreational activities for caregivers, is a good initiative that works in 10 cities (ADI 2017). Following the example of Goa, in India, community-based interventions to support caregivers of people with dementia were established in Russia, providing caregivers with basic information about the disease, advice on how to manage it, and information on the availability of public services. A similar initiative was implemented in Peru, a relatively younger country (WHO 2015).

d. Adapting human resources

Health care professionals of all types, including doctors, nurses, community workers, and other health care support staff, will need to adapt to meet the challenges of an aging population. Health care workers need not only to understand which are the main ailments that affect the elderly, their comorbidity patterns, and their main risk factors, but also to recognize signs of frailty that could lead to functional dependency, and to identify warning signals of abuse and neglect. They also need to be able to engage older people in health promotion activities and understand how to communicate effectively with them (WHO 2015).

Despite the increasing recognition of population aging as a challenge that health care systems need to address, the training and adaptation of human resources is still an area in which progress has been sluggish. Training is needed at all levels of care, from nurses and caregivers (see Section 4, paragraphs 4.56 to 4.61) to medical doctors. Ageism, i.e., negative attitudes towards older people and towards people because of their age, is not rare in health care settings. It is observed in the use of a patronizing tone; dismissing health problems and associating them with the supposed natural process of aging; not involving older people in consultations or decisions; spending less time in consultations; and even not performing some diagnostic procedures. Evidence across a variety of settings has shown how ageism negatively impacts older people's quality of life and the quality of care they receive (Levy et al. 2020; Ben-Harush et al. 2016). Ageism also raises the question of what it means to provide adequate care for older patients.

In most developing countries (and in many developed ones), the number of geriatricians is insufficient, and medical personnel, in general, lack the necessary training to treat older adults. In many cases, medical curricula do not even include gerontolog-

ical or geriatric training (WHO 2015). A survey from 1999, comprising 36 countries, showed that, at that time, 19 percent of medical schools in high-income countries, 43 percent in transitional economies, and 38 percent in middle- and lower-income countries did not have any training in geriatric medicine (WHO 2015). More recent research done in Latin America and the Caribbean suggests little change (López and Reyes-Ortiz 2015). Data from Uruguay, one of the oldest countries in Latin America, shows that, in 2014, there were only 81 geriatric doctors in the country (Aguirre 2014). A similar situation can be seen in the Middle East and North Africa, where only in Kuwait, Lebanon, Morocco, Oman, Sudan, and Tunisia is geriatrics considered a separate specialty in medical school (UN ESCWA 2017). As a result, the ratio of geriatricians is less than one per 100,000 older persons in most Arab countries, except for Bahrain, Lebanon, and Tunisia (Sibai et al. 2017).

The progress made in this area has been meager (WHO 2015), although some efforts are worth highlighting. In Latin America, as a response to the workforce shortage, the Pan-American Health Organization, the Inter-American Centre for Social Security Studies, and the Latin American Academy of Medicine for Older Persons have designed a specialized course in the management of health services for the elderly (UN and HelpAge International 2012). Aging countries in the Caribbean, such as Jamaica and Barbados, have taken steps to include formal geriatric and gerontological training in schools (UN ECLAC 2017). In Asia, there have been efforts to improve the quality and quantity of human resources in the area of older people's health, such as the inclusion of geriatric care in the medical curriculum in Bangladesh and Pakistan, the integration of geriatric medicine and services in hospitals in Malaysia, and the establishment of geriatric training programs in Armenia, Pakistan, Sri Lanka, and Thailand (Williamson 2015; UN ESCAP 2017; Yiengprugsawan et al. 2017). In Middle Eastern countries, geriatrics is still considered a relatively new field, although recently it has started to be recognized as a specialty of its own, particularly in rapidly aging countries, such as Kuwait, Lebanon, Morocco, and Tunisia, but also in relatively younger countries such as Oman or Sudan (UN ESCWA 2017). Despite the efforts made to extend and improve gerontological and geriatric trainings, making these specialties an attractive option for young professionals remains a challenge (UN ESCWA 2017; UN ESCAP 2017).

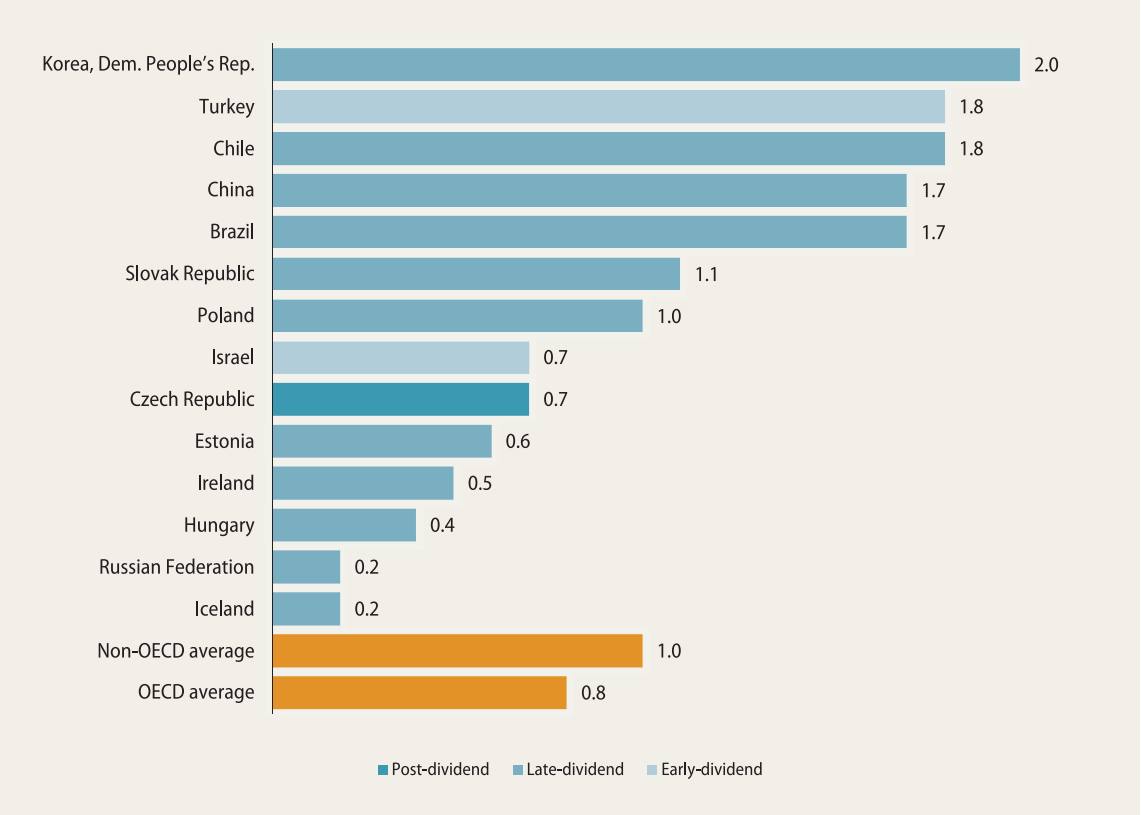
Financial pressures and the challenge of keeping costs contained

Developing countries are facing these challenges under restrictive fiscal constraints. Although more than 80 percent of the world's population lives in low- and middle-income countries, they account for only 20 percent of global health spending (WHO 2018b). An analysis of trends for the period 2000-2016 shows that this situation might be changing, as total health expenditure has been growing faster in low- and middle-income countries when compared to their higher-income counterparts (WHO 2018b).

Projected demographic changes are expected to exert additional pressures on health care expenditure, as older people account for a large share of health care utilization, both measured as health expenditure and as utilization of bed-days (Rechel et al. 2009). Moreover, the shift of the burden of morbidity from infectious to chronic diseases pushes costs upwards, as the latter usually require more expensive treatments and follow-up for extensive periods of time (Guanais et al. 2018). There is some debate, however, about the extent of the impact of population aging on health care costs, as some argue that factors such as technology and proximity to death have a much larger impact than age per se (Rechel et al. 2009.).

The costs of aging in terms of health care resources could be largely contained by promoting a healthy aging approach. Lifetime health care costs for obese individuals or smokers are significantly higher than for their healthier counterparts (Yang and Hall 2008; Sloan et al. 2004). However, estimates by the OECD show that, even under a healthy aging scenario that assumes that all gains in life expectancy are translated into healthy life years, population aging alone will make total health expenditure increase from 5.5 percent of GDP in 2010 to 6.3 percent of GDP in 2060 in OECD countries, and from 2.4 percent to 3.4 percent of GDP in the so-called BRIICS countries (Brazil, Russia, India, Indonesia, China, and South Africa) (de la Maissoneuve and Martins 2013). A recent study of Latin American countries estimates that health care expenditures attributable to people aged 65 or more are expected to increase from 2.2 percent of GDP in 2020 to 4.8 percent in 2050 (Aranco et al. 2022). A closer look shows that in late-dividend and some early-dividend countries that are aging at a relatively faster speed, for example Türkiye and Israel, the impacts of demographic change on health care expenditures are expected to be larger (Figure 10.8).

FIGURE 10.8 Projected increase in health care expenditures due to demographic effects, 2010-2060 (in percentage points)



Source: Adapted from de la Maissoneuve and Martins (2013), Table 3.
Note: The non-OECD average and the OECD average include countries not shown in the graph

These results are in line with recent IMF projections that estimate that health expenditure will increase in all regions in the world from 2015 to 2100 due to population aging. Latin America will be the region that experiences the largest increase, moving from a total health expenditure of 4.4 percent of GDP to 13.5 percent during the period. For emerging European countries, the increase will be from 5 percent to 11.9 percent, and in emerging Asian countries health expenditures are projected to rise from 2.3 percent to 7.1 percent of GDP over the period (Flamini et al. 2018). Another study for the Asia Pacific region estimates that, from 2015 to 2030, health care expenditure per capita could experience a 9-fold increase in Viet Nam, and almost a 5-fold increase in China. The factors behind the projected trends are the projected increase in the population older than 65, the projected increase in medical costs, and the projected increase in the demand for long-term care (Hedrich et al. 2016). For countries where health care insurance is funded through contributions linked to participation in the formal labor market, as is the case in almost all Latin American countries, the fiscal outlook is even worse as the increase in old-age dependency ratios shrinks the contributory base for funding.

The economic costs of chronic diseases are also well documented. Assuming that no efforts are made to control the rising trends in prevalence, it is estimated that in low- and middle-income countries cumulative losses due to cardiovascular disease, diabetes, cancer, and chronic respiratory diseases could reach up to US$ 7 trillion during the period 2011-2025. In developing countries, estimates show that cardiovascular disease, cancer, chronic respiratory disease, diabetes, and mental health disorders are going to be responsible for a reduction in economic output equal to $27.6 trillion in China and India from 2012 to 2030 (Bloom et al. 2014).

INCREASING RISK OF FUNCTIONAL DEPENDENCY AND CHALLENGES FOR LONG-TERM CARE SYSTEMS

Highlights

- *In rapidly aging countries, rates of functional dependency are expected to rise with the expected increase in the share of older people in the population and the prevalence of chronic diseases.*
- *Thus, an increase in expenditures related to long-term care is expected, given the increasing demand for long-term care and the need to provide support to informal caregivers.*
- *The rising demand emerges in a context of reduced availability of traditional informal and family care and in the absence of other affordable, good-quality care options in many countries.*
- *The provision of long-term care services for people with diminished functional abilities needs immediate attention, given changes at the societal and family levels and the current scarcity of affordable and high-quality private services.*
- *The role of the government is crucial. Important gaps still exist in meeting the needs of functionally dependent older adults. Progress towards the development of long-term care services has been slow, and little is known about implementation, especially in low- and middle-income settings.*
- *Key challenges for long-term care services include: (i) achieving accessibility and affordability while ensuring adequate quality, (ii) developing a person-centered approach to care, respecting older people's dignity and rights; (iii) encouraging - whenever possible - the provision of home care services; (iv) supporting informal caregivers as needed. Investing in the training and professionalization of human resources and the improvement of their work conditions is essential to improve the quality of care that older people receive.*
- *Coordination and integration between the social care and health care sectors is central to achieve a continuum of care for the older person and to obtain much-needed efficiency gains.*

Rising long-term care needs

a. More people with functional dependency

Increased age is usually associated with physical impairment and a decline in sensory and cognitive functions, as well as with a debilitation of the immune system (WHO 2015). While in some cases the changes are linked to the onset of chronic conditions and diseases of old age, in others, they are simply the result of a "lifelong accumulation of molecular and cellular damage" (WHO 2015, p. 52). These transformations may have important consequences for a person's autonomy and ability to function independently.

BOX 10.3 How is functional dependency measured?

The loss of functional capacity is usually measured through difficulties and/or the need of assistance in performing a set of activities of daily living, which are classified as basic activities of daily living (ADL) or instrumental activities of daily living (IADL) (WHO 2015). The former are basic activities that are necessary for survival and self-care, like eating, dressing, using the toilet, or bathing (WHO 2004). The latter are more complex activities that involve some degree of cognitive function and interaction with the external world, such as cooking, shopping, using public transport, managing personal finances, and taking care of one's own health (WHO 2004). Abilities are lost in the inverse order in which they are gained, so instrumental activities are usually the first to be affected (Katz et al.1983; Dunlop et al. 1997).

Cross-country differences in the share of the older population reporting difficulties with basic or instrumental activities of daily living (Box 10.3) can be substantial, with lower- and middle-income countries showing higher rates of functional dependency at old ages than higher income countries, probably due to differences in subjacent health status (WHO 2015). Results from the Study on global AGEing and Adult Health (SAGE) show that, in China, around 35 percent of people 75 years old or more need some type of assistance for at least one basic activity of daily living; this figure reaches 45 percent in South Africa, more than 60 percent in Mexico, and around 80 percent in India and Russia (WHO 2015). In Thailand, almost 25 percent of people older than 80 need help with basic activities of daily living, and the figure reaches 70 percent in the case of instrumental activities (Knodel et al. 2015). In contrast, fewer than 20 percent of people aged 75 or more have difficulties with basic activities in Denmark, the Netherlands, or Switzerland (WHO 2015).

The series of Longitudinal Surveys of Social Protection, carried out in various countries in Latin America, show that the prevalence of difficulties in performing basic activities of daily living among people 80 years old or more reaches 30 percent in Chile (2015) and around 12 percent in El Salvador (2014), Paraguay (2015), and Uruguay (2013), while the Costa Rican Longevity and Healthy Aging Study (2009) shows a prevalence of more than 40 percent. Figures for instrumental activities of daily living, when available, are much larger, and reach 23 percent in Uruguay and 60 percent in Costa Rica (Aranco et al. 2018). Data based on the Mexican Health and Aging Study (2015) show somewhat lower degrees of dependency both on basic and instrumental activities than the SAGE survey, both around 40 percent for individuals aged 80 or more (Aranco et al. 2018).

In rapidly aging countries, rates of functional dependency are expected to increase following the rise in the share of older people in the population. It is estimated that by 2050, due only to demographic pressures (i.e., maintaining functional dependency rates constant), the number of persons with difficulties in basic daily activities could triple in countries in Latin America and the Caribbean, rising from 8 million today to 23 million or, its equivalent, 15.7 percent of the population aged 65 years or more (Aranco, Ibarrarán, and Stampini 2022). Similarly, the proportion of elderly with difficulties in basic activities of daily life is projected to increase by 169 percent in Thailand from 2014 to 2050; when future increases in education levels are considered, the figure is estimated at 127 percent (Loichinger and Pothisiri 2018). Increases are also projected in other developing regions, such as Europe and Central Asia (World Bank 2015).

Results could be even more problematic if the prevalence of chronic diseases increases, in which case increasing rates of functional dependency are expected to be seen even when comparing the same age groups over time. Some evidence already points in this direction. Data from Mexico shows that the proportion of people 80 years old or more with difficulties in performing basic activities of daily life increased from 30 percent in 2001 to 44 percent in 2015; in the case of difficulties with instrumental activities, the share rose from 31 percent to 39 percent during the same period (López-Ortega and Aranco 2019). Data for China also show an increase in the rates of disability for the "younger old" (people from 60 to 74 years old) between 1987 and 2006, although the trend is reversed for individuals 75 years old or more (Liu et al. 2009).

Long-term care services are services provided with the objective of assisting functionally dependent individuals with the performance of their daily activities. Services offered can be varied, and their suitability usually depends on the level of dependency of the beneficiary. Services that are often part of the menu include: long-term residential care, home care, daycare centers, tele-assistance services, and support to informal caregivers (Table 10.3).

It is argued that, unlike the case of health care services, for which increases in projected demand due to aging are more uncertain, the increase of long-term care expenditures is certain to happen as the share of older individuals in the population increases (Rechel et al. 2009).

Table 10.3 Long-term care services by type

Residential care	Services provided in institutions and that include housing, meals, help with daily activities, and basic health care services. These services usually focus on individuals with severe degrees of dependency.
Home care services	Services provided in the house of the dependent person. Usually includes a personal assistant who helps with daily activities, but can also include a wider array of services, such as meal delivery or help with household chores. These services are suitable for individuals with all levels of dependency.
Day centers	Services offered at facilities for a number of hours a day but not including accommodation. These usually focus on preventive activities and promoting healthy aging, so their target population is autonomous individuals or people with only mild levels of dependency.
Tele-assistance services	Information technology-based services that monitor and assist the dependent person remotely (emergency hotlines, fall detectors, and others.). They usually focus on autonomous individuals or individuals with mild levels of dependency.
Services for caregivers	Support services for unpaid caregivers, which may include training, counseling, respite services, and special work leave.

Source: Adapted from Cafagna et al. (2019)

b. Reduced availability of informal care networks

Traditionally, the role of caregiver has been mainly a responsibility for the family, especially women, who receive no payment for these tasks. Cultural reasons explain the overarching role of the family, particularly women, when it comes to caregiving responsibilities. Traditional values regarding filial responsibilities towards older people are strongly embedded in many cultures, sometimes hindering the development of other public and private solutions to cater to the needs of older people. Children's obligation to take care of their parents is even regulated by law in several countries in Asia, including Cambodia, India, Singapore, Sri Lanka, and Viet Nam (HelpAge International 2015b; UN ESCAP 2017). Some Eastern European countries (for example, Serbia and Latvia) also stipulate through legislation the obligation of children to take care of their parents (Stokic and Bajec 2018; Rajevska 2018). Care for older adults is also seen mainly as the responsibility of the family in Middle Eastern countries (Hussein and Ismail 2017).

This is also the case in many countries in Latin America. In Uruguay, for instance, almost half of the population younger than 70 agrees that older people should be taken care of exclusively by family mem-bers, while around 30 percent think that the best option is collaboration between a family member and a formal personal assistant. Only around 20 percent consider formal care (either through a paid assistant or through institutionalization) to be the best option (Batthyány, Genta, and Perrota 2012). Individuals of lower socioeconomic status are more likely to believe that the responsibility of taking care of older people should lie mainly with the family instead of with the market or the state (Batthyány, Genta, and Perrota 2012). This may partly explain why older people from lower socioeconomic strata are more prone to live in extended family households.

Yet changes in female labor participation and family structures are shrinking the network of available family caregivers and posing additional challenges for countries when it comes to developing sustainable long-term care strategies. Female labor participation rates have increased markedly in Latin American and the Caribbean; increases have also been seen Sub-Saharan Africa and South-Eastern Asia and the Pacific (ILO 2016). Consequently, women have less time to dedicate to non-remunerated activities, such as caring for older members of the family. And when women do provide such care, the opportunity costs are higher.

Declining fertility rates and migration flows have reduced the typical family size. As a result, a greater number of older people are living alone, with fewer close relatives to rely on. In Latin America and the Caribbean, on average, the proportion of older people living alone went from 9 percent circa 1990 to 13 percent circa 2010 (UN 2017c). In Uruguay, for instance, 26 percent of people older than 65 live alone, and more than 30 percent live only with their spouse. These figures are also high among the functionally dependent population, 24 percent of whom live alone, and another 24 percent only with their spouse (Monteiro and Paredes 2016). Similar patterns are seen in other Latin American countries, with the percentage of

people living alone being high even for the "oldest old." Evidence from other regions also points to a reduction in family size (Bongaarts and Zimmer 2002; United Nations 2017). In Asia, the proportion of older people living alone increased from 18 percent in 1990 to 27 percent in 2010, and the proportion living with children decreased from 73 percent to 64 percent in the same period (UN 2017c). In Thailand, for instance, the percentage of older people living with children declined from 77 percent in 1986 to 55 percent in 2014 (Knodel et al. 2015). Similar trends were seen in Eastern Europe and in Middle Eastern countries.

In general, the probability of living alone or living only with a partner is higher the higher the person's socioeconomic status, as people of higher socioeconomic status tend to have fewer children, they are usually in better health (and hence, less dependent on help), and they can more easily afford to hire good-quality private care in case of need.

At a time when the demand for care is rising in developing countries, the reduction in the availability of informal care brought about by these changes leads to a large share of elderly people with functional limitations not receiving any help whatsoever. In fact, it is estimated that, in Thailand, among the population aged 60 years or more, 36 percent of those needing assistance do not receive any (Knodel et al. 2015), while in Uruguay this percentage reaches almost half of those requiring help with either basic or instrumental daily activities (Aranco and Sorio 2019). Evidence for China shows that only around 50 percent of older individuals requiring help in using the toilet have someone to assist them (Glinskaya and Feng 2018).

c. Women are still the main unpaid caregivers for older people

In the absence of public solutions for long-term care in many aging countries, families, and particularly women, are still the main unpaid caregivers for older dependent people. This situation forces many caregivers—again, principally women—to either forego participation in the labor market altogether or to endure excessive working hours, when combining paid and unpaid work. This is true in most countries, regardless of their level of development, but it is even more acute in developing countries, where both public and private alternatives to long-term care are limited.

A study conducted in China, Mexico, Nigeria, and Peru (Mayston et al. 2014) shows that in these countries most of the help is provided by either the recipient's spouse or a child and that—except in rural China, where care responsibilities seem to be shared equally between genders—caretakers are mostly women. The study also shows that only in the urban regions of China and Peru are care responsibilities shared with paid workers. In Uruguay, data from 2013 show that among older adults who receive help with their daily activities, almost 76 percent rely on unpaid family members to provide such care; in most cases the help comes from a woman (Aranco and Sorio 2019). In Chile, the percentage of functionally dependent older adults who receive family help is 70 percent, exclusively (46.4 percent); with estimates showing that between 70 percent and 90 percent of this unpaid help is provided by women (Molina et al. 2020). In Colombia, the 2015 SABE survey shows that 84 percent of those providing care to the elderly are women, and only 7 percent receive some kind of payment for the task, either in cash or in kind (UN 2017d). Similarly, in Thailand, 90 percent of older people receiving assistance with their daily activities report getting it from a family member, daughters being the main caregivers, followed by spouses (Knodel et al. 2015).

Globally, unpaid care work is estimated at approximately 3 percent of economic output; most unpaid caregivers are family members, usually women; and a large proportion of this care work is associated with non-communicable disease-related care (The Lancet Commission on Women 2015).[25] In some countries the contribution of unpaid work to GDP is even larger. For example, in many Latin American countries it has been estimated to reach 20 percent, with women responsible for 70 percent of this contribution (ONU Mujeres 2018; Vaca 2021).

The consequences that care responsibilities have for family members' (very often women's) health, wellbeing, and labor market participation are well documented. More than 48 percent of caregivers in rural China were forced to give up or reduce paid working time to fulfill their caregiver responsibilities; this number reaches almost 40 percent in Nigeria and rural Mexico (Mayston et al. 2014). In Poland, around 66 percent of caregivers do not participate in the labor market, while in Slovakia 28 percent of inactive women declare

25 https://www.thelancet.com/commissions/women-health-2015

caregiving responsibilities (either towards children or towards older individuals) as one of the main reasons behind not seeking a job (Sowa-Kofta 2018; Gerbery and Bednárik 2018). A study that includes data from Chile, Colombia, Costa Rica, and Mexico shows that women taking care of parents are less likely to participate in the labor market and that, when they do, they work for a smaller number of hours (Stampini et al. 2020; cf. Gatti et al. 2024).

The burden of caregiving responsibilities toward family members also takes its toll in terms of the emotional and physical health of the caregivers. A multi-country survey conducted in 11 countries in Latin America, India, and China highlights the emotional strains suffered by caregivers of people with dementia (Prince et al. 2012). Research from Chile (Flores, Rivas and Seguel 2012; Villalobos 2018), Colombia (Giraldo and Franco 2006), and Philippines (Varona et al. 2007), among others, also confirms this.

Country responses in long-term care

a. General context

As a result of the increasing demand for long-term care services and the shrinking network of family caregivers, there is a gap between the needs for and the supply of care. This gap will widen as populations age if no actions are taken (Glinskaya et al. 2024). Given the barriers to developing a private long-term care insurance market, and the prohibitive costs of financing older-adult care out-of-pocket (Barr 2010), public intervention is critical to ensure that individuals have the support they need to continue living as autonomously as possible as they grow old (Caruso, Galiani and Ibarrarán 2017; Glinskaya et al. 2024).

The development of national long-term care systems is relatively new on the political agenda globally. While some countries (particularly high-income OECD countries) have well-developed national systems in place, in low- and middle-income countries the provision of long-term care services is – at best – characterized by a multiplicity of small-scale interventions with limited coordination and integration. Even in countries where public solutions do exist, coverage is low and institutional factors often affect accessibility. According to a study done for 46 developed and developing countries in 2015, 48 percent of older adults were not legally covered for their long-term care needs, and an additional 46 percent were excluded from coverage due to restrictive means-testing accessibility rules (Scheil-Adlung 2015).

In developing countries, the lack of state-organized services, coupled with barriers to accessibility and affordability of services, leads to extremely low levels of coverage, issues of poor quality, and long waiting lists (Glinskaya et al. 2024). A recent review of the state of the art in 26 Latin American and Caribbean countries shows that the region performs poorly when it comes to coverage and quality of services. The countries that perform better in terms of coverage are Argentina and Costa Rica, but even in these countries only 20 percent of dependent people older than 65 receive some public long-term care services (Aranco et al. 2022). Small and relatively richer countries like Barbados achieve just 15 percent coverage, while Uruguay has 11 percent and Chile only 7 percent. Most of the other countries studied have an estimated coverage of less than 5 percent. Regarding quality, the report shows that, despite most countries having quality standards for residential care in place, the level of compliance is very low, and challenges are even starker in the case of home care (Aranco et al. 2022). Results also show that the bulk of human resources working in the field do not receive proper training for the tasks they are expected to perform.

In countries where no formal long-term care system is in place, like Serbia, the problem is particularly acute: waiting lists for admission to institutional and daycare centers are long and the level of coverage very low. In 2016, only 8.5 percent of older individuals in Serbia received some kind of long-term care service, in the form of residential care, home and day care, or cash allowances (Stokic and Bajec 2018). In Hungary the figure reaches 10.2 percent (Gal 2018). High levels of out-of-pocket payments could also be a barrier to effective coverage: for instance, such payments represent around 50 percent of relevant costs in the Czech Republic (Maly 2018), while in Latvia, 90 percent of the older person's pension is used to cover the cost of institutional care (Rajevska 2018).

Efforts should be made to design and implement long-term care systems that are affordable, accessible, ensure minimum quality, and are person-centered, respecting older people's dignity and rights and, whenever possible, improving their functional abilities (WHO 2015). In what follows, we provide examples of some actions taken in that direction by developing countries.

b. Development of national long-term care policies in developing countries

Many countries have started to raise the issue of long-term care on the political agenda, either with the aim of addressing the problems posed by current systems – when they exist – and/or designing new solutions to ensure that older people receive the care they need. In 2021, Costa Rica approved a 10-year policy program to implement a care system at the national level. Colombia is in the process of designing a national long-term care system, as is Saint Maarten (UN ECLAC 2017), while relatively younger countries such as Paraguay and Ecuador have recently included the subject on their public agenda.

The process of designing and implementing a long-term care system is not easy and one size does not fit all (Glinskaya et al. 2024). Countries need to consider at least four factors when planning such a system (Medellin, Ibarrarán, and Stampini 2018): (1) Who are the beneficiaries? (2) Which benefits will the system cover, and how will they be delivered? (3) Which mechanisms should be used to ensure the quality of services? and (4) How will the system be financed?

In Latin America and the Caribbean, the case of Uruguay is worth highlighting. As one of the countries with the oldest populations in the region, Uruguay has also been the first to design and implement an integrated national long-term care system, the *Sistema Nacional Integrado de Cuidados*. This is a tax-funded system, which came into operation at the end of 2015. The system covers children and persons with functional dependency due to aging or disability. Due to budget constraints, the system focuses on the most vulnerable populations, with the aim to progressively increase its coverage over time (cf. Glinskaya et al. 2024). Those aged 80 or more (or younger than 30) with severe dependency are entitled to 80 hours a month of home care; those 65 and older with mild levels of dependency can go to publicly funded day centers and have the right to access a basic teleassistance service after they turn 70 years old. In the case of homecare services and telecare, the percentage of the cost financed by the government depends on household income, with individuals of higher socioeconomic status being subjected to higher copayments.

Given that functional dependency is usually concentrated at older ages and that it correlates negatively with socioeconomic status (Aranco et al. 2022), targeting the most vulnerable sectors of the population – i.e., the oldest and the poorest – could be a good strategy when, due to budget limitations, universal coverage is not possible (WHO 2015). Yet, these restrictions could leave an important share of the dependent population uncovered (Villalobos 2018). In Chile and Costa Rica, for example, there are systems in place, but their geographical coverage is limited. The Chilean system *Chile Cuida*, which started in 2017, covered only 22 of the 360 counties in the country by 2020. The system targets the most socioeconomically vulnerable population aged 18 years or more with moderate to severe levels of dependency. One of its main objectives is to coordinate the fragmented and uncoordinated public supply of long-term care services in Chile. The case of Costa Rica is similar: the country's long-term care program (*Red de Atención Progresiva para el Cuido Integral de las Personas Adultas Mayores*) is implemented at the local level, in counties/communities that express interest and that meet certain prerequisites in terms of financial resources and management capacities. The program covers functionally dependent people over 65 years old from low socioeconomic settings who have no other support networks available. The benefits are provided in the form of cash subsidies to purchase services/goods that range from home care help to home adaptations, transportation, food, and medicines, among others.

Progress has been slower in developing countries in Asia, despite their advanced stage in the demographic transition. The heterogeneity of both the stage of economic development and the stage of the demographic transition across Asian countries explains, in part, the different state of long-term care policies in the region (Esquivel and Kaufmann 2017). While high-income countries such as Japan, Korea, and Singapore have integrated and coordinated long-term care policies, the situation is different in low- and middle-income countries. Although in some countries governments are stepping in to close the gap between the growing demand for long-term care services and the declining support from informal caregivers, the implementation of national long-term care policies is still at early stages. In China, some local governments (for example, the cities of Qingdao, Wuxi, and Suzhou) have launched experimental long-term care insurance schemes that cover home, institutional, and hospital care, but a national coordinated policy is still not in place (UN ESCAP 2017).

The situation is highly heterogenous in Eastern European countries. Bulgaria approved a national strategy for long-term care in 2018 (Bogdanov and

Georgieva 2018), while Slovakia is currently working on the design and approval of an integrated and coordinated national system (Gerbery and Bednárik 2018); steps to integrate social and health care services, and to transform long-term care services into an independent policy field, are being taken in Hungary (Gal 2018). Some countries have taken actions to improve long-term care service coverage for populations living in rural areas. These include Russia, with the construction of new nursing homes, and Poland, with its Care 75+ program, which provides partial financial support to local authorities for the provision of services (Sowa-Kofta 2018).

Despite the existence of stand-alone initiatives in countries such as Ghana or Tanzania, the only three countries that have developed national efforts to implement national long-term care policies in Sub-Saharan Africa are Mauritius, Seychelles, and South Africa (WHO 2017c).

Efforts to design and implement long-term care systems reflect countries' commitment to bridge the gap between increasing demand and shrinking supply of long-term care. However, in most cases more needs to be done. Financing is, most of the time, one of the main constraints for further progress (Glinskaya et al. 2024). Budgets devoted to long-term care services are often inadequate, resulting in low levels of coverage and limited services.

In Uruguay, for example, the cost of the system in 2017 amounted to 0.04 percent of GDP, a figure that was estimated to be five times lower than what would be necessary to achieve the explicit objective of the system of reaching 60 percent coverage by 2020 (SNIC 2018; Matus-Lopez 2017). In fact, data from 2018 show that the system covers only 6 percent of the country's dependent elderly (SNIC 2019). Similarly, initial projections in Chile were for the system to cover 70 municipalities in 2018, 181 in 2019, 263 in 2020, and 345 in 2021. The lack of financial resources and political commitment have made it impossible to reach these aims, and in 2020 the system was in place in only 22 municipalities (Barraza 2017).

An alternative to the lack of resources is to fund the system through compulsory insurance, as is the case in some developed countries, such as France, Germany, Japan, Korea, or the Netherlands (Aranco and Ibarrarán 2020). Among developing countries, this source of financing has not taken hold, despite some recent discussions in the context of the pension reform in Chile (Macías Muñoz 2019).

c. Strengthening home care and community services

All over the world, in recent years, there has been a tendency towards deinstitutionalization of care, while home and community care services are increasing in importance (Aranco and Ibarraran 2020). In addition to being aligned with older people's preferences, "aging in place," when possible, has advantages both in terms of economic costs for governments and of older adults' mental and physical health (WHO 2015; Boland et al. 2017).

Several countries have undertaken initiatives to improve the care of the elderly, with or without the framework of a national and integrated system. In many OECD countries, the emphasis has been on policies that encourage an aging-in-place approach, promoting home and community services that allow older people to live independently as long as possible (UN ECE 2017; Spasova et al. 2018; Colombo et al. 2011). The 2015 long-term care system reform in the Netherlands, for example, limited the option of institutional care to those cases where home care is not feasible; similarly, reforms in Germany (2015-2017) and in Japan (in the late 1990s) favored the utilization of home care services by making them more attractive than institutional services (Aranco and Ibarraran 2020).

Following these global trends, developing countries have taken steps to strengthen the importance of home-based long-term care services. In Latin America and the Caribbean, for instance, home care services are the backbone of the newly created systems in Uruguay and Chile, and in Argentina the government subsidizes the hiring of a personal assistant for older adults who need help in their daily activities. While in Argentina and Chile the benefit is targeted at the economically vulnerable population, in Uruguay it covers all severely dependent older individuals, but cost-sharing is means-tested (Aranco and Ibarraran 2020).

Development of home care programs and services has also been seen in many Caribbean countries: in Antigua and Barbuda and Barbados, the public sector runs a free home care program that assists older people with basic daily activities, while in Trinidad and Tobago means-tested home care services are provided; a home health care service for those who have been released from hospital has recently been launched in Guyana (UN ECLAC 2017).

Other Caribbean countries that have taken steps in this direction are Anguilla, Bermuda, Cayman Islands, Dominica, Jamaica, Saint Lucia, and Saint Vincent and the Grenadines. In Bermuda, the government not only provides a home care subsidy but also offers services that help older adults to remain in their home for as long as possible, such as meal deliveries and handyman services (UN ECLAC 2017).

Within Middle Eastern economies, home care programs are available in Jordan, Kuwait, Oman, and the West Bank and Gaza, while in Lebanon such services are provided mainly by the private sector (Hussein and Ismail 2017; UN-ESCWA 2017). In Kuwait, services are provided for free (Hussein and Ismail 2017).

The development of home care services seems to be somewhat more advanced across Eastern European countries, regardless of the existence of a comprehensive national system. In 2013, Lithuania implemented a home care program (Integral Assistance Development Programme) that offers nursing and social home services for dependent people and advice to family caregivers (UN ECE 2017). A mobile team of specialists (social workers, psychologists, and others) that provide at-home services to the older population has been developed as a solution to cover populations in rural areas in Latvia (Rajevska 2018); because of this and other efforts toward de-institutionalization, expenditure for home-based long-term cares services increased 27 percent between 2014 and 2016 (Rajevska 2018). Bulgaria has also taken action to discourage institutionalization and promote community and family-based home services by expanding the range of services provided by its public system, while Slovakia approved a strategy for the de-institutionalization of social services (including long-term care services) in 2011 (European Commission 2019).

In Sub-Saharan Africa, the case of Seychelles is worth noting: a home care scheme has been in place in the country since 1987, where the older person can choose the caregiver, including a family member, but no standards for quality are set (i.e., the caregiver does not receive any kind of training). In addition, the fact that the program is funded by government revenues alone puts its fiscal sustainability in jeopardy (WHO 2017c).

It is important to highlight that the range of benefits included as home care services is not limited to the help offered by a personal assistant with daily activities; home care can include a wide array of other services that, even if they do not involve the assistance of a professional caregiver, can help older people to remain in their homes as long as possible (Aranco and Ibarraran 2020). Countries such as Estonia, Israel, Italy, or Ukraine help with errands and daily chores (UN ECE 2017). In Latvia, where municipalities have the obligation to provide home care in cases where the dependent person does not have any other family support, home services include not only assistance services but also laundry, meal delivery, and teleassistance (European Commission 2019). In Chile, local governments have the freedom to decide which services to include as part of the system's benefits through the so-called Specialized Services (Servicios Especializados), depending on the specific needs of the local older-adult population. Other countries, such as Myanmar and Sri Lanka, provide loans for home adaptations and encourage the construction of dwelling units for parents adjacent to the family's main house (Williamson 2015). Other programs, such as home delivery of meals for older people, are available in Lebanon and the West Bank and Gaza (Hussein and Ismail 2017).

Alternative solutions to support older people in remaining in a home-like context have been developed for cases in which staying at home is not possible; in Belarus, Estonia, and Russia, for instance, foster families that provide accommodation for older persons in exchange for a monthly state payment are common (UN ECE 2017; European Commission 2019). Foster care for older people is also a standard practice in Croatia and has been encouraged since the approval of the country's Foster Families Act in 2012; however, the number of adults in foster care increased only marginally from 2011 to 2015, rising from 1,409 to 1,581 over the period (Stubbs and Zrinščak 2018; European Commission 2019). In Tunisia, the government pays a modest sum to families that are willing to host older persons in their homes through a Surrogate Family program (UN ESCWA 2017).

The role of community care has been particularly important for the promotion of home care in Asian countries (UN ESCAP 2017). Within the Association of Southeast Asian Nations (ASEAN) countries,[26] volunteer-based home care programs for the elderly have proliferated as a way to help older people remain in their homes for as long as possible.

26 ASEAN countries include Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam.

Through a joint initiative, HelpAge International, ASEAN, and the Republic of Korea have collaborated with NGOs, government ministries, community volunteers, families, and older people to implement a volunteer-based home care model across ASEAN countries. The model is based on the Korean experience and adapted to the local context of each country (HelpAge International 2014b). The implementing NGOs are responsible for selecting and managing the volunteers. Volunteers receive basic training before they start working, and their tasks range from providing companionship and support to help with daily activities; in countries with weak health care systems (Myanmar, Laos, and the Philippines) the provision of basic health services can also be arranged (HelpAge International 2014b). The criteria for selecting participants vary across countries, but usually services are targeted to dependent older people from low-income settings. Volunteers and beneficiaries are matched, considering not only the needs of the older person but also the skills and preferences of the unpaid volunteers. Aims of the project include fostering an institutional status for home care ser-vices and encouraging the development of guidelines and policies in the countries where the services are implemented. This was accomplished in Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, and Viet Nam. Policies and guidelines already existed in Singapore and Thailand (HelpAge International 2014b).

Community care services are also important outside ASEAN countries. In China, for example, the development of so-called "time banks" in some provinces is an example of an innovative way of organizing community-based care. Under this scheme, time is used as a currency: relatively younger persons care for their older peers and receive, in exchange, a time credit that allows them to use an equivalent number of hours of care when they need it (UN ESCAP 2017). Another popular model of home-based care in the country is the Virtual Elder Care Home, where local governments maintain an information hotline and service center, which acts as a referral for older people in need of services. Providers are reimbursed by the government for services provided to vulnerable dependent people (Feng et al. 2012). The Happiness Homes are a community-based solution for older people living in rural areas. They consist of village homes in which older adults live together and help each other. Housing and utilities are provided free by the government, as are living expenses for those who have no source of income; those who can do so must pay their living expenses out of pocket. By 2014, the initiative covered around 12 percent of villages in the country (Glinskaya and Feng 2018).

Community-based care is also being encouraged by the government and international organizations in Sri Lanka (UN ESCAP 2017). Some community initiatives encourage integration between health and social care, as in East-Timor, Singapore, and Thailand (HelpAge International 2013). Community care has also been gaining momentum in Europe. In the Netherlands, nurses are the main pillars of a model that has proved successful for many years and is now well known worldwide. The so-called Buurtzorg approach (meaning "neighborhood care"), run by a not-for-profit organization, relies on self-managed teams of (no more than 12) highly qualified nurses that are responsible for between 40 and 60 patients in each geographic area. Working closely with general practitioners and other health care professionals, the nurses provide comprehensive and personalized care to patients in their own homes, with services that can range from administering medications to help with basic activities or preparing a simple meal (Kreitzer et al. 2015).

Less-developed countries in Eastern Europe have followed the same path. For example, in Bulgaria, an Action Plan for the implementation of a national long-term care system over the period 2018-2021 anticipated the completion of 100 new community-based social services (European Commission 2019). Community day and home-based care is also a distinctive feature of the provision of long-term care services in Serbia, while in Lithuania community services are expected to take a leading role by 2030 under the country's "Guidelines for the Deinstitutionalization of Social Care Homes for the Disabled, Children Deprived of Parental Care, and Adult Disabled Persons" (Lazutka, Poviliunas, and Zalimiene 2018).

As in the case of health care, faith-based organizations also play a role in the delivery of long-term care, particularly when it comes to residential and nursing services. Information regarding the importance of these institutions in terms of coverage and services provided is, however, limited, and more research is needed in order to quantify their contribution,

The establishment of day centers is another way to enable older adults to stay in their homes for as long as possible, although usually this type of service targets individuals with lower levels of dependency (Cafagna et al. 2019). In many countries in Eastern Europe, such centers are usually provided and fund-

ed by local governments, as is the case in Bulgaria, Poland, and Serbia (Slavina et al. 2018), and with the aid of not-for-profit organizations (UN ECE 2017).

Another example of day centers developed at the local level is seen in Brazil. Under the program "*Brasil, Amigo do Idosso*" (Brazil, Friend of the Elderly), which encourages local governments to carry out elder-friendly initiatives, the state of São Paulo has expanded the number of day and community care centers for older adults as a way to promote their levels of autonomy and social participation.[27] In Uruguay, nine day-centers were built under the new long-term care system for adults who are moderately dependent (SNIC 2020). In Chile, the Ministry of Health runs day centers dedicated to people that have been diagnosed with dementia.

Despite this progress, home and community services are still under-developed in many countries, hindering the process of deinstitutionalization. More than 50 percent of public expenditure on long-term care in Estonia, for example, is devoted to institutional care (Paat-Ahi and Masso 2018); evidence for Latvia shows that, despite efforts toward deinstitutionalization, demand and funding for institutional care has remained stable (Rajevska 2018). Romania has witnessed an important increase in both public and private residential homes since 2006 (Pop 2018). Similarly, in Poland, where the number of daycare centers has increased recently as part of the government initiative Senior+, lack of funding has prevented further progress and challenges the sustainability of the program (Sowa-Kofta 2018).

While encouraging aging in place and community-led alternatives may be an interesting policy option, it still requires strong government stewardship and regulatory oversight to ensure that quality standards are met (Glinskaya et al. 2024). Investing in the proper training of human resources, as highlighted in the following paragraphs, is also of paramount importance to guarantee a person-centered approach to care in these settings and ensure that older people are protected from abuse and neglect.

d. Improving the quality of services and investing in human resources

Developed countries use several mechanisms to guarantee the quality of services provided. These include control and inspection-based mechanisms, the disclosure of information by public agencies to encourage competition, and the professionalization of the long-term care workforce (Mor, Leone, and Maresso 2014). Irrespective of the approach adopted, the role of the government in setting quality standards and enforcing their compliance is crucial.

In developing countries this might be a critical challenge. In fact, the evidence shows that in many low- and middle-income countries, private care services are often not regulated, compromising quality standards, and allowing situations of abuse to take place (WHO 2015). Even when private or public solutions do exist, the quality of services is often poor and unregulated. This is true for all regions. The 2017 Madrid International Plan of Action on Ageing progress report for the Middle East region, for example, highlighted that, in most countries in the region, the lack of a legal framework to regulate and control these institutions undermined their quality (UN ESCWA 2017). Lack of monitoring and regulation can lead to situations of abuse, especially in institutional settings. Recent global reviews document that 64 percent of the staff working in long-term care institutions have admitted to engaging in abusive practices, while the figure is 15.7 percent in community settings (Yon et al. 2017; Yon et al. 2019).

Within this context, efforts to improve the quality of services have been undertaken, whether through the inspection and control of facilities and providers, the training of caregivers, or both. However, these agendas are particularly challenging. Regulations regarding quality standards, such as infrastructure and personnel requirements in institutional facilities, are more prevalent across countries, as – by law – most require institutions to meet certain criteria to operate. In some countries, these regulations are relatively new. For example, quality standards for residential and daycare facilities in Lithuania were first approved in 2006 (Romas, Poviliunas, and Zalimiene 2018) and in Romania in 2012 (Pop 2018). In Trinidad and Tobago, actions are being taken to strengthen the control and inspection of care facilities, and Uruguay has also set new standards for institutional residences and reinforced inspection mechanisms (UN ECLAC 2017; Aranco and Sorio 2017).

Nevertheless, the gap between what is stated in the legislation and actual practice is sometimes

27 See Governo do São Paulo. Press Release: "Conheça as ações do Programa São Paulo Amigo do Idoso" 22nd December, 2015. Retrieved from: https://www.saopaulo.sp.gov.br/ultimas-noticias/conheca-as-acoes-do-programa-sao-paulo-amigo-do-idoso/

large. In Uruguay, for example, data from 2019 show that fewer than 2.7 percent of long-term care institutions have the social and sanitary authorization required by law to operate.[28] Lack of supervision is a widespread problem across developing countries in all regions. A review of the country reports in the ESPN *Thematic Report on Challenges in Long-term Care* from 2018 highlighted this as a common problem in most Eastern European countries.

Closely related to the quality of services is the need to ensure an adequate workforce, both in terms of quantity and quality. Nearly a decade ago, it was already estimated that the shortfall of formal caregivers had already reached about 13.6 million globally (Scheil-Adlung 2015). Recent estimates for Latin America and the Caribbean show that the need for caregivers for older adults in that region alone could reach 14 million by 2050 (Villalobos et al. 2022). Improving pay and working conditions could make the sector more attractive for potential workers (WHO 2015). In developing countries, where levels of labor informality are high, this represents an important challenge (Cafagna et al. 2019). Also, it is important to ensure that caregivers have the necessary skills by requiring that they engage in proper education and training courses. In most countries, this would imply updating the educational curriculum and even the development of specialized educational institutions (WHO 2015).

Given the intrinsic characteristics of the task at hand, caregivers need not only to have technical skills (how to move or bathe a bedridden person, for example), but they also need to be trained in a wide array of softer skills such as patience and interpersonal communication, particularly in the case of patients with cognitive decline. They also need to be able to identify when the dependent person might need other services, such as health care or additional social care services.

Even in cases in which care is paid, it is often provided by workers with no formal training or expertise (WHO 2015). Women are more likely to work in the care sector, and female occupations tend to pay less well than typical male occupations. Paid care jobs are characterized by low wages, informality, work overload, poor career prospects, and, in general, a lack of recognition of the work done. In many countries, especially in relatively more developed ones, the sector attracts many migrant workers, who must often accept lower wages and worse working conditions given the lack of alternative opportunities (Addati et al. 2018). Paid care workers may also suffer from emotional stress that could affect their mental and physical wellbeing. For those providing home care, the isolated nature of the job and the existence of conflicts with family members due to privacy issues or delimitation of responsibilities can make the situation even harder. Poor working conditions make it challenging to recruit and retain workers in the sector, compromising the viability of services (Addati et al. 2018).

Investing in the training of human resources in the care sector not only improves the quality of care, but also gives recognition and value to the caregiving task, opening opportunities for career paths, increasing salaries, and hence attracting more people to the sector, creating a virtuous cycle. Given the over-representation of women in this sector, with adequate policies, population aging can increase women's opportunities in the formal labor market in low- and middle-income countries, and equip women with knowledge, skills, professional careers, and business opportunities.

Some countries have started to invest in the training and certification of formal caregivers, although there is still much to be done. Even in OECD countries, educational requirements for long-term care workers are low, and only Canada, Denmark, Germany, and Korea have a career structure for formal caregivers (OECD 2020). In developing countries, some examples are worth noting. Uruguay has made important efforts in this regard, as training and accreditation of formal caregivers have become compulsory since 2015 (SNIC 2015). Formal training is also required in Chile (UN and HelpAge International 2012; Molina et al. 2020). In Asia, aging countries such as Thailand and China are among the countries that require a formal certification course for those working as caregivers (HelpAge International 2015b), while other countries such as Fiji, Sri Lanka, and Viet Nam encourage voluntary training for community caregivers (Williamson 2015).

However, as in the case of institutional care, sometimes these requirements are not enforced. For example, in China, data from 2015 show that, at that time, two-thirds of the workers in the sec-

28 Based on interview with Adriana Rovira from INMAYORES published in La Diaria newspaper article, June 2019. Retrieved from: https://salud.ladiaria.com.uy/articulo/2019/6/solo-25-de-los-940-residenciales-para-ancianos-tienen-habilitacion-del-msp/

tor lacked the required formal training (Glinskaya and Feng 2018). A similar situation has been reported in Serbia. There, while licensed home and daycare services are required to employ properly trained staff, the lack of a regulated labor supply forces many families to rely on the informal labor market (Stokic and Bajec 2018). In other cases, such as Uruguay, the lack of an adequate supply of educational opportunities prevents caregivers from engaging in the necessary trainings, forcing the government to relax the requirements initially set regarding the accreditation of care workers; data from 2017 show that, while 18,000 people had applied for the caregiver training course given by the government, only 1,000 had been able to attend and complete it (Aranco and Sorio 2019).

e. The provision of cash benefits

An important aspect to consider when defining the combination of services to be offered is how they are going to be delivered. One of the main decisions is whether services are going to be delivered in the form of direct benefits or in the form of cash transfers.

Cash transfers have the advantage of providing users with increased flexibility and freedom (as they allow the dependent person or their family to buy the services they choose), and they are usually less expensive to deliver (Cafagna et al. 2019). On the other hand, the use of cash can be difficult to monitor. Hence, cash transfers can generate distortions and inefficiencies within families, particularly when their use is discretionary (Costa-Font et al. 2018; Costa-Font and Vilaplana 2017). In Serbia, for example, 72 percent of those who receive the benefit do not use it to buy care services (Hirose and Czepulis-Rutkowska 2016). Also, when transfers are not tied to the specific purchase of care services, it is not possible to monitor the quality of such services.

Moreover, when cash transfers are used to pay the main caregiver, it is argued that they tend to reinforce gender roles and hence are a poor instrument when one of the aims of the long-term care system is to liberate women from the social mandate that assumes they are responsible for caregiving (Cafagna et al. 2019; Geyer and Korfhage 2015; Brimblecombe et al. 2018). Conversely, others argue that paying women for the care they provide at least gives recognition to a job they would be doing anyway (Holmes et al. 2010; Esser, Bilo, and Tebaldi 2019). The cases of Uruguay and Chile in Latin America provide excellent examples of these tradeoffs. In Uruguay, where one of the main benefits provided by the system is a subsidy to hire a formal caregiver at home, the system does not allow family members to apply for this subsidy (i.e., the person hired should be external to the family). In the policy discussions preceding the implementation of the system, the argument was explicitly made that paying family members would reinforce traditional gender roles. This is not the case in Chile, where family caregivers who are socioeconomically vulnerable can apply for a monthly stipend. While the aim of both systems is to recognize and value the work of caregivers and ultimately to release women from the unpaid obligation of caring, the path to get there is different. While in Uruguay the main objective is to professionalize and formalize the caregiver's task, in Chile the main objective is to provide some monetary relief and recognition to those doing the job, regardless of whether they are family members or not.

Most developed countries have opted for the use of conditional transfers, which are determined based on a personal-care plan that considers the specific needs of the dependent individual and allows for the purchase of the services established in that plan, making it easier to monitor the use of the funds. This is the case in France, the Netherlands, Scotland, and Spain, for example (Aranco and Ibarrarán 2020).

Cash allowances paid either to the dependent person or to the main family caregiver are used in many countries in Eastern Europe, such as Bulgaria, Croatia, the Czech Republic, Estonia, Poland, Serbia, Slovakia, and Ukraine (Slavina et al. 2018; Gerbery and Bednárik 2018; Stubbs and Zrinščak 2018; Maly 2018; Praat-Ahi and Masso 2018; Hirose and Czepulis-Rutkowska 2016; European Commission 2019). Russia approved a compensation benefit for caregivers of older people who cannot participate in the labor market, providing some financial security to family caregivers (UNECE 2017). While in a few countries the cash can be used in the way that best suits the beneficiary or their family (Austria, Lithuania, Serbia, Slovenia, and Slovakia, for example), in most cases the payment is linked to the purchase of care services.

The use of cash benefits to support dependent adults and their families in lower-and middle-income countries is not as common and, when such programs do exist, they are generally focused on the socioeconomically vulnerable population. In Chile, for example, informal caregivers of severely dependent adults that belong to the poorest segments of the population are entitled to a monthly stipend, if

they do not participate in the formal labor market (Molina et al. 2020). In Argentina, economically vulnerable families with a dependent elderly member receive a monetary subsidy to hire a caregiver; the amount of the subsidy depends on the economic and medical evaluation of each situation (Oliveri 2020).[29]

Monetary benefits to dependent people or their caregivers exist in a very few countries in the Middle East and North Africa, such as Iraq, where a cash transfer program for older people with disabilities has recently been implemented, or Tunisia, where a program of government subsidies is in place. As another way to provide additional monetary support to potential caregivers, in most Arab countries the value of pensions increases if the beneficiary has surviving parents (Hussein and Ismail 2017).

Cash transfers for dependent older individuals or their caregivers are not common in Asia, although in some cities in China monthly vouchers are given to the dependent person so that he/she can buy care services. Tax incentives for family caregivers are provided in India, Malaysia, the Philippines, Singapore, and Thailand, while allowances for low-income families with a dependent elder are also given in Sri Lanka (HelpAge International 2015b; Williamson 2015). In Sub-Saharan Africa, the government of Mauritius offers a monthly cash benefit to family caregivers of people with severe loss of functional capacity (WHO 2017c).

f. Other forms of support to informal caregivers

Acknowledging the fact that most caregiving responsibilities are borne by the family, even in countries where long-term care systems provide accessible and high-quality services, many nations have made provisions to support unpaid caregivers, ranging from the delivery of cash benefits (as discussed above) to flexible working conditions, training, or counseling services. A long-term care system that supports informal caregivers by providing training, respite care, labor flexibility, counseling, or cash transfers might help to mitigate the negative effects that care responsibilities can have on caregivers' physical and emotional health and ensure the quality of care (WHO 2015).

Support to informal caregivers is more widespread in developed countries, where an iconic example is that of Scotland, where the needs of unpaid caregivers are formally assessed by the government and a support plan is elaborated depending on the care burden and the age of the caregiver.[30] Benefits in terms of labor flexibility (Canada, France, Germany, Spain), counseling services (Austria, France, Germany, the Netherlands, Spain), or respite services (Denmark, Finland, Germany, Japan, Korea, the Netherlands) are among the most common ways in which developed countries support informal caregivers (Aranco and Ibarraran 2020).

In developing countries, other than cash benefits (discussed in the previous sub-section), informal caregivers' support relies almost exclusively on counseling and training services. Among Asian countries, counseling services are provided in India, Iran, and Sri Lanka, while training courses are given in China, Fiji, India, Iran, the Democratic People's Republic of Korea, Myanmar, Sri Lanka, and Viet Nam (Williamson 2015). Examples from other regions include Chile, Latvia, and Slovenia (European Commission 2019).

Labor flexibility legislation generally does not include those who care for an elderly person, although in Costa Rica those who care for a terminally ill patient have the right to unpaid leave from work and to receive a monetary subsidy from the state.[31] A law project that aims at recognizing the work of family caregivers by entitling them to a cash allowance, subsidizing their contributions to the health care and pension systems (under specific conditions), and providing them with counseling and training services is currently being discussed in Colombia. In Chile, the pension system reform project, currently under discussion, includes a social security contributions' subsidy for caregivers of people with moderate or severe dependency, for a maximum of two years.[32]

29 See Instituto de Seguridad Social Salud y Préstamos, Argentina, webpage at https://www.insssep.gob.ar/Coberturas/Index/daafa79f-a7a9-40b4-8d51-a7ae00954052

30 See "The Carers Scotland Act 2016" at https://www.legislation.gov.uk/asp/2016/9/contents

31 Law 7756 of Costa Rica. Retreived from: https://www.pgrweb.go.cr/scij/.

32 See Ministerio de Trabajo y Protección Social Chile. Press Release, November 2nd, 2022. Retrieved from: https://www.pensionesparachile.cl/noticia-02-11-2022.html

Actions to promote social and health care integration

A person-centered and integrated approach to care is paramount to achieving the shift in the care paradigm that is necessary to tackle the challenges of an aging society. According to the WHO, *"integrated care refers to services that span the care continuum, are integrated within and among the different levels and sites of care within the healthcare and long-term care systems (including within the home) and are offered according to people's needs throughout the life course"* (WHO 2015, p. 103).

The coordination between health and social care services is key to ensure the continuity of care along the life cycle and its multiple health states, and to prevent as much as possible older adults' loss of functionality. Integrated care not only entails the integration of the various medical steps involved in the treatment of a given disease, but also the consideration of the person as a central part of the community and the acknowledgment that, in most cases, the need for care exists even after the person leaves the health care system (Amelung et al. 2014). A comprehensive approach to care that situates the individual in their social context and considers not only acute care but also preventive, rehabilitative, long-term, and palliative care is needed.

The aim of social care, of which long-term care is part, is to *"improve quality of life and subjective well-being of individuals, groups, and communities who are in need or at risk of being in need"* (Amelung et al. 2014, p.10). As such, the distinction between health and social care is sometimes vague, as health and social care needs could affect and reinforce each other (Amelung et al. 2014).

However, the integration of these two dimensions of care is particularly challenging, because they usually depend on different institutions and are subject to different regulations and legislation (Slavina et al. 2018). Moreover, in many countries, social care is underfunded, organized at the local level, and is characterized by a large degree of participation of the community and informal networks, making coordination and integration with the health care system even more challenging, even for developed countries (Genet et al. 2012).

A lack of coordination, both within health care services and between health and social care services, poses problems for the treatment of older people, particularly given the increasing prevalence of multimorbidity and risk-factor clustering (WHO 2018a; He, Goodkind, and Kowal 2016). Multimorbidity poses particularly complex challenges when it comes to health care delivery and calls for a patient-centered integrated and coordinated system that brings together not only the different levels of health care but also different care systems, such as health and social systems (van der Heide et al. 2015).

The absence of solutions for long-term care also affects health care systems, as sometimes older people who are admitted to hospitals for acute or short-term conditions end up staying longer than necessary because they lack other care alternatives (WHO 2015). In fact, evidence shows that the implementation of long-term care systems could lead to a reduction in health care costs in the form of fewer hospital admissions and re-admissions, fewer emergency entries, and shorter hospital stays (Costa-i-Font et al. 2018; Cho and Kwon 2020; Holland et al. 2014; De Souza and Peixoto 2017).

Some successful examples of integration initiatives are worth highlighting, both at the community (local) level and at the national level. Among developed countries, the System of Integrated Care for Older Persons (SIPA) in Quebec, Canada, is a community-based care program for older people whereby self-managed multidisciplinary teams of physicians, nurses, social workers, therapists, home care workers, and, sometimes, nutritionists and pharmacists, are responsible for 160 patients each, with the aim of minimizing functional decline and allowing aging at home for as long as possible (Amelung et al. 2014). In the United States, a similar initiative exists, called the Program of All-inclusive Care of the Elderly (PACE) (Amelung et al. 2014). The Dutch Buurtzorg model described earlier is also a well-known example of a community-led integration approach that has proved to be successful.

The example of Japan, where the government has set an agenda for a "Community-based Integrated Care System" for older people, also merits attention. The aim is to fully integrate long-term care, health care, and community-provided care services by 2025. The country has been working towards this aim since 2012 (Morikawa 2014). The model is based on a decentralization approach in which responsibility is gradually shifted from the central government to local authorities, and where prefectures have responsibility for designing care policies that allow for the most efficient allocation and coordination of the different models of care (Tomita 2017).

In Sweden, the implementation of the "Esther Model" in Jönköping county (named after the real experience of an older patient) shows how a model

that aligns different care providers in the definition of what is best for the patient could have positive impacts on the quality of care. The implementation of the model has been linked to a 30 percent reduction in emergency department admissions between 1998 and 2013 and a 9 percent reduction in the 30-day readmission rate for patients aged 65 years or more.[33] Collaboration and coordination between providers is encouraged through: (1) quarterly Esther Cafes: cross-sectional meetings where providers share stories from patients; (2) a yearly steering group, which consists of a committee of community care managers from municipalities, hospitals, and primary care facilities to discuss challenges across organizations; (3) an annual "strategy day," where nurses, doctors, coaches, and managers come together for team-building exercises and to create a vision for the network; and (4) ongoing inter-organizational training (Tomita 2017). Due to its proven success, the model is being replicated in Singapore and the United Kingdom.

Besides some community-led initiatives, in developing countries, efforts to better integrate health and social care services are still incipient. Examples include the "Bangkok 7 model" and the "Community-Based Integrated Services of Health Care and Social Welfare" from Thailand, implemented as pilot programs and involving the collaboration of local authorities, volunteers, and older adults themselves (HelpAge International 2013). Another example is a pilot project in four municipalities of the *Litoral Norte* region in the State of Sao Paulo, Brazil, that took place from November 2018 to November 2019 in collaboration with the International Center for Integrated Care. The project, called "Transforming Together," took an integrative, collaborative, and interdisciplinary approach in which each municipality identified the objectives that were more important to them in the context of integrated care and worked towards them (Integrated Care Foundation 2019).

In some countries, such as Chile and Brazil, the health care system has the capacity to make referrals to social services (including long-term care services), but integration does not go much further than that. Moreover, sometimes, even when integration is an explicit goal in legislation or government plans, these efforts have not succeeded, as is the case in Bulgaria and the Czech Republic (European Commission 2019).

In spite of these efforts, much more is needed to ensure that older people receive continuous and integrated care that encompasses all dimensions of care, both at the medical and at the social level.

FINAL REMARKS AND KEY POLICY CONSIDERATIONS

Population aging is good news; it is a consequence of a myriad of social, economic, and technological advances that allow people to live longer. It is not, however, exempt from challenges. Health care and long-term care systems are particularly affected, as the demographic transition brings about an epidemiological transformation, leading to an increasing prevalence of chronic diseases and rising functional dependency rates.

Countries should consider the epidemiological characteristics underlying their own demographic transformation to shape policy responses. If countries observe a compression of morbidity, it would be important to focus on increasing the opportunities for older people to continue to contribute actively to their communities, adapting labor and pension markets accordingly, and providing them with access to life-long learning and training opportunities, promoting active and healthy aging (UN 2017). If, on the contrary, countries are witnessing an expansion of morbidity (whereby people are living more years with a particular disease or ailment), the priority should be to adapt and prepare health care and long-term care systems, guaranteeing timely access and quality of care, while promoting prevention and healthier lifestyles, to ease the financial burden that inevitably results from increasing demand.

Yet, even in an optimistic scenario, in which older people are living healthier lives than in the past, the absolute increase in the number of older people means an absolute increase in the need for care resources (Parker and Thorslund 2007). Population aging comes with a rising prevalence of chronic diseases, as evidenced by the increasing trends in conditions that are known to be strongly age-dependent, such as cardiovascular diseases, diabetes, dementia, or chronic obstructive pulmonary

33 See "The Esther Model: How one patient redefined an entire system vision in Sweden", Advisory Board blog post, June 21, 2018. Available at:https://www.advisory.com/blog/2018/06/esther-model

disease (Prince et al. 2015). As the share of older adults in the population increases, the importance of geriatric neurological conditions, such as dementia and Alzheimer's disease, also grows. Depression and musculoskeletal disorders in older adults are also major causes of disability.

Several characteristics of the epidemiological transition in developing countries create additional pressures. These include the following facts: (i) Many of today's older adults in developing countries were exposed to infectious diseases in their early childhood, with unknown effects on their health as older adults; (ii) The double burden of disease common in developing countries increases the risk of multimorbidity; (iii) Under-diagnosis of key medical conditions and lack of affordable, timely, and effective treatments are common problems in many developing countries; and (iv) The adoption of harmful habits such as smoking, alcohol use, lack of physical activity, and unhealthy eating has fueled the increase in chronic diseases and the speed of the epidemiological change.

Thus, population aging comes with at least three main challenges for health care systems in developing countries: (i) first, guaranteeing coverage, access, and affordability of services in a context of increasing demand; (ii) second, shifting the care model from a curative-based approach towards a person-centered holistic and integrated approach that encourages the continuum of care throughout the life course, with a greater emphasis on primary health care and health promotion and prevention activities; and (iii) third, keeping costs under control without losing attention to quality.

How people age is, to a large extent, determined by their health earlier in life and the choices they made when young. Countries should therefore promote healthy lifestyles, like physical activity and healthy eating, through the entire life course (Rechel et al. 2009). Adaptation of health care systems is critical to anticipate and successfully manage the consequences of an aging population, especially given the challenges of coverage, accessibility, adequacy and quality of services, and financing outlined in previous sections of this chapter. Moreover, for the appropriate management of chronic diseases, a person-centered model focused on adequate attention to comorbidities is crucial (Grumbach 2003).

Health care systems need to adapt and prepare. Universal health care coverage should adopt distinctive characteristics in countries with aging populations, as older adults not only have different health care needs than the younger population but are often less able to afford care. In the absence of cost containment policies, an increased demand for health care services exerts upward pressure on costs, challenging the fiscal sustainability of systems. Countries need to invest in the efficiency of health care systems, focusing on prevention and primary care, without compromising the quality of care.

The provision of long-term care services for people with diminished functional abilities needs immediate attention. Given the changes that are taking place at the societal and family levels, and the lack of affordable, high-quality private services in many settings, the role of the government in providing the long-term care services that functionally dependent people need becomes crucial (Caruso, Galiani, and Ibarrarán 2017).

Besides being accessible and affordable, long-term care services should be person-centered, encouraging - whenever possible - the provision of home care services, as aging in place has proved to be the preferred option for older people and their families. Aging in place has also been shown to deliver the best results in terms of older people's mental and physical health and to be cost-effective for governments (WHO 2015; Boland et al. 2017). Coordination and integration between the social care and health care sectors is of paramount importance both to achieving a continuum of care for the older person and securing needed efficiency gains.

The training and adaptation of human resources is an area in which progress has been slow. In most developing countries, the number of geriatricians is insufficient, and medical personnel, in general, lack the necessary training to treat older adults. The professionalization of human resources in the long-term care sector is even less developed. Investing in the training of human resources, their professionalization, and the improvement of their working conditions is essential not only to improve the quality-of-care older people receive but also to narrow the important gender gaps that still exist in terms of labor participation, financial autonomy, and the burden of care responsibilities.

As this review has shown, several developing countries have designed and implemented some of the key policies described above. In the case of health care, promising policies have aimed at increasing coverage, adapting health care systems to new epidemiological profiles, focusing on the prevention of chronic diseases, and promoting healthy aging. Attention has also been given to the devel-

opment or reinforcement of mental health policies, an area that was until recently somewhat neglected.

Long-term care policies and programs aimed at assisting those with difficulties in performing their daily activities have also been part of the policy agenda in some countries, although important gaps still exist in covering the needs of functionally dependent older adults. Despite efforts, progress has been slow and uneven (Zaidi 2018; UN 2017b). The scope and depth of policies vary, and, in some cases, little is known about their actual implementation (Williamson 2015).

Future policy responses to population aging should also consider the important distributional issues that come with population aging. These include gender gaps; intergenerational disparities; spatial differences (e.g., rural vs. urban); and socioeconomic inequalities (World Bank 2021). This will require paying more attention to the unequal burdens faced by women both in accessing services and in providing health and social care to others across the life course. Notable are the unpaid care responsibilities women often have to bear and the consequences that these have both for women's mental and physical health and their income-generation capacity.

There are important limitations regarding data related to aging and health (Box 10.4). These gaps may complicate the design of effective policies. Data limitations were found in: (i) the determinants of healthy aging; (ii) the evolution of health and functionality as people age; (iii) the variation of health inequalities among older adults over time and across and within countries; and (iv) the needs and preferences of older adults regarding health care and long-term care services. These are areas where granular and specialized data are needed to enable the changes required in health care and long-term care systems. Examples include data on disability, functional dependency, cognitive status, and mental health, as well as health care service utilization (World Bank 2021).

BOX 10.4 The importance of timely and sound data

To facilitate evidence-based policy decisions, data need to be comparable across countries and time, yet consensus does not exist on key definitions or on which data should be prioritized. As early as 2001, a seminal report from the National Research Council [NRC] highlighted the need for improved data on aging and stressed the importance of comparable cross-national and longitudinal data (Moore 2001). This has been echoed more recently in the milestone WHO report on Ageing and Health (2015) and subsequent work. Attention is needed to the harmonization and standardization of data collected across countries (Boersch-Supan 2016).

Despite notable efforts made in countries, longitudinal, good-quality, and comparable information regarding the health status of the elderly is either lacking or difficult to access, particularly in developing countries. Data on health status (either self-reported or through medical diagnosis) is more commonly available than data on disability, functional dependency, risk factors, cognitive status, mental health, and health care service utilization. Health data come from different sources (ranging from censuses or nationally representative household surveys to administrative records, vital statistics, and specific/targeted surveys, among others), but none of these sources is without limitations.

Few countries have specific health surveys targeted at older adults. The Health, Ageing and Retirement Surveys are an example of such surveys. They are available in China, Costa Rica, England, India, Ireland, Israel, Japan, Korea, the United States, and 27 European countries. Multiple waves have been conducted, which allows for longitudinal analysis. The WHO Surveys on Ageing and Health, carried out in several developing countries during 2006/2007 and later in 2014, offer another example of such efforts. In Latin America, the Longitudinal Social Protection Surveys (ELPS as per the acronym in Spanish, standing for "Encuesta Longitudinal de Protección Social") are another group of surveys with specific focus on the elderly, available in Chile, Colombia, El Salvador, Paraguay, and Uruguay.

Even when surveys were designed to enable comparability, differences in methodology can prevent cross-national comparisons or generalizations. Even when the same "type" of questions are included in health-specific surveys, the exact questions are often different, making comparisons difficult. For instance, the section on functional dependency in the Uruguay ELPS survey makes it the only country administering an ELPS survey to include both basic and instrumental activities of daily living.

Source: World Bank (2021).

BOX 10.4 The importance of timely and sound data *(continued)*

The other ELPS countries only include basic activities, yet these activities are not standardized in ELPS surveys across countries.

Census and National Household Surveys sometimes (but not always) include a health section, but in those cases, cross-country comparison is even more difficult. Administrative and medical records, which usually span the entire life of the individual, are also rich sources of information; however, harmonization across countries may require addressing issues of format and software compatibility (Moore 2001). Privacy concerns also usually surround the use of administrative records. Being able to link administrative and medical records to survey data would open immense research possibilities useful for evidence-based policy (Moore 2001).

The National Research Council recommends that countries follow a system of "hierarchy of data collection modules," where minimum sets of data are defined for each module, from basic data to increasingly elaborated datasets, that guarantee comparability across countries. These datasets should include, at least, "the frequency and rates for: (1) deaths and their main causes, (2) main medical conditions, (3) self-reported health status, (4) population levels of physical, social, and mental function, (5) preventive and health promotional behaviors, and (6) disabilities. Regarding health care utilization data, the minimum information should include: (1) utilization rates for important types of health services, along with the use of long-term care services; (2) personal and family expenses for formal health services; (3) rates of use of medications and devices; (4) major cultural influences on the concept of health and the use of health services (such as gender, ethnicity, geographic residence, and socioeconomic status); and (5) the use of informal and alternative and complementary health care services" (Moore 2001).

Source: World Bank (2021).

Finally, several issues not considered in this chapter are part of the pressures placed by population aging on health and long-term care systems and countries' responses to them. These include: the importance of technology, the role of the private sector in the delivery of services, the need to strengthen palliative care services, the importance of investing in more resilient health care and social care systems, and the need to educate not only health and long-term care workers but the whole of society to fight ageism and discrimination towards the elderly. Also, the impacts of the pandemic generated by the spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in 2020 were not part of this review.

Undoubtedly, the COVID-19 pandemic presents a unique set of age-related challenges to health care and long-term care services. In many countries, COVID-19 has highlighted the weaknesses of systems, as the lack of adequate resources and protocols has led to unprecedented strains on health care systems. Long-term care services unprepared for such a shock have also been disrupted, leaving many older adults without the assistance they need. Although the impacts of the health and economic crisis generated by the pandemic are not yet fully understood, one thing is sure: the consequences will be unprecedented, and all countries will need to revise their social protection matrix (including health care and long-term care systems) in order not only to deal with the consequences of the current coronavirus, but to be prepared for other potential crises in the future (Twigg et al. 2021).

REFERENCES

1. Addati, L., U. Cattaneo, V. Esquivel, and I. Valarino (2018). *Care work and care jobs for the future of decent work*. International Labour Office, Geneva.
2. ADI (Alzheimer's Disease International) (2015). *World Alzheimer Report 2015: The global impact of dementia: An analysis of prevalence, incidence, cost and trends*. London, England. ADI.
3. ADI (Alzheimer's Disease International) (2017). *Dementia Friendly Communities Global developments, 2nd Edition.* London, England. ADI.
4. ADI (Alzheimer's Disease International) (2019a). *From plan to impact II: the urgent need for action.* London, England. ADI.
5. ADI (Alzheimer's Disease International) (2019b). *World Alzheimer Report 2019: Attitudes to dementia*. London, England. ADI.
6. Afshar, S., PJ. Roderick, P. Kowal, BD. Dimitrov, and AG. Hill. (2015). "Multimorbidity and the inequalities of global ageing: a cross-sectional study of 28 countries using the World Health Surveys." BMC Public Health 15(1): 776.
7. Aguilera, I., A. Infante, H. Ormeño, and C. Urriola. Improving

health system efficiency: *Chile: Implementation of the Universal Access with Explicit Guarantees (AUGE) reform*. WHO/HIS/HGF/CaseStudy/15.3. World Health Organization.
8. Aguirre, M. (2014). *La institucionalización de la vejez en Uruguay*. Paper presented at the XIII Research Seminar of the Faculty of Social Ciences, Public Uruguayan University, UdelaR, Montevideo, September de 2014.
9. AHWAIN (Asia Health and Wellbeing Initiative) (2020). "The Intergenerational Self-Help Club (ISHC) Development Model". Available at: https://www.ahwin.org/helpage-vietnam-ishc/.
10. Aikins, A, N. Unwin, C. Agyemang, P. Allotey, C. Campbell, and D. Arhinful (2010). "Tackling Africa's chronic disease burden: from the local to the global." *Globalization and Health* 6(1): 1-7.
11. Alfonso-Sierra, E.; Arcila Carabalí, A.; Bonilla Torres, J.; Latorre Castro, M.L.; Porras Ramírez, A. and Urquijo Velásquez, L. 2018. Situación de multimorbilidad en Colombia 2012 -2016. Ministerio de Salud y Protección Social. Estudios Sectoriales. Bogotá, Colombia. https://documents1.worldbank.org/curated/en/801401550612917615/pdf/134506-SPANISH-WP-P164632-OUO-9-Multimorbilidad-en-Colombia-sin-formato.pdf.
12. Allen, L., J. Williams, N. Townsend, B. Mikkelsen, N. Roberts, C. Foster, and K. Wickramasinghe (2017). "Socioeconomic status and non-communicable disease behavioural risk factors in low-income and lower-middle-income countries: a systematic review." *The Lancet Global Health* 5(3): e277-e289.
13. Almeida, G., O. Artaza, N. Donoso, and R. Fábrega (2018). "La atención primaria de salud en la Región de las Américas a 40 años de la Declaración de Alma-Ata." *Revista Panamericana de Salud Pública* 42: e104.
14. Amelung, V. E., A. Reichert, D. Urbanski, L. Matejevic, E. O'riordan, and E. Blatt. (2014). "Integrating Health and Social Care A global perspective of experience, best practices and the way forward." *INAV–Institute for Applied Health Services Research*.
15. Aranco, N., M. Stampini, P. Ibarrarán, Medellín, N. (2018). "Panorama de envejecimiento y dependencia en América Latina y el Caribe". *Resúmen de Políticas IDB-PB-273. Banco Interamericano de Desarrollo.*
16. Aranco, N. and R. Sorio (2019). "Envejecimiento y atención a la dependencia en Uruguay". Nota Técnica IDB-TN-1615. *Banco Interamericano de Desarrollo*.
17. Aranco, N. and Ibarrarán, P. (2020). "Servicios de apoyo personal para personas con dependencia funcional: Antecedentes, características y resultados". Nota Técnica IDB-TN-1884. *Banco Interamericano de Desarrollo*.
18. Aranco, N., Ibarrarán, P., Stampini, M. (2022). "Prevalencia de la dependencia funcional entre las personas mayores en 26 países de América Latina y el Caribe". Nota Técnica IDB-TN-2470. *Banco Interamericano de Desarrollo*.
19. Aranco, N., Bosch, M., Stampini, M., Azuara, O., Goyeneche, L., Ibarrarán, P., Oliveira, D., Reyes, M., Savedoff, W., Torres, E. (2022*). Envejecer en América Latina y el Caribe: protección social y calidad de vida de las personas mayores.* Banco Interamericano de Desarrollo. Arsenijevic J, Pavlova M, Rechel B, Groot W (2016) Catastrophic Health Care Expenditure among Older People with Chronic Diseases in 15 European Countries. PLoS ONE 11(7): e0157765. https://doi.org/10.1371/journal.pone.0157765.
20. Arredondo, A., and A. L. Recaman (2018). "Determinants of uncontrolled hypertension in the context of universal health coverage in middle-income countries." *American Journal of Hypertension* 31(11): 1175-1177.
21. Atun, R., L. O. Monteiro De Andrade, G. Almeida, D. Cotlear, T. Dmytraczenko, P. Frenz, P. Garcia, O. Gómez-Dantés, F.M. Knaul, C. Muntaner and J.B. De Paula (2015). "Health-system reform and universal health coverage in Latin America." *The Lancet 385*(9974): 1230-1247.
22. Barr, N. (2010). "Long-term care: a suitable case for social insurance" *Social Policy and Administration* 44(4): 359-374.
23. Barraza, M. (2017). "Dependencia y apoyo a los cuidados, un asunto de derechos humanos" en Forttes, P. (ed) *Subsistema Nacional de Apoyos y Cuidados*: Un desafío país: 60-67. Gobierno de Chile. Dirección Sociocultural, Presidencia de la República.
24. Batthyany, K., N. Genta and V. Perrotta (2012). "La población uruguaya y el cuidado: persistencias de un mandato de género. Encuesta nacional sobre representaciones sociales del cuidado, principales resultados". *Serie Mujer y Desarrollo 117*, CEPAL.
25. Ben-Harush A, Shiovitz-Ezra S, Doron I, Alon S, Leibovitz A, Golander H, Haron Y, Ayalon L. Ageism among physicians, nurses, and social workers: findings from a qualitative study. Eur J Ageing. 2016 Jun 28;14(1):39-48. doi: 10.1007/s10433-016-0389-9.
26. Bishwajit, G., S. Tang, S. Yaya, and Z. Feng (2017). "Burden of asthma, dyspnea, and chronic cough in South Asia". *International journal of chronic obstructive pulmonary disease* 12: 1093-1099.
27. Blas, E., and A. S. Kurup, eds. (2010). *Equity, social determinants and public health programmes*. World Health Organization.
28. Bloom, D. E., E. Cafiero-Fonseca, M.E. McGovern, K. Prettner, A. Stanciole, J. Weiss, and L. Rosenberg (2014). "The macroeconomic impact of non-communicable diseases in China and India: Estimates, projections, and comparisons". *The Journal of the Economics of Ageing* 4: 100–111.
29. Bloom, G., Y. Katsuma, K. D. Rao, S. Makimoto, J. DC Yin, and G. M. Leung (2019). "Next steps towards universal health coverage call for global leadership." *Bmj* 365.
30. Boersch-Supan (2016). "Enhancing the Comparability of SHARE with HRS and ELSA". Max Planck Institute/Social Law/Social Policy, Muenchen, Germany.
31. Bogdanov, G. and L. Georgieva (2018). ESPN *Thematic report on challenges on long-term care: Bulgaria*. The European Social Policy Network, European Commission.
32. Boland, L., F. Légaré, M. Becerra Perez, M. Menear, M. Garvelink, D. McIsaac, G. Painchaud Guérard, J. Emond, N. Brière, and S. Dawn (2017). "Impact of home care versus alternative locations of care on elder health outcomes: an overview of systematic reviews". BMC Geriatrics 17(1): 20.
33. Bonilla-Chacin, M.E., G. Afandiyeva, and A. Suaya (2018). "Challenges on the path to universal health coverage: the experience of Azerbaijan". *Universal Health Care Coverage Series* 28, World Bank Group, Washington, DC.
34. Boutayeb, A., S. Boutayeb, and W. Boutayeb (2013). "Multi-morbidity of non-communicable diseases and equity in WHO Eastern Mediterranean countries." *International journal for Equity in Health* 12.1 (2013): 1-13.
35. Brimblecombe, N., J.L. Fernandez, M. Knapp, A. Rehill and R. Wittenberg (2018). "Review of the international evidence on support for unpaid carers". *Journal of Long-Term Care* September: 25 - 40.
36. Burki, T.K. (2017). "Latin America makes progress on tobacco control." *The Lancet Respiratory Medicine* 5(6): 470.
37. Byers, AL., and K. Yaffe (2011). "Depression and risk of developing dementia." *Nature Reviews Neurology* 7(6): 323-331.
38. Cafagna, G., N. Aranco, P. Ibarrarán, M.L. Oliveri, N. Medellín, and M. Stampini (2019). *Envejecer con cuidado: atención a la dependencia en América Latina y el Caribe*. Inter-American De-

velopment Bank.
39. Caruso Bloeck, M, S. Galiani, and P. Ibarrarán (2017). "Long-term care in Latin America and the Caribbean? Theory and policy considerations". *IDB Working Paper Series* Nº IDB-WP- 834.
40. Vaca, I. (2021). "Valorización económica del trabajo no remunerado de los hogares". División de Asuntos de Género, Comisión Económica para América Latina y el Caribe.
41. Chang, A. Y., Skirbekk, V. F., Tyrovolas, S., Kassebaum, N. J., and Dieleman, J. L. (2019). "Measuring population ageing: an analysis of the global burden of disease study 2017." *The Lancet Public Health*, 4(3), e159-e167.
42. Chateau, D., A. Katz, C. Metge, C.C.M. Taylor, and S. McCulloch (2017). *Describing Patient Populations for the My Health Team Initiative.* Manitoba Centre for Health Policy.
43. Chatterji, S., Byles, J., Cutler, D., Seeman, T., and Verdes, E. (2015). "Health, functioning, and disability in older adults—present status and future implications". *The Lancet* 385: 563–75.
44. Chen, Y., H. Ding, M/. Yu, J. Zhong, R. Hu, X. Chen, C. Wang, K. Xie. and K. Eggleston (2019). "The Effects of Primary Care Chronic-Disease Management in Rural China" *National Bureau of Economic Research* w26100.
45. Cho, Y. M., & Kwon, S. (2022). Effects of public long-term care insurance on the medical service use by older people in South Korea. *Health Economics, Policy and Law*, 1-18.
46. Clarfield, A. M., O. Manor, G. Bin Nun, S. Shvarts, Z. S. Azzam, A. Afek, F. Basis, and A. Israeli (2017). "Health and health care in Israel: an introduction." *The Lancet* 389(0088): 2503-2513.
47. Coleman, R., G. Gill, and D. Wilkinson (1998). "Noncommunicable disease management in resource-poor settings: a primary care model from rural South Africa." *Bulletin of the World Health Organization* 76(6): 633-640.
48. Colombo, F., A. Llena-Nozal, J. Mercier, and F. Tjadens (2011). "Help Wanted? Providing and Paying for Long-Term Care" OECD *Health Policy Studies*. OECD Publishing.
49. Costa-Font, J., S. Jimenez-Martin, and C. Vilaplana-Prieto (2018). "Thinking of incentivizing care? The Eefect of demand subsidies on informal caregiving and intergenerational transfers". *IZA Discussion Papers* 11774.
50. Costa-Font, J. and C. Vilaplana-Prieto (2017). "Does the expansion of public long-term care funding affect saving behaviour?. *Fiscal Studies*, 38(3): 417-443.
51. Costa-Font, J., Jimenez-Martin, S., & Vilaplana, C. (2018). Does long-term care subsidization reduce hospital admissions and utilization? *Journal of health economics*, 58, 43-66.
52. De la Maisonneuve, C. and J. Oliveira Martins (2013). "Public spending on health and long-term care: a new set of projections." *OECD Economic Policy Papers.*
53. Dmytraczenko, T. and G. Almeida (eds.) (2015). *Toward universal health coverage and equity in Latin America and the Caribbean: evidence from selected countries*. The World Bank.
54. Druetz, T. (2019). "Integrated primary health care in low-and middle-income countries: a double challenge." *BMC medical ethics* 19(1): 89-96.
55. Dunlop, D. D., S. L. Hughes and L.M. Manheim (1997). "Disability in activities of daily living: patterns of change and a hierarchy of disability". *American Journal of Public Health*, 87(3): 378-383.
56. Esquivel, V.R., and A. Kaufmann. *Innovations in care: New concepts, new actors, new policies*. Friedrich Ebert Stiftung.
57. Esser, A., C. Bilo, and R. Tebaldi (2019). "How can cash transfer programmes work for women and children? A review of gender-and child-sensitive design features" *International Policy Centre for Inclusive Growth.* Working Paper 178.
58. European Commission 2019. *Joint report on health care and long-term care systems & fiscal sustainability. Country Documents* 2019 Update. Institutional Paper 105.
59. Fang, H., K. Eggleston, K. Hanson, and M. Wu. (2019)"Enhancing financial protection under China's social health insurance to achieve universal health coverage." *bmj* 365: l2378.
60. Feng, Z., C. Liu, X. Guan, and V. Mor (2012). "China's rapidly aging population creates policy challenges in shaping a viable long-term care system." Health Affairs 31(12): 2764-2773.
61. Flamini, V., M. Galdamez, F. Lambert, M. Li, B. Lissovolik, R. Mowatt, J. Puig, A. D. Klemm, and M Soto. *Growing Pains: Is Latin American Prepared for Population Aging?* International Monetary Fund, 2018.
62. Flores, E., E. Rivas, and F. Seguel. "Nivel de sobrecarga en el desempeño del rol del cuidador familiar de adulto mayor con dependencia severa." *Ciencia y Enfermería* 18(1): 29-41.
63. Fries, J. F. (1980). "Aging, natural death, and the compression of morbidity". *New England Journal of Medicine* 303(3): 130–135.
64. Gaál P., M. Csere, A. Conklin, et al. (2015). "Hungary. In: Nolte E, Knai C, editors. Assessing Chronic Disease Management in Euroa pean Health Systems: Country reports". *Copenhagen (Denmark): European Observatory on Health Systems and Policies* 29(8.)
65. Gakidou, E., A. Afshin, A. A. Abajobir, K. H. Abate, C. Abbafati, K. M. Abbas, F. Abd-Allah et al. (2017). "Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016". *The Lancet* 390(10100): 1345-1422.
66. Gal, R.I. (2018). ESPN *Thematic report on challenges on long-term care: Hungary.* The European Social Policy Network, European Commission.
67. Garg, S. et al. (2020). "Hospitalization rates and characteristics of patients hospitalized with laboratory-confirmed coronavirus disease 2019—COVID-NET, 14 States, March 1–30, 2020." Center for Disease Control and Prevention. Morbidity and Mortality Weekly Report 69.
68. Gatti Roberta, Daniel Halim, Allen Hardiman and Shuqiao Sun. 2024. "Gendered Responsibilities, Elderly Care, and Labor Supply: Evidence from Four Countries," in Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative. Washington D.C.: World Bank.
69. GBD DALYs and HALE Collaborators (2017). "Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017". *The Lancet* 392: 1859–922.
70. Genet, N., W. Boerma, M. Kroneman, A. Hutchinson and R.B. Saltman eds. (2012). *Home care across Europe: current structure and future challenges*. European Observatory on Health Systems and Policies, World Health Organization.
71. Gerbery, D. and R. Bednárik (2018). *ESPN Thematic report on challenges on long-term care: Slovakia*. The European Social Policy Network, European Commission.
72. Geyer, J. and T. Korfhage (2015). "Long - term care insurance and carers' labor supply: a structural model". *Health Economics* 24(9):1178-1191.
73. Giraldo Molina, C.I and G.M. Franco Agudelo. "Calidad de vida de los cuidadores familiares: Life Quality among Family Carers." *Aquichan* 6(1): 38-53.

74. Glassman, A., T. A. Gaziano, C.P. Bouillon Buendia, and F. C. Guanais de Aguiar (2010). "Confronting the chronic disease burden in Latin America and the Caribbean." *Health Affairs* 29 (2): 2142-2148.
75. Glinskaya, E., and Z. Feng (eds) (2018). *Options for aged care in China: Building an efficient and sustainable aged care system*. The World Bank, Washington D.C.
76. Glinskaya, Elena, Xiaohui Hou, Zhanlian Feng, Marco Angrisani, Guadalupe Suarez, Jigyasa Sharma, Drystan Phillips, et al. 2024. "Demand for and Supply of Long-Term Care for Older persons in Low- and Middle-Income Countries," in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington D.C.: World Bank.
77. Goeppel, C., P. Frenz, P. Tinnemann, and L. Grabenhenrich (2014). "Universal health coverage for elderly people with non-communicable diseases in low-income and middle-income countries: a cross-sectional analysis." *The Lancet* 384: S6.
78. Goldman, N. (2001). Social inequalities in health. *Annals of the New York Academy of Sciences* 954(1):118–139.
79. Gruenberg, E. (1977). "The failure of success". *Milbank Memorial fund Quarterly/ Health and Society* 55: 3–24.
80. Grumbach, K. (2003). "Chronic illness, comorbidities, and the need for medical generalism". *Annals of Family Medicine* 1(1): 4-7.
81. Guanais, F., F. Regalia, R. Pérez-Cuevas, M. Anaya. eds. (2018). *From the patient's perspective: experiences with primary health care in Latin America and the Caribbean*. Inter-American Development Bank.
82. Han, W. (2012) "Health care system reforms in developing countries." *Journal of public health research* 1(3): 199.
83. He Y, Lam TH, Jiang B et al. (2009). "Combined effects of tobacco smoke exposure and metabolic syndrome on cardiovascular risk in older residents of China". *Journal of the American College of Cardiology* 53: 363–71.
84. He, W., D. Goodkind, and P. Kowal (2016). "An aging world: 2015, international population reports." *Washington: US Government Printing Office*. Washington DC.
85. http://www.census.gov/library/publications/2016/demo/P95-16-1.html.
86. Hedrich, W., J. Tan, B. Chalmers, and J. Yeo. "Advancing into the Golden Years: Cost of Healthcare for Asia Pacific's Elderly." *Marsh & McLennan Companies Asia Pacific Risk Center: Singapore.*
87. HelpAge International (2013). "Care in old age in Southeast Asia and China: situational analysis".
88. HelpAge International (2014a). "Why health systems must change: Addressing the needs of ageing populations in low- and middle-income countries".
89. HelpAge International (2014b). "Home care for older people: The experience of ASEAN countries".
90. HelpAge International (2015a). *Forget Me Not. Improving dementia care in Andean countries. Project Summary.* HelpAge International. Regional Development Centre for Latin America and the Caribbean.
91. HelpAge International (2015b). *Community-based social care in East and Southeast Asia* HelpAge International. East Asia and Pacific Regional Office.
92. Hirose, K. and Z. Czepulis-Rutkowska (2016). "Challenges in Longterm Care of the Elderly in Central and Eastern Europe." *ILO DWT and Country Office for Central and Eastern Europe, Budapest.*
93. Hoang, V.M. and H.Y. Duong (2018). "Health and health care for older people in Vietnam". Healthy Aging Research 7:15
94. Hoang-Vu Eozenou, P.; Neelsen, S. and Smitz, M.F. 2021. Financial Protection in Health among the Elderly – A Global Stocktake. Published in Health Systems & Reform 2021, vol. 7, no. 2, e1911067 https://doi.org/10.1080/23288604.2021.1911067.
95. Hoang, H. T., Nguyen, T., & Medina, C. K. (2023). Faith-based organizations' support for older adults in Vietnam: A comparison of Catholic and Buddhist efforts. *Social Work and Social Sciences Review*, 24(1).
96. Hoogendijk, E.; Rijnhart, J. Kowal, P.; Pérez-Zepeda, M.; Cesari, M.; Abizanda, P.; Flores Ruano, T.; Schop-Etman, A.; Huisman, M.; Dent, E. (2018) Socioeconomic inequalities in frailty among older adults in six low- and middle-income countries: Results from the WHO Study on global AGEing and adult health (SAGE), Maturitas, Volume 115, 2018: 56-63, ISSN 0378-5122, https://doi.org/10.1016/j.maturitas.2018.06.011.
97. Holmes, R. and N. Jones (2010). "Cash transfers and gendered risks and vulnerabilities: lessons from Latin America." *Overseas Development Institute.*
98. Holland, S. K., Evered, S. R., & Center, B. A. (2014). "Long-Term Care Benefits May Reduce End-of-Life Medical Care Costs." Population Health Management, 17(6), 332–339.
99. Honorato dos Santos de Carvalho, V.C., Rossato, S.L., Fuchs, F.D. et al. (2013). "Assessment of primary health care received by the elderly and health related quality of life: a cross-sectional study". BMC Public Health 13 (605).
100. Howse, K. (2006). "Increasing life expectancy and the compression of morbidity: a critical review of the debate". *Oxford Instute of Ageing. Working Paper* 206.
101. Huenchan, S. ed. (2010). *Ageing, human rights and public policies*. CEPAL. Serie Libros de la CEPAL – Desarrollo Social 100.
102. Hughes, D, and S. Leethongdee. (2007). "Universal coverage in the land of smiles: lessons from Thailand's 30 Baht health reforms." *Health Affairs* 26 (4): 999-1008.
103. Hussein, S., and M. Ismail (2017). "Ageing and elderly care in the Arab region: policy challenges and opportunities." *Ageing International* 42(3): 274-289.
104. Ibrahim, M. M, and A. Damasceno (2012) "Hypertension in developing countries." *The Lancet* 380 (9841): 611-619.
105. International Labour Office (ILO) (2016). *Women at work: trends 2016. Geneva*: ILO.
106. International Diabetes Federation. (2013). *IDF Diabetes Atlas. 6th Edition*.
107. International Diabetes Federation. (2019). *IDF Diabetes Atlas. 9th Edition*.
108. Jeet, G., J. S. Thakur, S. Prinja, and M. Singh (2017). "Community health workers for non-communicable diseases prevention and control in developing countries: evidence and implications." *PloS One* 12(7): e0180640.
109. Kagawa, R. C., Anglemyer, A., & Montagu, D. (2012). The scale of faith-based organization participation in health service delivery in developing countries: systemic review and meta-analysis. *PloS one,* 7(11), e48457.
110. Kaselitz, E., G. K. Rana, and M. Heisler (2017). "Public policies and interventions for diabetes in Latin America: a scoping review." *Current Diabetes Reports* 17 (8): 65.
111. Katz, S. (1983). "Assessing self-maintenance: activities of daily living, mobility, and instrumental activities of daily living". *Journal of the American Geriatrics Society* 31(12): 721-727.
112. Khanam, M. A., P. K. Streatfield, Z. N. Kabir, Qiu, C. Cornelius, and Å. Wahlin (2011). "Prevalence and patterns of multimorbidity among elderly people in rural Bangladesh: a cross-sectional study". *Journal of Health, Population, and Nutrition* 29(4): 406-414.
113. Kieny, M.P.; Evans,T.; Scarpetta, S.; Kelley, E.T.; Klazinga, N.; Forde,

I.; Veillard, J.; Leatherman, S.; Syed, S.; Kim, S.; Nejad, S.; Donaldson, L. 2018. "Delivering quality health services: a global imperative for universal health coverage." Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/482771530290792652/Delivering-quality-health-services-a-global-imperative-for-universal-health-coverage.

114. Kilpi, F., L. Webber, A. Musaigner, A. Aitsi-Selmi, T. Marsh, K. Rtveladze, K. McPherson, and M. Brown. (2014). "Alarming predictions for obesity and non-communicable diseases in the Middle East." *Public Health Nutrition* 17 (5): 1078-1086.
115. Knaul, F.M., R. Wong, H. Arreola-Ornelas, O. Méndez, R. Bitran, A. Carlos Campino, C.E. Flórez Nieto, U. Giedion, D. Maceira, M. Rathe and M. Valdivia. (2011). "Household catastrophic health expenditures: a comparative analysis of twelve Latin American and Caribbean Countries". *Salud Pública de México* 53: s85-s95.
116. Knodel, J., B.P Teerawichitchainan, V. Prachuabmoh, and W. Pothisiri (2015). "The situation of Thailand's older population: An update based on the 2014 Survey of Older Persons in Thailand." *Research Collection School of Social Sciences 1948*. Institutional Knowledge at Singapore Management University.
117. Kreitzer, M.J., K. A. Monsen, S. Nandram, and J. De Blok (2015). "Buurtzorg Nederland: a global model of social innovation, change, and whole systems healing." Global Advances in Health and Medicine 4(1): 40-44.
118. Kronfol, N.M. (2012). "Access and barriers to health care delivery in Arab countries: a review". *Eastern Mediterranean Health Journal* 18 (12): 1239-1246.
119. Kruk, M.E., D. Porignon, P. C. Rockers, and W. Van Lerberghe (2010). "The contribution of primary care to health and health systems in low-and middle-income countries: a critical review of major primary care initiatives." Social Science & Medicine 70(6): 904-911.
120. Kruk, M. E., Gage, A. D., Joseph, N. T., Danaei, G., García-Saisó, S., & Salomon, J. A. (2018). Mortality due to low-quality health systems in the universal health coverage era: a systematic analysis of amenable deaths in 137 countries. *The Lancet*, 392(10160), 2203-2212.
121. Kujawska, J. (2017) "The Efficiency of Post-Communist Countries' Health Systems." *Advances in Health Management* 23: 93-111.
122. Lagomarsino, G., A. Garabrant, A. Adyas, R. Muga, and N. Otoo. "Moving towards universal health coverage: health insurance reforms in nine developing countries in Africa and Asia." *The Lancet* 380 (9845): 933-943.
123. Lall, D., N. Engel, N. Devadasan, K. Horstman, and B. Criel. "Models of care for chronic conditions in low/middle-income countries: a 'best fit'framework synthesis." *BMJ Global Health* 3 (6): e001077.
124. Lee, H.Y, Juhwan Oh, J. R. Moon, and S. V. Subramanian (2019). "Use of high-level health facilities and catastrophic expenditure in Vietnam: can health insurance moderate this relationship?" *BMC health services research* 19(1): 318.
125. Levy BR, Slade MD, Chang ES, Kannoth S, Wang SY. Ageism Amplifies Cost and Prevalence of Health Conditions. Gerontologist. 2020 Jan 24;60(1):174-181. doi: 10.1093/geront/gny131.
126. Llibre Rodriguez, JJ., C. P. Ferri, D. Acosta, M. Guerra, Y. Huang, K. S. Jacob, E. S. Krishnamoorthy, A. Salas, Sosa, A.L., I. Acosta and M.E. Dewey (2008). "Prevalence of dementia in Latin America, India, and China: a population-based cross-sectional survey." *The Lancet* 372 (9637): 464-474.
127. Liu, J., G. Chen, X. Song, I. Chi and X. Zheng (2009). "Trends in disability-free life expectancy among Chinese older adults." Journal of Aging and Health 21(2): 266-285.
128. Loichinger, E. and W. Pothisiri (2018). "Health prospects of older persons in Thailand: the role of education." *Asian Population Studies* 14(3): 310-329.
129. López-Ortega, M. and Aranco, N. (2019). "Envejecimiento y atención a la dependencia en México". Nota Técnica IDB-TN 1614. *Banco Interamericano de Desarrollo*.
130. López, J. H. and C. A. Reyes-Ortiz (2015). "Geriatric education in undergraduate and graduate levels in Latin America." *Gerontology & Geriatrics Education* 36(1): 3-13.
131. Lustigova, M., D. Dzurova, H. Pikhart, R. Kubinova, and M. Bobak (2018). "Cardiovascular health among the Czech population at the beginning of the 21st century: a 12-year follow-up study." *Journal of Epidemiology and Community Health* 72(5): 442-448.
132. Luy, M. and Minagawa, Y., 2014. "Gender Gaps-Life expectancy and proportion of life in poor health." *Health Reports* 25(12): 12.
133. Macías Muñoz, O. (2019). "Reforma al sistema chileno de pensiones". XVII *Convención Anual de la Asociación de Administradoras de Fondos Mutuos de Chile (AAFM)*.
134. Macinko, J., B. Starfield, and T. Erinosho (2009) "The impact of primary healthcare on population health in low-and middle-income countries." *The Journal of ambulatory care management* 32(2): 150-171.
135. Macinko, J., F.C. Guanais, P. Mullachery, and G. Jimenez (2016). "Gaps in primary care and health system performance in six Latin American and Caribbean countries." *Health Affairs* 35(8): 1513-1521.
136. Macinko, J., F.C.D Andrade, B. P. Nunes, and F. C. Guanais (2019). "Primary care and multimorbidity in six Latin American and Caribbean countries." *Revista Panamericana de Salud Pública* 43: e8.
137. Mallawaarachchi, DS V., S.C. Wickremasinghe, L.C. Somatunga, V.T.S.K Siriwardena, and N.S. Gunawardena (2016). "Healthy Lifestyle Centres: a service for screening noncommunicable diseases through primary health-care institutions in Sri Lanka." *WHO South-East Asia journal of public health* 5(2): 89-95.
138. Maly, I. (2018). ESPN *Thematic report on challenges on long-term care: Czech Republic*. The European Social Policy Network, European Commission.
139. Mamo, Y., E. Seid, S. Adams, A. Gardiner, and E. Parry (2007). "A primary healthcare approach to the management of chronic disease in Ethiopia: an example for other countries." Clinical Medicine 7(3): 228-231.
140. Manes, F. (2016). "The huge burden of dementia in Latin America." *The Lancet Neurology* 15(1): 29.
141. Manton, KG. (1982). "Changing concepts of morbidity and mortality in the elderly population". *Milbank Memorial Fund Quarterly/Health and Society* 60: 183–244.
142. Mathers, CD., Stevens, GA., Boerma, T., White, R. A., & Tobias, M. I. (2015). "Causes of international increases in older age life expectancy." *The Lancet* 385(9967): 540-548.
143. Matus-López, M. (2017). "Análisis prospectivo de los servicios de cuidado a la dependencia en Uruguay". Unpublished. Inter-American Development Bank.
144. Mayston, R., M. Guerra, Y. Huang, A.L. Sosa, R. Uwakwe, I. Acosta, P. Ezeah, S. Gallardo, V. Montes de Oca, H. Wang, M. Guerchet, Z. Liu, M. Sanchez, P. Lloyd-Sherlock and M. J. Prince (2014). "Exploring the economic and social effects of care dependence in later life: protocol for the 10/66 research group INDEP study." Springerplus 3 (1): 379.
145. Maziak, W., R. Nakkash, R. Bahelah, A. Husseini, N. Fanous, and T. Eissenberg. "Tobacco in the Arab world: old and new epidem-

ics amidst policy paralysis." *Health Policy and Planning* 29(6): 784-794.
146. McEniry, M. (2013). "Cross-national comparisons of health disparities among aging populations in Latin America, the Caribbean, Asia and Africa". *Population Studies Center, University of Michigan*.
147. McEniry, M., and J. McDermott (2015). "Early-life conditions, rapid demographic changes, and older adult health in the developing world." *Biodemography and social biology* 61 (2): 147-166.
148. Medellin, N., Ibarrarán, P. and Stampini, M. (2018). "Cuatro elementos para diseñar un sistema de cuidados". Banco Interamericano de Desarrollo, Nota Técnica IDB-TN-1438.
149. Miranda, J. J, S. Kinra, J. P. Casas, G. D. Smith, and S. Ebrahim (2008). "Non-communicable diseases in low-and middle-income countries: context, determinants and health policy." *Tropical Medicine & International Health* 13 (10): 1225-1234.
150. Molina, H., L. Sarmiento, N. Aranco and P. Jara (2020). "Envejecimiento y atención a la dependencia en Chile". Nota Técnica IDB-TN-2004. Inter-American Development Bank.
151. Monteiro, L., and M. Paredes. "Arreglos de convivencia en la vejez en Uruguay: perfiles específicos para una política de cuidados." *Papeles de Población* 22(87): 133-160.
152. Montenegro Torres, F. (2013). "Costa Rica Case Study: Primary Health Care Achievements and Challenges within the framework of the Social Health Insurance". *UNICO Studies Series 14, The World Bank,* Washington D.C.
153. Mor, V., T. Leone and A. Maresso eds. (2014). *Regulating long-term care quality: an international comparison*. Cambridge University Press.
154. Morikawa, M. (2014). "Towards community-based integrated care: trends and issues in Japan's long-term care policy." *International Journal of Integrated Care* 14: e005.
155. Mounier-Jack, S., S. H. Mayhew, and N. Mays. "Integrated care: learning between high-income, and low-and middle-income country health systems." *Health policy and planning* 32(4): iv6-iv12.
156. Moore, E. (2001). "Preparing for an aging world: the case for cross-national research". Panel on a Research Agenda and New Data for an Aging World, National Research Council. Washington, DC, National Academy Press.
157. Ministerio de Salud Pública (MSP) Uruguay. Plan Nacional de Salud Mental. 2020-2027.
158. Nitrini, R., C. Bottino, C. Albala, N. Santos Custodio Capunay, C. Ketzoian, J. J. Llibre Rodriguez, G. E. Maestre, A.T. A. Ramos-Cerqueira, and P. Caramelli (2009). "Prevalence of dementia in Latin America: a collaborative study of population-based cohorts." *International Psychogeriatrics* 21(4) : 622-630.
159. Olivier, J., Tsimpo, C., Gemignani, R., Shojo, M., Coulombe, H., Dimmock, F., ... & Wodon, Q. (2015). Understanding the roles of faith-based health-care providers in Africa: review of the evidence with a focus on magnitude, reach, cost, and satisfaction. *The Lancet*, 386(10005), 1765-1775.
160. Organization for Economic Co-operation and Development (OECD) (2017), *Preventing Ageing Unequally*, OECD Publishing, Paris, https://doi.org/10.1787/9789264279087-en.
161. Organization for Economic Co-operation and Development and World Health Organization (OECD and WHO) (2018a). *Health at a Glance: Asia/Pacific 2018: Measuring Progress towards Universal Health Coverage*. OECD Publishing, Paris.
162. Organization for Economic Co-operation and Development and World Health Organization (OECD and WHO) (2018b). "Renewing priority for dementia: Where do we stand?" *OECD Policy Brief.*
163. Organization for Economic Co-operation and Development and World Health Organization (OECD and WHO) (2019a). "Chile: A healthier tomorrow. Assessments and recommendations". *OECD Reviews of Public Health*.
164. Organization for Economic Co-operation and Development and World Health Organization (OECD and WHO) (2019b). "Realising the full potential of primary health care". *OECD Policy Brief*.
165. Organization for Economic Co-operation and Development and World Health Organization (OECD and WHO) (2020). *Who Cares? Attracting and retaining care workers for the elderly.* OECD Health Policy Studies, OECD Publishing, *Paris, https:*//doi.org/10.1787/92c0ef68-en.
166. Organization for Economic Co-operation and Development and World Bank (OECD and WB)(2020), Health at a Glance: Latin America and the Caribbean 2020, OECD Publishing, Paris, https://doi.org/10.1787/6089164f-en.
167. ONU Mujeres (2018). "El trabajo de cudados: una cuestión de derechos humanos y políticas públicas". *ONU Mujeres, Entidad de las Naciones Unidas para la Igualdad de Género y el Empoderamiento de las Mujeres*.
168. Organización Panamericana de la Salud (OPS)(2017). "Día mundial de la hipertensión: Conoce tus números".
169. Oliveri, L. (2020). "Envejecimiento y atención a la dependencia en Argentina". *Nota Técnica IDB-TN-2044*. Inter-American Development Bank.
170. Olshansky, S. (1991). "Trading off longer life for worsening health". *Journal of Aging and Health 3:* 194–216.
171. Omran, AR. 1971. "The epidemiologic transition. A theory of the epidemiology of population change". *The Milbank Memorial Fund Quarterly* 49(4): 509-538.
172. Palloni, A., G. Pinto-Aguirre, and M. Peláez. (2002). "Demographic and health conditions of ageing in Latin America and the Caribbean". *International Journal of Epidemiology* 31(4): 762-771.
173. Parker, MG. and M. Thorslund. (2007). "Health Trends in the Elderly Population: Getting Better and Getting Worse". *The Gerontologist* 47 (2):150–158.
174. PHCPI Brazil (Primary Healthcare Performance Initiative Brazil). n/d. "Brazil: A community-based approach to comprehensive primary care".
175. PHCPI Costa Rica (Primary Healthcare Performance Initiative Costa Rica). n/d. "Costa Rica: Universal health coverage and community-based health teams create effective care".
176. PHCPI Estonia (Primary Healthcare Performance Initiative Estonia). n/d. "Estonia: Establishing family medicine as a specialty to strengthen primary health care".
177. Pitheckoff, N. (2017). "Aging in the Republic of Bulgaria." *The Gerontologist* 57 (5): 809-815.
178. Pop, L. (2018). *ESPN Thematic report on challenges on long-term care: Romania*. The European Social Policy Network, European Commission.
179. Praat-Ahi, G. and M. Masso (2018). *ESPN Thematic report on challenges on long-term care: Estonia.* The European Social Policy Network, European Commission.
180. Prentice, A. M. (2006). "The emerging epidemic of obesity in developing countries." International Journal of Epidemiology 35(1):93-99.
181. Prince, M., H. Brodaty, R. Uwakwe, D. Acosta, C.P. Ferri, M. Guerra, Y. Huang, K.S. Jacob, J.J. Llibre Rodriguez, A. Salas, and A.L.

Sosa (2012). "Strain and its correlates among carers of people with dementia in low-income and middle-income countries. A 10/66 Dementia Research Group population-based survey." *International journal of geriatric psychiatry* 27 (7): 670-682.
182. Prince, M. J., Wu, F., Guo, Y., Robledo, L. M. G., O'Donnell, M., Sullivan, R., and Yusuf, S. (2015). "The burden of disease in older people and implications for health policy and practice". *The Lancet,* 385(9967): 549-562.
183. Rajevska, F. (2018). *ESPN Thematic report on challenges on long-term care: Latvia*. The European Social Policy Network, European Commission.
184. Ramli, A. S., and S. W. Taher. (2008). "Managing chronic diseases in the Malaysian primary health care–a need for change." *Malaysian family physician: the official journal of the Academy of Family Physicians of Malaysia* 3 (1): 7.
185. Rampal, L., Rampal, S., Khor, G.L., Zain, A.M., Ooyub, S.B., Rahmat, R.B., Ghani, S.N. and Krishnan, J., (2007). "A national study on the prevalence of obesity among 16,127 Malaysians". *Asia Pacific journal of clinical nutrition*, 16(3).
186. Rechel, B., Doyle, Y., Grundy, E. and McKee, M. (2009). *How can health systems respond to population ageing*. Copenhagen: WHO Regional Office for Europe. World Health Organization.
187. Rechel, B., M. Ahmedov, B. Akkazieva, A. Katsaga, G. Khodjamurodov, and M. McKee (2012). "Lessons from two decades of health reform in Central Asia." *Health Policy and Planning* 27(4): 281-287.
188. Romas L., A. Poviliunas and L. Zalimiene (2018). *ESPN Thematic report on challenges on long-term care: Lithuania*. The European Social Policy Network, European Commission.
189. Rodda, J., Z. Walker, and J. Carter (2011). "Depression in older adults." *BMj* 343.
190. Rosen, B., H. Samuel, and S. Merkur (2009) "Israel Health system review". *Health Systems in Transition* 17(6): 253-253.
191. Sadana, R., A. Soucat, and J. Beard (2018) "Universal health coverage must include older people." *Bulletin of the World Health Organization* 96 (1): 2.
192. Salhab, N., J. Yartey, S. Rawaf, P. Musgrove, M. Claeson, I. Kickbusch, C. Jenkins, D. Robalino, A. Downing, B. Sadrizadeh, and A.M. Pierre-Louis (2004). *Public health in the Middle East and North Africa: meeting the challenges of the twenty-first century*. WBI Learning Resources Series Washington, D.C.: World Bank Group.
193. Samb, B., N. Desai, S. Nishtar, S. Mendis, H. Bekedam, A. Wright, J. Hsu, A. Martiniuk, F. Celletti, K. Patel and F. Adshead (2010). "Prevention and management of chronic disease: a litmus test for health-systems strengthening in low-income and middle-income countries." *The Lancet* 376 (9754): 1785-1797.
194. Sandoya, E. (2016). "Diabetes y enfermedad cardiovascular en Uruguay". *Revista Uruguaya de Cardiología* 31: 505-514.
195. Sassi, F., A. Belloni, A. J. Mirelman, M. Suhrcke, A. Thomas, N. Salti, S. Vellakkal, C. Visaruthvong, B. M. Popkin, and R. Nugent (2018): "Equity impacts of price policies to promote healthy behaviours." *The Lancet* 391(10134): 2059-2070.
196. Scazufca, M., P. R. Menezes, H. P. Vallada, A. L. Crepaldi, M. Pastor-Valero, L. MS Coutinho, V. D. Di Rienzo, and O. P. Almeida (2008). "High prevalence of dementia among older adults from poor socioeconomic backgrounds in Sao Paulo, Brazil." *International Psychogeriatrics* 20(2): 394-405.
197. Scheil-Adlung, X. (2015). *Long-term care protection for older persons: a review of coverage deficits in 46 countries.* UNECE Working Group on Ageing, Geneva, Switzerland, ILO.
198. Shah, N. M., H. E. Badr, K. Yount, and M. A. Shah. "Decline in co-residence of parents and children among older Kuwaiti men and women: What are the significant correlates?" *Journal of Cross-Cultural Gerontology* 26(2): 157-174.
199. Shekar, M. and Popkin, B. eds. 2020. Obesity: Health and Economic Consequences of an Impending Global Challenge. Human Development Perspectives series. Washington, DC: World Bank. doi:10.1596/978-1-4648-1491-4.
200. Sibai, A. M., Semaan, A., Tabbara, J., and Rizk, A. (2017). "Ageing and health in the Arab region: Challenges, opportunities and the way forward". *Population Horizons* 14(2): 73-84.
201. Singh, P.K., A. Cassels, and P. Travis (2018). "Primary health care at forty: reflections from south-east Asia." World Health Organization. Regional Office for South-East Asia.
202. Sloan, F. A., J. Ostermann, D. H. Taylor Jr, C. Conover, and G. Picone (2004). *The price of smoking*. MIT press, 2004.
203. Smith, J.P, and Majmundar, M. eds. (2012). *Aging in Asia: Findings from new and emerging data initiatives.* Committee on Population, Division of Behavioral and Social Sciences and Education, National Research Council. Washington, D.C.
204. Smith, O. and S.N. Nguyen. (2013*). Getting better: improving health system outcomes in Europe and Central Asia*. The World Bank.
205. SNIC (Sistema Nacional Integrado de Cuidados) (2015). *Plan Nacional de Cuidados* 2016-2020. Ministerio de Desarrollo Social, Uruguay.
206. SNIC (Sistema Nacional Integrado de Cuidados) (2018). *Informe Anual* 2017. Ministerio de Desarrollo Social, Uruguay.
207. SNIC (Sistema Nacional Integrado de Cuidados) (2019). *Informe Anual 2018.* Ministerio de Desarrollo Social, Uruguay.
208. SNIC (Sistema Nacional Integrado de Cuidados) (2020). *Cuidados rinde cuentas: informe mensual, marzo 2020.* Ministerio de Desarrollo Social, Uruguay.
209. Somanathan, A., A. Tandon, H. Lan Dao, K. L. Hurt, and H L. Fuenzalida-Puelma. (2014). *Moving toward universal coverage of social health insurance in Vietnam: assessment and options*. The World Bank, Washington, D.C.
210. Somkotra, T., and L. P. Lagrada (2009). "Which Households Are At Risk Of Catastrophic Health Spending: Experience In Thailand After Universal Coverage: Exploring the reasons why some households still incur high levels of spending—even under universal coverage—can help policymakers devise solutions." *Health Affairs* 28 (1): w467-w478.
211. Souza, D. K. de, & Peixoto, S. V. (2017). "Estudo descritivo da evolução dos gastos com internações hospitalares por condições sensíveis à atenção primária no Brasil, 2000-2013." Epidemiologia e Serviços de Saúde, 26(2), 285-294.
212. Spasova, S., R. Baeten, S. Coster, D. Ghailani, R. Peña-Casas and B. Vanhercke (2018). *Challenges in LTC in Europe: a study of national policies*. European Commission.
213. Sowa-Kofta, A. (2018). *ESPN Thematic report on challenges on long-term care: Poland*. The European Social Policy Network, European Commission.
214. Stampini, M., Olivieri, L., Ibarrarán, P., Londoño, D., Rhee, H. J., James, G. M. (2022). "Working les to take care of parents? Labor market efects of family long-term care in Latin America". *Working Paper Series* IDB-WP-1105. Inter-American Development Bank.
215. Stokic, L.P. and J. Bajec (2018). *ESPN Thematic report on challenges on long-term care: Serbia*. The European Social Policy Network, European Commission.
216. Storr, Carla L., Hui Cheng, Jordi Alonso, Matthias Angermeyer, Ronny Bruffaerts, Giovanni De Girolamo, Ron De Graaf et al. (2010). "Smoking estimates from around the world: data from

the first 17 participating countries in the World Mental Health Survey Consortium." *Tobacco control* 19(1): 65-74.
217. Stubbs, P. and S. Zrinščak (2018). ESPN Thematic report on challenges on long-term care: Croatia. The European Social Policy Network, European Commission.
218. Suwannaphant, K., W. Laohasiriwong, N. Puttanapong, J. Saengsuwan, and T. Phajan. "Association between socioeconomic status and diabetes mellitus: The National Socioeconomics Survey, 2010 and 2012." *Journal of Clinical and Diagnostic Research* 11 (7):LC18-LC22.
219. Tejativaddhana, P., D. Briggs, O. Singhadej, and R. Hinoguin (2018). "Developing primary health care in Thailand." *Public Administration and Policy*.
220. Tham, T.Y., T.L. Tran, S. Prueksaritanond, J. S. Isidro, S. Setia, and V. Welluppillai (2018). "Integrated health care systems in Asia: an urgent necessity." *Clinical interventions in aging* 13: 2527-2538.
221. Thumé, E., L.A. Facchini, G. Wyshak, and P. Campbell (2011). "The utilization of home care by the elderly in Brazil's primary health care system." American journal of public health 101(5): 868-874.
222. Tomita, K. (2017). "Japanese healthcare at a crossroads (1): toward integrated community care". *The Tokyo Foundation for Policy Research*.
223. Tonoyan, T., and L. Muradyan (2012). "Health inequalities in Armenia-analysis of survey results." *International Journal for Equity in Health* 11(1): 32.
224. Trieu, K., B. Neal, C. Hawkes, E. Dunford, N. Campbell, R. Rodriguez-Fernandez, B. Legetic, L. McLaren, A. Barberio, and J. Webster (2015). "Salt reduction initiatives around the world–a systematic review of progress towards the global target." *PloS ONE* 10(7): e0130247.
225. Twigg, J., Bardasi, E., Garcia, G. (2021). Covid-19 has exposed the fragilities of aging countries. World Bank blog. Available at: https://ieg.worldbankgroup.org/blog/covid-19-has-exposed-fragilities-aging-countries
226. United Nations (UN). 2002. *Political Declaration and Madrid International Plan of Action on Ageing.* Second World Assembly on Ageing, Madrid, Spain.
227. United Nations (UN). 2015a. *World population ageing report 2015*. New York: Department of Economic and Social Affairs, United Nations 2015.
228. United Nations (UN). 2017a. *World population ageing 2017: Highlights*. New York: Department of Economic and Social Affairs, United Nations.
229. United Nations (UN). 2017b. *Population ageing and policy options in the Arab region*. United Nations Population Fund, Arab States Regional Office.
230. United Nations(UN). 2017c. *Living arrangements of older persons: a report on an expanded international dataset*. New York: Department of Economic and Social Affairs. Population Division, United Nations.
231. United Nations (UN). 2017d. Una Mirada sobre el envejecimiento ¿Dónde están varios países latinoamericanos a 15 años del Plan de Acción Internacional de Madrid? Population Division, United Nations.
232. United Nations (UN). 2019. *World Population Ageing 2019: Highlights*. New York: Department of Economic and Social Affairs, United Nations.
233. United Nations (UN) and HelpAge International (2012). *Overview of available policies and legislation, data and research, and institutional arrangements relating to older persons - Progress since Madrid*. United Nations Population Fund and HelpAge International.
234. UN ECA (United Nations Economic Commission for Africa) (2017). *The Third Review and Appraisal Cycle of the implementation of the Madrid International Plan of Action on Ageing in Africa for the period 2012 – 2017*. United Nations.
235. UN ECE (United Nations Economic Commission for Europe) (2017). *Synthesis Report on the implementation of the Madrid International Plan of Action on Ageing in the ECE region between 2012 and 2017. United Nations,* Working Group on Ageing.
236. United Nations Economic Commission for Latin American and the Caribbean (UN ECLAC) (2017a). *Caribbean Synthesis Report on the implementation of the Madrid International Plan of Action on Ageing and the San Jose Charter on Rights of Older People in Latin America and the Caribbean*. United Nations.
237. United Nations Economic Commission for Latin American and the Caribbean (UN ECLAC) (2017b). *Fourth Regional Intergovernmental Conference on Ageing and the Rights of Older Persons in Latin America and the Caribbean*. United Nations.
238. United Nations Economic Commission and Social Commission for Asia and the Pacific (UN ESCAP) (2017). *Government actions towards the implementation of the Madrid International Plan of Action on Ageing, 2002: Achievements and remaining challenges*. United Nations.
239. United Nations Economic and Social Commission for Western Asia (UN ESCWA) (2017). *Third review and appraisal of the Madrid International Plan of Action on Ageing*. United Nations.
240. United Nations Population Fund Well Woman Programme (UNFPA WWP) (2019). National Strategic Plan 2019-2023. Family Health Bureau, Ministry of Health, Sri-Lanka.
241. United Nations General Assembly (UNGA). 2019. Political Declaration of the High-level Meeting on Universal Health Coverage "Universal health coverage: moving together to build a healthier world", September 2019 https://www.un.org/pga/73/wp-content/uploads/sites/53/2019/07/FINAL-draft-UHC-Political-Declaration.pdf.
242. Van der Heide, I, S. Snoeijs, M. Gabriella Melchiorre, S. Quattrini, W. Boerma, F. Schellevis, and M. Rijken. (2015). "Innovating care for people with multiple chronic conditions in Europe: An overview." ICARE4EU. *Health Programme of the European Union*.
243. Van Minh, H., N. S. Pocock, N. Chaiyakunapruk, C. Chhorvann, H.A. Duc, P. Hanvoravongchai, J. Lim, D.E. Lucero-Prisno III, N. Ng, N. Phaholyothin and A. Phonvisay (2014). "Progress toward universal health coverage in ASEAN." *Global Health Action* 7 (1): 25856.
244. Varona, R., T. Saito, M. Takahashi, and I. Kai (2007). "Caregiving in the Philippines: A quantitative survey on adult-child caregivers' perceptions of burden, stressors, and social support." *Archives of Gerontology and Geriatrics* 45(1): 27-41.
245. Vathesatogkit, P, G. D. Batty, and M. Woodward (2014). "Socioeconomic disadvantage and disease-specific mortality in Asia: systematic review with meta-analysis of population-based cohort studies." *J Epidemiol Community Health 68* (4): 375-383.
246. Verity, R., L.C. Okell, I. Dorigatti, P. Winskill, C. Whittaker, N. Imai et. al. (2020). "Estimates of the Severity of Coronavirus Disease 2019: A Model-Based Analysis." *The Lancet Infectious Diseases* 20(6): 669-677.
247. Villalobos, P. 2018. Long-term care systems as social security: the case of Chile. *Health Policy and Planning, Volume 33, Issue 9, November 2018, Pages 1018–1025*, https://doi.org/10.1093/heapol/czy083
248. Villalobos, P. "Is aging a problem? Dependency, long-term care, and public policies in Chile." *Revista Panamericana de Salud Pública* 42: e168.

249. Villalobos, P., Oliveira, D., Stampini, M. (2022). "Estimación de las necesidades de recursos humanos para la atención de personas mayores con dependencia de cuidados en América Latina y el Caribe". Nota Técnica IDB-TN-02556. *Banco Interamericano de Desarrollo.*
250. Wang, B., R. Li, Z. Lu, and Y. Huang (2020). "Does comorbidity increase the risk of patients with COVID-19: evidence from meta-analysis." *Aging (Albany NY)* 12(7): 6049-6057.
251. Wilkinson, R. G., and M. Marmot, eds. (2003). *Social determinants of health: the solid facts.* World Health Organization.
252. Williamson, C. (2015). "Policy mapping on ageing in Asia and the Pacific: Analytical report". *HelpAge International, East Asia/ Pacific Regional Office, Chiang Mai, Thailand*.
253. Woldie, M., G.T. Feyissa, B. Admasu, K. Hassen, K. Mitchell, S. Mayhew, M. McKee, and D. Balabanova (2018)."Community health volunteers could help improve access to and use of essential health services by communities in LMICs: an umbrella review." *Health Policy and Planning* 33(10): 1128-1143.
254. Woolf, AD., J. Erwin and L. March (2012). "The need to address the burden of musculoskeletal conditions." *Best practice & research Clinical rheumatology* 26(2): 183-224.
255. Workie, N.W., E. Shroff, A. S. Yazbeck, S.N, Nguyen, and H. Karamagi. "Who Needs Big Health Sector Reforms Anyway? Seychelles' Road to UHC Provides Lessons for Sub-Saharan Africa and Island Nations." *Health Systems & Reform* 4(4): 362-371.
256. World Bank. 2015. "World Bank Group Gender Strategy (FY16–23): Gender Equality, Poverty Reduction and Inclusive Growth." World Bank, Washington, DC.
257. World Bank. 2021. World Bank Support to Aging Countries: An Independent Evaluation. Independent Evaluation Group. Washington, DC: World Bank.
258. World Bank and International Monetary Fund (2016). *Development goals in an era of demographic change*. Global Monitoring Report 2015/2016.
259. World Bank Independent Evaluation Group (2018). Project performance assessment report. Oriental Republic of Uruguay. Non-communicable diseases prevention project (IBRD-74860).
260. World Cancer Research Fund International (2018). *Building momentum: lessons on implementing a robust sugar sweetened beverage tax*.
261. World Economic Forum and World Health Organization (WEF and WHO) (2011). From Burden to "Best Buys": Reducing the Economic Impact of Chronic Diseases in Low- and Middle-Income Countries.
262. World Health Organization (WHO) (2008). *Preventing Chronic Diseases: A Vital Investment: WHO Global Report 2008*. Geneva: World Health Organization.
263. World Health Organization (WHO) (2009). "Armenians struggle for health care and medicines". *Bulletin of the World Health Organization 87(7)*: 485-564.
264. World Health Organization (WHO) (2011a). *Global Health and Aging*. WHO; US National Institute of Aging.
265. World Health Organization (WHO) (2011b). *Global status report on noncommunicable diseases* 2010. WHO; US National Institute of Aging.
266. World Health Organization (WHO) (2015). *World report on ageing and health*. World Health Organization.
267. World Health Organization (WHO) (2017a). Tackling NCDs: *'best buys' and other recommended interventions for the prevention and control of noncommunicable diseases*. World Health Organization.
268. World Health Organization (WHO) (2017b). *WHO Report on the global tobacco epidemic 2017: monitoring tobacco use and prevention policies*. World Health Organization.
269. World Health Organization (WHO) (2017c). Towards long-term care systems in sub-Saharan Africa. *WHO Series on Long-Term Care*.
270. World Health Organization (WHO) (2018a). *The state of food security and nutrition in the world 2018: building climate resilience for food security and nutrition*. Food & Agriculture Organization.
271. World Health Organization (WHO) (2018b). *Public Spending on Health: A Closer Look at Global Trends*. World Health Organization.
272. World Health Organization (WHO) (2018c). Country cooperation strategy at a glance: Seychelles.
273. World Health Organization (WHO) (2019). *Global report on trends in prevalence of tobacco use 2000-2025, third edition*. Geneva: World Health Organization.
274. World Health Organization (WHO) (2020). *"Obesity and overweight – Key facts"*. Retrieved from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.
275. Wu, F., Guo, Y., Chatterji, S., Zheng, Y., Naidoo, N., Jiang, Y., ... and Manrique-Espinoza, B. (2015). "Common risk factors for chronic non-communicable diseases among older adults in China, Ghana, Mexico, India, Russia and South Africa: the study on global AGEing and adult health (SAGE) wave 1". BMC *public health*, 15(1), 1-13.
276. Xu, F., X. M. Yin, M. Zhang, E. Leslie, R. Ware and N. Owen (2006). "Family average income and diagnosed type 2 diabetes in urban and rural residents in regional mainland China". *Diabetic Medicine* 23(11): 1239-1246.
277. Yamaguchi, N., N. Pilnik, J. De La Garza, L. Ashton, A. Garcia, E. Bianco, and G. Kevorkof. "Tobacco Control Policies in Latin America". *Journal of Thoracic Oncology* 12(1): S56-S57.
278. Yang Z., Hall A. (2008). "The financial burden of overweight and obesity among elderly Americans: the dynamics of weight, longevity, and health care cost". Health Services Research 43(3):849–868.
279. Yiengprugsawan, V., J. Healy, H. Kendig, M. Neelamegam, P. Karunapema, and V. Kasemsup. "Reorienting health services to people with chronic health conditions: diabetes and stroke Services in Malaysia, Sri Lanka and Thailand." (2017). *Health Systems & Reform* 3(3): 171-181.
280. Yon, Y., C. R. Mikton, Z. D. Gassoumis, and K. H. Wilber. "Elder abuse prevalence in community settings: a systematic review and meta-analysis." *The Lancet Global Health* 5(2): e147-e156.
281. Yon, Y., M. Ramiro-Gonzalez, C. R. Mikton, M. Huber, and D. Sethi. "The prevalence of elder abuse in institutional settings: a systematic review and meta-analysis." *European Journal of Public Health* 29(1): 58-67.
282. Zaidi, A. (2016). "Sustainable Development Goals have put ageing back onto the agenda". *Global AgeWatch Index Blogs*, 08 June 2016.
283. Zaidi, S., R. Bennet and R.C. Summer (2017). The Madrid International Plan of Action on Ageing: *Where is Eastern Europe and Central Asia region fifteen years later*? United Nations Population Fund.
284. Zaidi, S., P. Saligram, S. Ahmed, E. Sonderp, and K. Sheikh. (2017). "Expanding access to healthcare in South Asia." *bmj* 357 (j1645): 1-4.
285. Zaidi, A. (2018). "Implementing the Madrid Plan of Action on Ageing: What have we learned? And, where do we go from here?". *Human Development Reports*. United Nations Development Programme.

CONSULTED SURVEYS AND DATABASES

i. Encuesta de Hogares de Propósitos Múltiples de El Salvador (2018). Retrieved from: https://onec.bcr.gob.sv/encuesta-de-hogares-de-propositos-multiples-ehpm/

ii. Encuesta Longitudinal de Protección Social (ELPS), Chile (2015). Available upon request.

iii. Encuesta Longitudinal de Protección Social (ELPS), El Salvador (2013). Retrieved from: https://onec.bcr.gob.sv/metadatos/index.php/catalog/12

iv. Encuesta Longitudinal de Protección Social (ELPS), Paraguay (2013). Retrieved from: https://www.stp.gov.py/v1/encuesta-longitudinal-de-proteccion-social-elps/

v. Encuesta Longitudinal de Protección Social (ELPS), Uruguay (2013). Retrieved from: https://www.elps.org.uy/

vi. Encuesta de Salud y Bienestar del Adulto Mayor en Perú (2012). Retrieved from: http://webinei.inei.gob.pe/anda_inei/index.php/catalog/584

vii. United Nations World Population Prospects (2019). Retrieved from: https://population.un.org/wpp/

viii. GBD (Global Burden of Disease and Collaborators Results Tool) (2019) Retrieved from: http://ghdx.healthdata.org/gbd-results-tool

ix. United Nations. Department of Economic and Social Affairs. World Population Prospects (UNWPP) (2019). Retrieved from: https://population.un.org/wpp2019/

x. World Health Organization (WHO) (2004). "A glossary of terms for community health care and services for older persons". WHO Centre for Health Development, Ageing and Health Technical Report, 5

xi. World Health Organization Global Health Estimates. Global Burden of Disease (2018). Retrieved from: https://www.who.int/healthinfo/global_burden_disease/en/

xii. World Health Organization Global Health Observatory Data Repository (2020). Retrieved from: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4680

xiii. World Bank Open Data website. Retrieved from: https://data.worldbank.org/

11

Demand for and Supply of Long-Term Care for Older Persons in Low- and Middle-Income Countries

Elena Glinskaya [a], Xiaohui Hou [b], Zhanlian Feng [c], Marco Angrisani [d,e], Guadalupe Suarez [c], Jigyasa Sharma [b], Drystan Phillips [d], Jenny Wilkens [d], Jinkook Lee [d,e], Yeeun Lee Yoo [d], Samuel Lau [d], Hae Yeun Park [d], and Yizhou Chen [d]

[a] Social Protection and Labor, West Africa Region, World Bank
[b] Health, Nutrition, and Population Global Practice, World Bank
[c] Research Triangle Institute
[d] Center for Economic and Social Research, University of Southern California
[e] Department of Economics, University of Southern California

INTRODUCTION

In virtually all countries across the world, the population is aging, and consequently, both the number and proportion of older people are growing. Notably, the aging process is accelerating at a more rapid pace in low- and middle-income countries (LMICs) than in high-income countries (HICs). In 2020, older people aged 65 and over accounted for roughly 8 percent of the population in middle-income countries. This proportion is projected to double in 2050 to over 16 percent. Even in low-income countries, which typically have much younger populations, the proportion of older people aged 65 and over will jump from about 3 percent in 2020 to over 5 percent in 2050 (United Nations 2019). In comparison, the proportion of individuals aged 65 and over in HICs will increase more gradually, from 18 percent in 2020 to 27 percent by 2050. In 2020, there were an estimated 727 million people aged 65 and over worldwide, of whom over two-thirds (68 percent) lived in LMICs (United Nations 2019). Projections indicate that by 2050 the global population aged 65 and over will more than double, to top 1.5 billion and more than three-quarters (77 percent) of older individuals will live in LMICs.

While the population is growing older and life expectancy is increasing steadily across LMICs, the burden of non-communicable diseases (NCD) and age-related disabilities are also on the rise (Kazibwe, Tran, and Annerstedt 2021). Recent research on disability trends among older adults in 23 LMICs forecasts that the prevalence rate of people living with severe activity limitations will change very little in the next 30 years; however, the absolute number of persons with activity limitations will increase as the sheer size of older population swells (Weber and Scherbov 2020). Thus, despite anticipated gains in life expectancy, the number of years in later life in ill health and with disability is expected to increase. Meanwhile, there is growing concern that family-based elder care alone—traditionally the mainstay of old age support and long-term care (LTC)—is no longer sufficient to meet the escalating demand for LTC services for rapidly aging populations across LMICs (Feng 2019).

Yet, in most countries, LTC has not received high enough priority on the national policy agenda (Scheil-Adlung 2015). To help all countries address the aging challenges, the United Nations launched the *Decade of Healthy Ageing 2021–2030*, to promote healthy aging and improve the lives of older people (World Health Organization 2020a). It identifies "*access to long-term care for people who need it*" as a priority area for action, which is crucial for older people with declining physical or mental capacity to optimize functional ability and live independently. Current estimates indicate that more than 142 million older people, or 14 percent of the world population aged 60 years and over, are currently unable to meet all of their basic daily needs due to functional limitations (World Health Organization 2020b). The majority of these older people are from LMICs, where the challenge for meeting their care needs is particularly acute, due to the absence of robust healthcare and LTC systems.

The LTC research literature to date has been dominated by studies in HICs with mature LTC systems. At the same time, in many LMICs, formal (paid) LTC services are emerging in the public sector and especially in the private market, but they are in early stages of development and not well documented. The lack of LTC research and empirical knowledge in LMICs is an impediment to evidence-based policy planning, formulation, and evaluation in these countries (Lloyd-Sherlock 2014, Aboderin 2019).

In this chapter, we provide an overview of the demand for LTC and describe the current landscape of supply of LTC services for old persons across six middle-income countries (MICs), namely China, India, Malaysia, Mexico, Poland, and Romania. The demand-side assessment is based on the analysis of individual-level datasets that are part of the International Network of Health and Retirement Studies. The supply-side evaluation is a synthesis of findings from a review of relevant literature, both published and grey, identified through a series of web searches and databases as well as national and international policy documents published in English in the past 22 years (2000-2022).[1] The review covers selected LMICSs and MICs in Asia (where we have most of data), Central and South America, Southern Europe and Middle East, and Sub-Saharan Africa.

1 This review also draws from the authors' earlier work, including (i) "Understanding the "state of play" of long-term care provision in low- and middle-income countries" , International Social Security Review Vol. 75, No. 3-4(2022), and (ii) "Primary Health Care Centered Integrated Care for an Aging Population", World Bank 2022.

What is LTC for older persons?

According to the definition used by the European Commission and the Social Protection Committee, LTC refers to "*a range of healthcare and social care services and assistance, for people who, as a result of mental and/or physical frailty and/or disability and/or old age, over an extended period of time depend on help with daily living activities, and/or need some permanent nursing care*" (European Commission 2021). As such, LTC covers both medical care and non-medical services and support for older adults. In this chapter, we focus primarily on the latter, namely, the non-medical long-term services and support to meet the every-day care needs of older adults with physical and/or cognitive impairments. Medical or health care for older people is discussed mainly in the context of integrating the full range of services in a continuum of care for older adults with LTC needs. Furthermore, although LTC encompasses both formal and informal care, and informal care is by far the more prevalent modality use in virtually all countries across the world, our supply-side discussion focuses on formal LTC provision, which is typically provided by paid carers, in contrast to informal LTC that is typically provided by unpaid family members, friends or neighbors. The focus on the formal care is intentional: the objective of this chapter is to raise awareness about the limitations that LMICs face in assuring that families have choices with respect to LTC for their older members.

A DEMAND SIDE VIEW - CURRENT LTC LANDSCAPE IN MICS

In this section, we analyze the demand for long-term care (LTC) among older adults across six middle-income countries – China, India, Malaysia, Mexico, Poland and Romania. The analysis is based on individual-level data comparable across these countries which are collected and maintained by the International Network of Health and Retirement Studies, see Box 11.1. Long-term care demand is measured by the prevalence of self-reported limitations in activities of daily living (ADLs) and instrumental activities of daily living (IADLs),which are the essential activities that individuals should perform without assistance to lead independent lives. ADLs and IALDs are commonly used to assess an individual's functional status and quality of life (Clark et al. 2004; Edemekong et al. 2022). Receipt of long-term care is measured by self-reported formal and informal care utilization. The analysis considers differences across several socio-demographic characteristics that influence both the need for, and the receipt of, long-term care. Specifically, we consider two age brackets (e.g., 65 to 79 and 80 and above), gender, urban and rural status, education categories (those with no education, those with primary education, and those with secondary education or more) and household income (low, middle, and high income tertiles). We also separate individuals into three groups according to their living situation: those living alone, those living with one other person, and those living with two or more other people.

BOX 11.1 Data used for the demand side analysis

The demand for long-term care (LTC) among older adults across six middle-income countries – China, India, Malaysia, Mexico, Poland, and Romania – is based on individual-level data comparable across these six countries which are collected and maintained by the International Network of Health and Retirement Studies. For China, we use Wave 4 (2018) of The China Health and Retirement Survey (CHARLS), which includes respondents aged 45 years and older and their spouses, regardless of age. For India, we use Wave 1 (2017-2019) of the Longitudinal Aging Study in India (LASI), which interviews respondents aged 45 years and older and their spouses, regardless of age. For Malaysia, we use Wave 1 (2018) of the Malaysia Ageing and Retirement Survey (MARS), which includes the three oldest respondents in the household aged at least 40 years and older. For Mexico, we use Wave 5 (2018) of the Mexican Health and Aging Study (MHAS), which includes respondents aged 50 years and older and their spouses regardless of age. For Poland and Romania, we use Wave 8 (2019-2020) of the Survey of Health, Ageing and Retirement in Europe (SHARE), which interviews respondents aged 50 years and older and their spouses, regardless of age.

We limit our analyses to respondents aged 65 years and older, and use survey sample weights, when available, to estimate the prevalence of long-term care needs and receipt at the population level. As such, our estimates should be interpreted as population-level estimates for a particular year and country, and do not reflect prevalence accurately at another time or in another country.

Limitations in activities of daily living (ADLs)

This section documents the prevalence of difficulties with activities of daily living (ADLs) separately for six countries. The five ADLs considered are: (i) dressing, (ii) bathing, (iii) eating, (iv) getting in and out of bed, and (v) using the toilet. Difficulties with each of these five ADLs have been elicited by each country-specific health and retirement study and included in the harmonized datasets.

It is worth noting that a few cross-study differences exist in the survey questions used to capture difficulties with activities of daily living. LASI, MHAS, SHARE, and CHARLS ask about difficulties with ADLs in a similar way: "Because of a physical or health problem do you have difficulty with any of these activities? Exclude any activities you expect to last less than three months." In LASI, SHARE, and MHAS, respondents answer "yes" or "no" to this question, separately for each ADL. MHAS respondents can also answer with a "can't do," which is coded as having difficulty in the harmonized variable, or "doesn't do," which is coded as having difficulty only if respondents report receiving help for that activity. For each activity in CHARLS, if the respondent reports they have no difficulty, then the harmonized variable is coded as not having difficulty. On the other hand, if the respondent reports that they have difficulty but can still do it, they have difficulty and need help, or they cannot do it, then the harmonized variable is coded as having difficulty.

MARS asks about receiving help with ADLs in this form: "In the last week, did you need any assistance in performing the following activities (excluding any difficulty that you expect to last less than 3 months)?" If the respondent reports being able to do it all by themselves, then the harmonized variable is coded as not needing help. If, however, the respondent reports that they sometimes need some help, always need some help, or always need help, then the harmonized variable is coded as needing help.

The difference in question wording between MARS and the other studies appears to be substantial. MARS provides a measure of whether an individual needs help with ADLs, whereas the other studies provide a measure of whether an individual has difficulties with ADLs. Needing help with and having difficulty with an activity are conceptually different. This prevents comparability between Malaysia and other countries. Because of that, we will comment about Malaysia's results separately, without attempting a comparison with the other countries. We should also point out that, in our analyses, we exclude individuals from MHAS who answered that they don't do the activity and don't receive help. Since LASI, SHARE, and CHARLS did not give respondents this option, it is not possible to identify the same group of people in these other studies.

TABLE 11.1 Individual ADLs (Age 65+)

	Having difficulty					Needing help
	China	India	Mexico	Poland	Romania	Malaysia
Dressing	11.74	8.58	14.90	14.82	14.06	3.26
Bathing	15.55	9.08	8.68	11.81	12.00	3.77
Eating	5.44	9.56	4.60	5.61	6.66	2.39
Getting in/out of bed	11.64	13.31	10.42	9.04	13.05	5.51
Using toilet	17.88	19.57	9.72	6.08	7.83	3.77

Prevalence estimates for China, India, Mexico, Poland, and Romania are weighted
Prevalence estimates for Malaysia are not weighted

Table 11.1 summarizes the estimated prevalence of having difficulty or needing help with each ADL across countries. The following patterns emerge. We find similarly high prevalence rates of around 14 percent in difficulty dressing for older individuals in Poland, Romania, and Mexico. In these three countries, difficulty dressing is the most prevalent ADL difficulty. In contrast, difficulty dressing is less prevalent in China and India, with rates closer to 10 percent. Older Indians and Chinese exhibit the highest prevalence rate of difficulty with using the toilet, approaching 20 percent, while their counterparts in Mexico, Romania, Poland report significantly lower prevalence rates ranging from 6 percent to 10 percent.

Difficulty eating is one of the least prevalent difficulties across countries. Older Indians have the most difficulty eating compared to residents of other countries, with a prevalence rate around 9.5 percent. The prevalence rate of difficulty eating in Romania, Poland, China, and Mexico is between 5 percent and 7 percent. Getting in and out of bed is one of the most prevalent ADL difficulties, with a rate of about 13 percent in India and Romania, and between 9 percent and 12 percent in Poland, Mexico, and China. In terms of difficulty bathing, older Chinese exhibit the highest prevalence rate of about 15 percent, followed by those in Poland and Romania, with a rate around 12 percent, and residents of India and Mexico, with a rate around 9 percent.

Malaysia's prevalence rates of needing help with each activity are relatively low, ranging from 2 percent, for eating, to 5.5 percent, for getting in and out of bed.

We construct and indicator taking value one if the respondent reports having difficulty with at least one ADL and zero otherwise. Figure 11.1 plots the prevalence of having difficulty with at least one ADL across countries, excluding Malaysia. As can be seen about 28 percent of older adults in China and India have difficulty with at least one ADL; this proportion is 8 percentage points lower (at around 20 percent) in Mexico, Poland and Romania. For the MARS dataset, we construct an indicator taking value one if the respondent reports needing help with at least one ADL and zero otherwise. Figure 11.2 shows that around 7 percent of older adults in Malaysia need help with at least one ADL.

To gauge the extent to which the prevalence of having difficulty with at least one ADL varies across socio-economic groups, we estimate multivariate logistic models relating the indicator for having at least one ADL difficulty (for all countries except Malaysia) and the indicator for needing help with at least one ADL (for Malaysia) to various individuals' characteristics. This exercise allows us to infer how strongly each individual characteristic correlates with ADL difficulty/needing help holding the others constant. We perform the estimation of the logistic regression separately for each country and report the corresponding marginal effects in Table 11.2. Below, we first comment about the results in columns 1-5 of Table 11.2, next we comment about the results in column 6 referring to Malaysia.

The results reveal that, holding other factors constant, those aged 80 and over are significantly more likely than those aged 65-79 to experience difficulty with any ADL. The difference in the likelihood of experiencing difficulty with at least one ADL between these two age groups ranges from 14 percentage points in Mexico to 20 percentage points in Romania. The association between gender and difficulty with an ADL exhibit different patterns across countries. Relative to men, women are about 7 percentage points more likely to experience at least one ADL difficulty in China, India, and Mexico. In contrast, women are 6 percentage points less likely than men to experience difficulty with an ADL in Poland. Among Romanian older adults, we do not detect any significant difference by gender. Education is a strong correlate of having an ADL

FIGURE 11.1 **Having difficulty with any one ADL (Age 65+)**

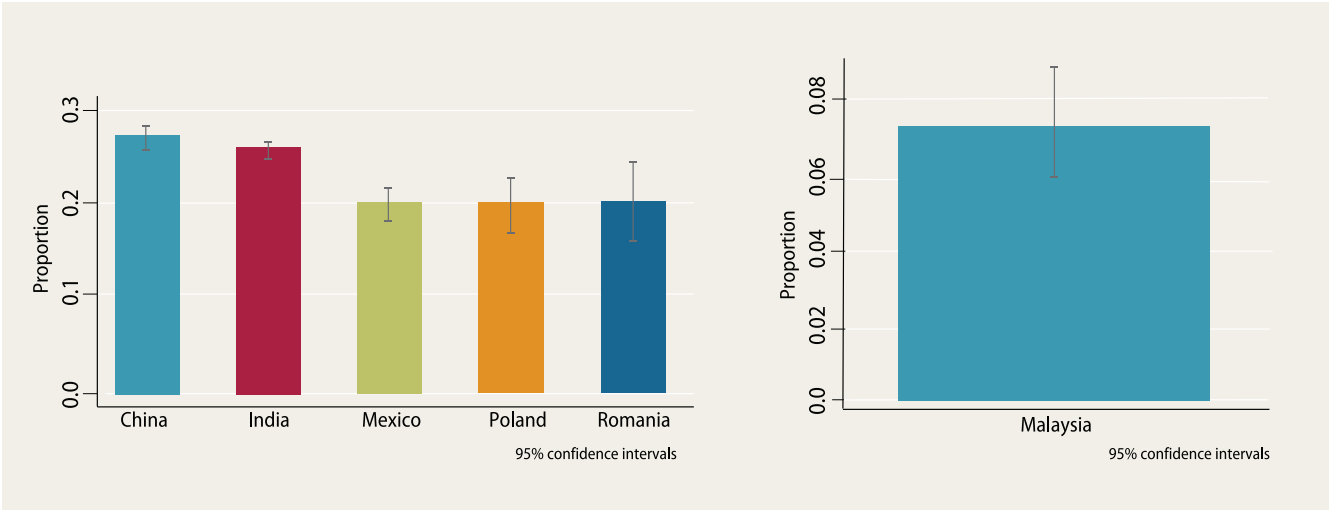


FIGURE 11.2 **Needing help with any one ADL (Age 65+)**

difficulty across all countries, although the features of this association are country specific. In China and Mexico there is an apparent education gradient as the likelihood of experiencing difficulty with at least one ADL increases monotonically as the level of education decreases. In Mexico those with no education and those with primary education are 11 and 6 percentage points more likely to experience an ADL difficulty relative to those with secondary education, respectively. Similarly, in China the likelihood of having at least one ADL difficulty is 8 and 6 percentage points higher, respectively, for individuals with no education and only primary education compared to those with secondary education. The education gradient is less apparent in India, where the likelihood of experiencing an ADL difficulty is between 5 and 6 percentage points higher among those with less than secondary education relative to those with secondary education. In both Poland and Romania, the fraction of older adults with no education is small. Likely because of that, the marginal effect of having no education is not significant. Yet we still detect a noticeable increase in the probability of having an ADL difficulty of about 10 percentage points when comparing individuals with secondary and primary education.

Rural residents are more likely to have any ADL difficulty in comparison to urban residents only in

TABLE 11.2 Marginal Effects from Logistic Regressions of Having Difficulty/Needing Help with at Least One ADL

	China	India	Mexico	Poland	Romania	Malaysia[1]
Age (ref: Age 65-79)						
Age 80+	0.160***	0.152***	0.144***	0.158***	0.199***	0.230***
	(0.017)	(0.009)	(0.019)	(0.027)	(0.042)	(0.040)
Gender (ref: Men)						
Women	0.064***	0.063***	0.076***	-0.060**	-0.002	0.087***
	(0.014)	(0.008)	(0.018)	(0.027)	(0.040)	(0.027)
Education (ref: Secondary or higher)						
No education	0.076***	0.046***	0.108***	0.092	-0.028	0.190***
	(0.022)	(0.012)	(0.032)	(0.066)	(0.083)	(0.037)
Primary education	0.058***	0.058***	0.061**	0.099***	0.109**	0.086***
	(0.021)	(0.012)	(0.028)	(0.030)	(0.045)	(0.032)
Urban/rural (ref: Urban)						
Rural	0.052***	-0.000	0.011	-0.046	0.021	0.072***
	(0.014)	(0.008)	(0.018)	(0.028)	(0.045)	(0.027)
Household income per person (ref: High income)						
Low income	0.076***	0.034***	0.002	0.067*	0.012	0.021
	(0.024)	(0.009)	(0.024)	(0.036)	(0.047)	(0.033)
Middle income	0.053**	0.022**	0.038*	0.033	0.043	0.058
	(0.024)	(0.009)	(0.022)	(0.034)	(0.046)	(0.036)
Missing income	0.044*					0.042
	(0.023)					(0.056)
Living arrangement (ref: Lives with two or more)						
Lives alone	0.010	0.000	0.012	0.039	-0.010	0.010
	(0.021)	(0.015)	(0.022)	(0.038)	(0.055)	(0.047)
Lives with one other	-0.007	-0.002	-0.004	-0.004	-0.037	-0.040
	(0.015)	(0.005)	(0.021)	(0.029)	(0.045)	(0.030)
N	6,967	21,255	6,930	1,205	685	1,375

Standard errors are reported in parentheses.
*, **, *** indicates significance at the 90%, 95%, and 99% level, respectively.
[1] The dependent variable for Malaysia is the cumulative number of ADL/IADLs a respondent needs help with, not the number they have difficulty with, as it is for all other countries

China, where living in a rural area is associated with a 5 percentage point increase in the probability of having an ADL difficulty. Per-capita household income correlates with the likelihood of having difficulty with an ADL in some countries but not in others. China exhibits a steep income gradient: relative to individuals in the highest income tertile, those in the lowest tertile (low income) and in the middle tertile (middle income) are 8 and 5 percentage points more likely to have an ADL difficulty, respectively. In India, relative to individuals in the highest income tertile, those in the lowest tertile (low income) and in the middle tertile (middle income) are 3 and 2 percentage points more likely to have an ADL difficulty, respectively. The association between household income and ADL difficulty is much weaker in Mexico, Poland, and Romania. Finally, we do not find that, holding other factors constant, living arrangement are significantly associated with the likelihood of having difficulty with an ADL across countries.

The last column of Table 11.2 presents the estimation results for Malaysia. Given the aforementioned differences between the MARS questionnaire and that used by all other studies, we describe these results separately. In Malaysia, we estimate that being 80 years or older is associated with a 23 percentage point increase in the probability of needing help with an ADL compared to being 65-79 years. Being female is associated with a 9 percentage point increase in the probability of needing help with at least one ADL compared to being male. We detect a steep monotonic increase in the likelihood of needing help with an ADL as an individual's education level decreases. Specifically, relative to those with secondary education, individuals with no education and individuals with primary education are 19 and 9 percentage points more likely to need help with an ADL, respectively. In Malaysia, living in a rural area rather than in an urban area is associated with a 7 percentage point increase in the probability of needing help with at least one ADL. Holding other factors constant there is no significant correlation of needing help with an ADL with either per-capita household income or living arrangements.

Limitations in instrumental activities of daily living (IADLs)

While instrumental activities of daily living (IADLs) are not as critical as ADLs in enabling functional living, they still play an integral role in determining the quality of an individual's life (Guo & Sapra, 2022). In this report, we document difficulty with three IADLs elicited by all studies and available in the harmonized dataset, namely: (i) difficulty preparing meals, (ii) difficulty shopping, and (iii) difficulty taking medications.

As for the questions asking about difficulty with ADLs, there exist some cross-study differences in how survey instruments elicit difficulties with IADLs. LASI, MHAS, SHARE, and CHARLS ask IADL questions in a similar way: "Because of a physical or health problem do you have difficulty with any of these activities? Exclude any activities you expect to last less than three months." In LASI, SHARE, and MHAS, respondents answer "yes" or "no" to this question, separately for each IADL. MHAS respondents can also answer with "can't do," which is coded as having difficulty in the harmonized variable, or "doesn't do", which is only coded as having difficulty if the respondents report receiving help for that activity. For each activity in CHARLS, if the respondent reports they have no difficulty, then the harmonized variable is coded as not having difficulty. On the other hand, if the respondent reports that they have difficulty but can still do it, they have difficulty and need help, or they cannot do it, then the harmonized variable is coded as having difficulty.

MARS asks about receiving help with IADLs in this form: "In the last week, did you need any assistance in performing the following activities (excluding any difficulty that you expect to last less than 3 months)?" If the respondent reports being able to do it all by themselves, then the harmonized variable is coded as not needing help. If, however, the respondent reports that they sometimes need some help, always need some help, or always need help, then the harmonized variable is coded as needing help.

The difference in question wording between MARS and the other studies prevents comparability between Malaysia and other countries. Because of that, we will comment about Malaysia's results separately, without attempting a comparison with the other countries. Similarly, to what we did for the analysis of ADL difficulties, we exclude individuals from MHAS who answer that they don't do and didn't receive help with an IADL, a group which cannot be identified in LASI, SHARE, and CHARLS. Lastly, CHARLS uses slightly more specific wording to assess difficulty shopping for groceries, by adding "deciding what to buy and paying for it," and taking medication, by including "taking the right portion of medication right on time." We do not expect this different wording to affect the comparability of prevalence estimates between China and India, Mexico, Poland, or Romania.

Table 11.3 summarizes the estimated prev-

TABLE 11.3 Individual IADLs (Age 65+)

	Having difficulty					Needing help
	China	India	Mexico	Poland	Romania	Malaysia
Preparing meals	20.49	21.69	8.18	9.64	11.64	25.94
Shopping	17.47	27.25	12.67	16.76	18.64	35.94
Taking medications	9.13	17.81	4.44	5.45	7.66	12.39

Prevalence estimates for China, India, Mexico, Poland, and Romania are weighted
Prevalence estimates for Malaysia are not weighted

alence of having difficulty with each individual IADL, documenting great heterogeneity across countries. While slightly more than 20 percent of individuals aged 65 and older need help preparing meals in India and China, this proportion is only about 10 percent in Mexico, Poland and Romania. Difficulty with shopping for groceries is the most prevalent IADL difficulty across countries, with a prevalence rate ranging from 13 percent in Mexico to 27 percent in India. On the other hand, difficulty taking medications is the least prevalent IADL difficult in each country. Older adults in India exhibit the greatest difficulty, with a prevalence rate of nearly 18 percent, followed by older adults in China and Romania, with a prevalence rate of 9 percent and 8 percent respectively, and older adults in Poland and Mexico, who have prevalence rates at around 5 percent.[2] As far as Malaysia is concerned, the results in the last column of Table 11.3 reveal that more than one third of individuals aged 65 and older need help with shopping for groceries, about a quarter need assistance preparing meals, and slightly more than 10 percent need help with taking medications. It is worth noticing that in Malaysia prevalence rates of needing help with IADL difficulties are much larger than those of needing help with ADL difficulties.

We construct and indicator taking value one if the respondent reports having difficulty with at least one IADL and zero otherwise. Figure 11.3 plots the prevalence of having difficulty with at least one IADL across countries, excluding Malaysia. Older Indians are at the highest risk of experiencing difficulty with an IADL, with an estimated prevalence rate of 36 percent. In comparison, the prevalence of having difficulty with at least one IADL is 9 percentage points lower in China (at 27 percent) and 16 percentage points lower in Romania (at 20 percent). Mexico is the country with the lowest prevalence rate of having an IADL difficulty (about 15 percent). For the MARS dataset, we construct and indicator taking value one if the respondent reports needing help with at least one IADL and zero otherwise. Figure 11.4 shows that around 45 percent of older adults in Malaysia need help with at least one IADL.

FIGURE 11.3 Having difficulty with any one IADL (Age 65+)

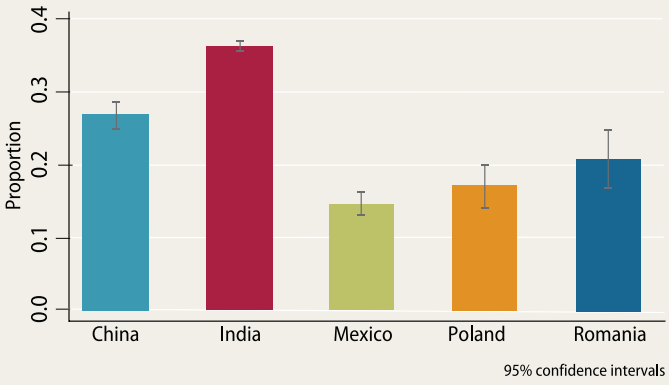
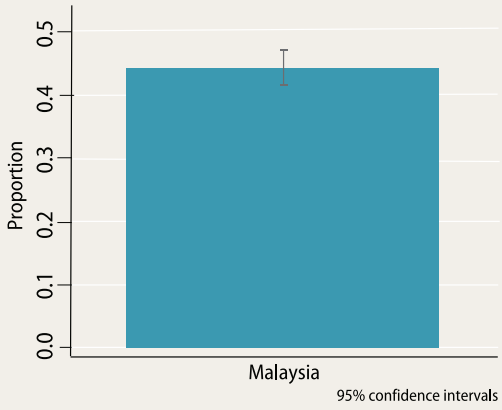


FIGURE 11.4 Needing help with any one IADL (Age 65+)



2 Access to medication is significantly more common in high income countries, which may explain the overall lower prevalence rates than those seen in other IADL activities. While western medicine use has been increasing over time in these countries, traditional medicine is still frequently used and found to have the highest use in India (Oyebode et al., 2016).

Next, we estimate multivariate logistic models relating the indicator for having at least one IADL difficulty (for all countries except Malaysia) and the indicator for needing help with at least one IADL (for Malaysia) to various individuals' characteristics. We perform the estimation of these logistic regressions separately for each country and report the corresponding marginal effects in Table 11.4.

The results in the first five columns of Table 11.4 show that, holding other factors constant, those aged 80 and over are more likely to experience difficulty with any IADL in all countries compared to those aged 65 to 79. The estimated increase in the likelihood of having difficulty with an IADL associated with being 80 and older appears to be highly variable across countries, ranging from 17 percentage points in Mexico and Poland to about 23 percentage points in China, India, and Romania. Women are between 7 and 9 percentage points more likely to experience an IADL difficulty compared to men in China, India, and Mexico, whereas the estimated marginal effect of gender is not statistically different from zero in Poland and Romania. Education is one of the strongest correlates of difficulty with an IADL across countries. Specifically, relative to those with secondary education, individuals with no education are between 9 percentage points (Mexico) and 16 percentage points (Poland) more likely to report an IADL difficulty. Relative to those with secondary education, individuals with only primary education are between 4 percentage points (Mexico) and 13 percentage points (Poland) more likely to report an IADL difficulty. With the exception of Poland, an education gradient is apparent in all countries.

Living in a rural area is associated with a statistically significant increase in the probability of having difficulty with an IADL only in China and India. These are also the two countries where the likelihood of reporting an IADL difficulty is significantly higher at lower levels of household per-capita income decreases. There is no association between household per-capita income and the probability of experiencing an IADL difficulty in Mexico, Poland, or Romania. Similarly, differences in living arrangement are only significantly associated with the probability of having difficulty with an IADL in China and India. interestingly, the estimated marginal effects are rather different in these two countries. In China, living alone is associated with a 9 percentage point decrease in the probability of having difficulty with an IADL relative to those living with at least two other household members; in India, this effect is less sizeable at 4.5 percentage points. In China, living with just one other person is associated with a 4 percentage point decrease in the probability of having difficulty with an IADL relative to those living with at least two other household members; in India, this effect is not distinguishable from zero.

TABLE 11.4 Marginal Effects from Logistic Regressions of Having Difficulty/Needing Help with at Least One IADL

	China	India	Mexico	Poland	Romania	Malaysia[1]
Age (ref: Age 65-79)						
Age 80+	0.233***	0.224***	0.174***	0.168***	0.237***	0.225***
	(0.015)	(0.010)	(0.014)	(0.022)	(0.033)	(0.040)
Gender (ref: Men)						
Women	0.067***	0.089***	0.090***	-0.012	0.036	0.088***
	(0.014)	(0.008)	(0.016)	(0.024)	(0.039)	(0.027)
Education (ref: Secondary or higher)						
No education	0.105***	0.121***	0.089***	0.161***	0.086	0.194***
	(0.022)	(0.012)	(0.030)	(0.054)	(0.058)	(0.037)
Primary education	0.056***	0.053***	0.043	0.133***	0.111***	0.094***
	(0.021)	(0.013)	(0.028)	(0.025)	(0.041)	(0.032)
Urban/rural (ref: Urban)						
Rural	0.033**	0.044***	0.009	-0.002	-0.043	0.070***
	(0.014)	(0.009)	(0.016)	(0.027)	(0.041)	(0.027)

	China	India	Mexico	Poland	Romania	Malaysia[1]
Household income per person (ref: High income)						
Low income	0.082***	0.028***	0.036	0.034	0.020	0.023
	(0.023)	(0.010)	(0.023)	(0.034)	(0.044)	(0.033)
Middle income	0.045*	0.022**	0.025	0.027	0.110***	0.060*
	(0.024)	(0.010)	(0.020)	(0.031)	(0.041)	(0.036)
Missing income	0.054**					0.039
	(0.023)					(0.056)
Living arrangement (ref: Lives with two or more)						
Lives alone	-0.097***	-0.045***	-0.022	-0.048	0.031	0.007
	(0.021)	(0.016)	(0.018)	(0.034)	(0.046)	(0.047)
Lives with one other	-0.040***	-0.006	-0.029	-0.026	-0.042	-0.035
	(0.014)	(0.010)	(0.018)	(0.025)	(0.042)	(0.030)
N	6,967	21,255	6,925	1,205	685	1,375

Standard errors are reported in parentheses.
*, **, *** indicates significance at the 90%, 95%, and 99% level, respectively.
1 The dependent variable for Malaysia is the cumulative number of ADL/IADLs a respondent needs help with, not the number they have difficulty with, as it is for all other countries

Even if the dependent variable of our logistic regression is fundamentally different for Malaysia, we find similar associations as those described for other countries. As can be seen in the last column of Table 11.4, being age 80+ is associated with nearly a 23 percentage point increase in the probability of needing help with an IADL relative to being 65-79 years. Also, women exhibit a 9 percentage point lower likelihood of needing help with an IADL compared to men. Relative to those with secondary education, older Malaysians with no education and only primary education have a 19 and 9 percentage point higher likelihood of needing help with an IADL, respectively. Finally, living in a rural area is associated with a 7 percentage point increase in the probability of needing help with at least one IADL compared to living in an urban area. For Malaysia, we do not detect statistical associations between needing help with an IADL and either household per-capita income or living arrangement.

Level of care need

To proxy for the level/intensity of an individual's care needs, we count the number of ADL and IADL activities that an individual reports difficulty (all countries, excluding Malaysia) or needing help with (Malaysia only). We then estimate a linear regression to gauge the relative importance of different socio-economic factors on this outcome. For this exercise, we limit the sample to those who report at least one difficulty with an ADL or IADL in China, India, Mexico, Poland, and Romania, and to those who report needing help with at least one ADL or IADL in Malaysia. This sample selection criterion is justified by the large number of individuals with no ADL and IADL difficulty.[3] The resulting sample sizes are well above 1,000 for China, India, and Mexico, leaving ample cases within each socio-economic category. For Poland, Romania and Malaysia, sample sizes are more limited. Because of that, the group of individuals with no education is particularly small in Romania and Poland, and so is the group of individuals living alone in Malaysia. These limited cell sizes should be taken into account when interpreting the regression results.

3 Keeping these individuals in the sample would require a different estimation approach, where the probability of having difficulty (needing help) with at least one ADL or IADL is modeled separately from the number of ADLs or IADLs the individuals have difficulty (needs help) with, conditional on this number being strictly positive. Since, we have already performed the former analysis, we only focus on the latter in this section .

FIGURE 11.5 **Average number of cumulative ADL & IADL difficulties (Age 65+ having difficulty with an ADL or IADL)**

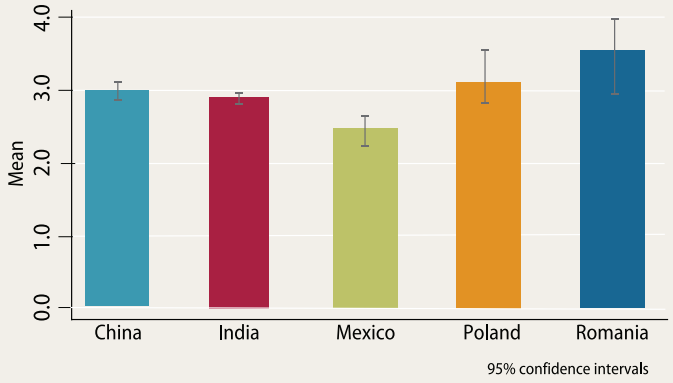


FIGURE 11.6 **Average number of cumulative ADL & IADL needs (Age 65+ needing help with an ADL or IADL)**

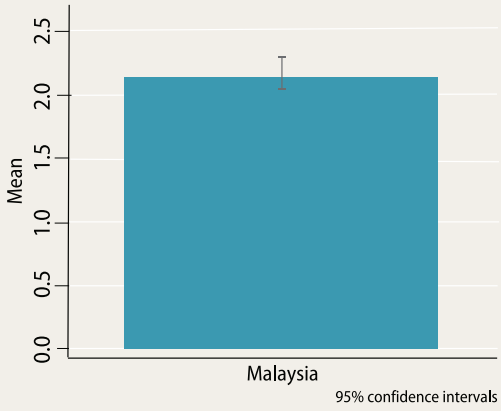


Figure 11.5 shows that, among individuals with at least one ADL or IADL difficulty, Romanians have the highest number across countries, with 3.5 difficulties on average. Poland, China, and India each report an average close to 3 difficulties, while Mexico has an average of 2.5 difficulties. Older Malaysians report needing help with 2.1 activities on average, conditional on needing help with at least one ADL or IADL (Figure 11.6). It is apparent that most individuals who have difficulty or need help with either an ADL or an IADL actually have difficulty or need help with multiple activities.

TABLE 11.5 **Linear Regressions of Count of Cumulative ADL & IADL Difficulties/Help Needs**

	China	India	Mexico	Poland	Romania	Malaysia1
Age (ref: Age 65-79)						
Age 80+	0.893***	1.062***	0.844***	0.091	0.496	1.052***
	(0.135)	(0.071)	(0.180)	(0.319)	(0.488)	(0.196)
Gender (ref: Men)						
Women	-0.178	0.203***	0.193	-0.055	-1.349***	-0.184
	(0.118)	(0.060)	(0.165)	(0.285)	(0.467)	(0.144)
Education (ref: Secondary or higher)						
No education	0.267	0.165*	0.260	0.750	0.539	0.360*
	(0.185)	(0.088)	(0.333)	(0.618)	(1.008)	(0.192)
Primary education	0.145	0.004	-0.003	1.605***	1.743***	0.245
	(0.173)	(0.092)	(0.289)	(0.385)	(0.525)	(0.181)
Urban/rural (ref: Urban)						
Rural	0.066	-0.159**	-0.086	-0.167	0.091	-0.378***
	(0.121)	(0.067)	(0.162)	(0.345)	(0.513)	(0.128)

	China	India	Mexico	Poland	Romania	Malaysia1
Household income per person (ref: High income)						
Low income	0.032	0.479***	0.010	-0.047	0.054	-0.060
	(0.195)	(0.069)	(0.231)	(0.416)	(0.617)	(0.186)
Middle income	-0.061	0.180***	0.334	0.255	-0.450	0.052
	(0.204)	(0.066)	(0.237)	(0.413)	(0.556)	(0.198)
Missing income	-0.151					-0.425*
	(0.199)					(0.217)
Living arrangement (ref: Lives with two or more)						
Lives alone	-0.044	-0.187*	-0.192	-0.456	-0.126	-0.831***
	(0.179)	(0.111)	(0.194)	(0.437)	(0.653)	(0.117)
Lives with one other	-0.056	-0.031	-0.197	-0.092	0.439	-0.174
	(0.116)	(0.025)	(0.200)	(0.368)	(0.525)	(0.162)
Constant	2.700***	2.399***	2.098***	2.610***	3.326***	2.096***
	(0.195)	(0.082)	(0.308)	(0.420)	(0.713)	(0.195)
N	2,610	8,568	1,852	285	149	612

Standard errors are reported in parentheses.
*, **, *** indicates significance at the 90%, 95%, and 99% level, respectively.
[1] The dependent variable for Malaysia is the cumulative number of ADL/IADLs a respondent needs help with, not the number they have difficulty with, as it is for all other countries

The regression results reported in Table 11.5 show great cross-country heterogeneity in which factors may predict the degree of an individual's care needs. Age stands out as one of the most important predictors. On average, individuals aged 80 and over have more difficulties – from 0.5 in Romania to 1 in India – than individuals aged 65 to 79, although the estimated coefficients are not statistically significant for Poland and Romania. Gender is significantly associated with the degree of care needs only in India, where women have 0.2 more difficulties than men, and in Romania, where women have 1.3 fewer difficulties than men. Having lower education is associated with a higher number of difficulties in Poland and Romania, where we estimate that individuals with only a primary education have on average more than 1 additional difficulty than individuals with secondary education. In China, India, and Mexico, there no significant association between education and number of ADL/IADL difficulties. Living in a rural area correlates negatively and significantly with the number of difficulties only in India, where older adults in rural areas have, on average, 0.2 fewer difficulties than their counterparts in urban areas. Similarly, per-capita household income correlates significantly with the number of difficulties only in India, where being in the low and middle income tercile is associated with 0.5 and 0.2 more difficulties than being in the high income tercile, respectively. Living arrangement does not correlate with the number of ADL/IADL difficulties in any country.

The last column of Table 11.5 reports the estimates for Malaysia. In this context, the number of ADLs/IADLs individuals need help with increases significantly with age (1 more activity for those aged 80 and over relative to those aged 65-79) and decreases with living in a rural area (0.4 fewer activities for those in a rural area relative to those in an urban area) and with living alone (0.8 fewer activities for those living alone relative to those living with at least two other household members).

Receipt of care

In this section, we assess the degree to which an individual's care needs are met and by whom. We note that there is significant variability across surveys in the questions eliciting whether a respondent receives care and who provides that care. We distinguish between informal care, usually provided by family members and friends, and formal care, which generally includes hired helpers, government-provided assistance, or nursing home staff.

In CHARLS, Chinese respondents who have difficulty with an ADL or IADL are asked whether

anyone ever helps with that specific activity, and, if someone helps, to indicate the relationship with the people providing help most often. When constructing the harmonized variables, spouse, children, children-in-law, grandchildren, sibling, parents, other relative, and other people are considered to provide informal care, while paid helpers, volunteers, employees of a facility, and the community are considered to provide formal care.

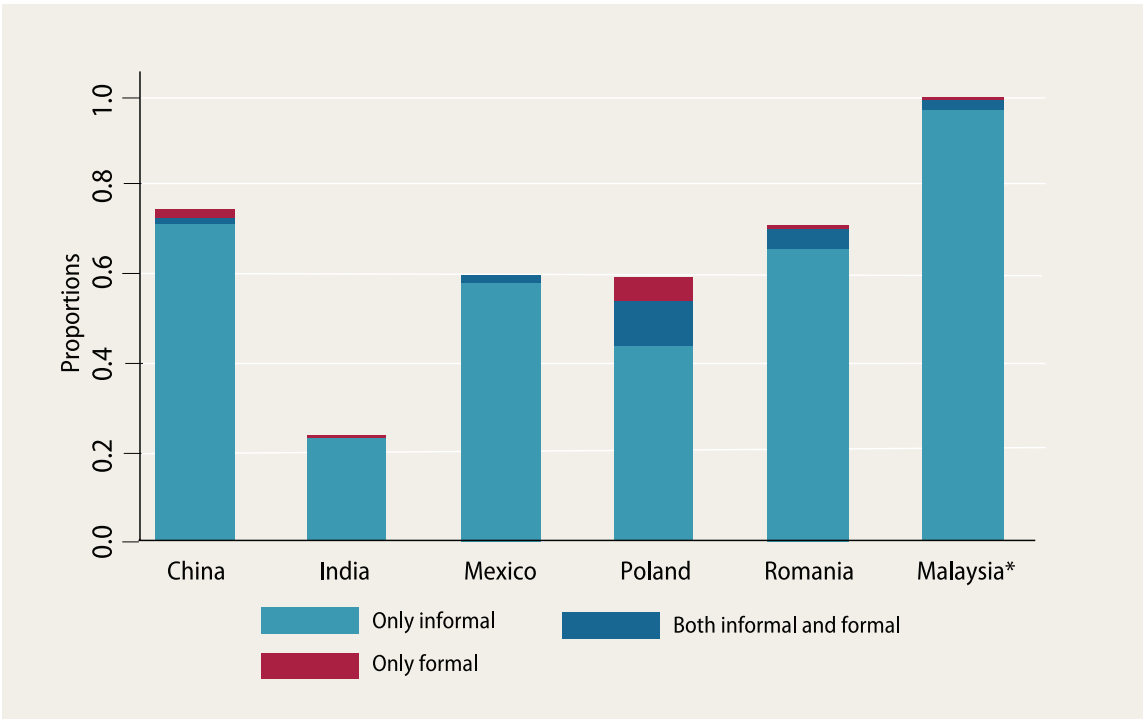
In LASI, Indian respondents who report having difficulty with an ADL or IADL are asked whether anyone helps with those difficulties and to indicate the relationship with the single person who helps them most often. When constructing the harmonized variables, spouse or partner, child, grandchild, parent, sibling, other relative, ex-spouse or partner, and other people are considered to provide informal care, while non-professional paid helpers and professionals (paid or non-paid) are considered to provide formal care. Since LASI only ascertains the relationship with the person providing help most often, it is not possible to determine to what extent the care received by an individual is obtained from informal and formal sources.

In MHAS, Mexican respondents who report having difficulty with an individual ADL or IADL are asked whether someone helps with that specific activity, and, if someone helps, to indicate the relationship with the three people who most help, separately for ADLs and IADLs. When constructing the harmonized variables, spouse, child, child-in-law, grandchild, parent, other relative, and other people are considered to provide informal care, while paid persons are considered to provide formal.

In SHARE, Polish and Romanian respondents are separately asked whether a family member, friend, or neighbor from outside the household has provided help with ADL or IADL in the past year, and whether someone living in their household has helped with ADL in the past year. If they report receiving help, respondents are asked to indicate their relationship with the helpers choosing from a list including spouse/partner, child, child-in-law, grandchild, parent, sibling, other relatives, and several non-relative categories like friend or neighbor. When constructing the harmonized variables, all these categories are classified as informal carers. Respondents are also asked if they have received professional or paid services in their home in the past year for ADL and IADL. In the harmonized variables, this is coded as formal help.

In MARS, Malaysian respondents who report needing at least some help are sometimes asked to report who usually helps with each ADL and IADL. When constructing the harmonized variables, spouse, child, grandchild, and other people are con-

FIGURE 11.7 **Care mix (Age 65+ having difficulty with an ADL or IADL)**



*The subsample for Malaysia is (Age 65+ needing help with an ADL or IADL)

sidered to provide informal care, while domestic maids and professional caregivers are considered to provide formal care. However, it is important to note that in MARS respondents who report needing help with an activity do not have an option to choose "not receiving help" for that activity. Once again, this questionnaire difference makes the MARS' variable measuring care receipt not directly comparable with the measure of care receipt in other studies.

Figure 11.7 shows that, among all individuals who have difficulty with an ADL or IADL, approximately 70 percent of older Chinese and Romanians receive any care, while close to 60 percent of older Mexican and Polish adults receive any care, and only 30 percent of older Indians receive any care. As such, the proportion of older adults with unmet care needs ranges from 30 percent to 70 percent across these countries. The striking difference between India and the other countries suggests that there is a different cultural understanding of family roles so that any help received by an individual with ADL/IADL difficulties is not necessarily recognized as such. As mentioned above, for Malaysia our measure of care receipt is only available for respondents needing help with ADLs/IADLs. For this reason, Figure 11.7 shows that the fraction of individuals receiving help in Malaysia is one. Because of that, Malaysia is excluded from the next set of analyses, which investigates the association between the likelihood of receiving care and socio-demographic characteristics.

TABLE 11.6 Marginal Effects from Logistic models of receiving any care (Age 65+ having difficulty with an ADL or IADL)

	China	India	Mexico	Poland	Romania
Age (ref: Age 65-79)					
Age 80+	0.128***	0.105***	0.188***	0.096	0.203**
	(0.024)	(0.013)	(0.033)	(0.067)	(0.080)
Gender (ref: Men)					
Women	-0.020	0.034***	0.046	0.016	-0.148*
	(0.020)	(0.013)	(0.034)	(0.064)	(0.082)
Education (ref: Secondary or higher)					
No education	0.061**	-0.035*	0.050	0.388***	0.076
	(0.031)	(0.019)	(0.056)	(0.144)	(0.137)
Primary education	-0.038	-0.001	0.052	-0.039	0.200**
	(0.029)	(0.019)	(0.049)	(0.081)	(0.086)
Urban/rural (ref: Urban)					
Rural	-0.019	0.001	-0.022	0.094	-0.142
	(0.020)	(0.013)	(0.034)	(0.068)	(0.087)
Household income per person (ref: High income)					
Low income	-0.062*	-0.062***	0.025	-0.080	-0.120
	(0.034)	(0.015)	(0.043)	(0.084)	(0.101)
Middle income	-0.065**	-0.021	-0.028	-0.047	0.112
	(0.033)	(0.014)	(0.041)	(0.084)	(0.094)
Missing income	-0.073**				
	(0.033)				
Living arrangement (ref: Lives with two or more)					
Lives alone	-0.210***	-0.182***	-0.118***	0.040	0.112
	(0.027)	(0.029)	(0.040)	(0.087)	(0.105)
Lives with one other	-0.032	-0.017	-0.120***	0.033	0.075
	(0.021)	(0.040)	(0.041)	(0.078)	(0.087)
Count of ADL/IADLs	0.078***	0.053***	0.142***	0.077***	0.027*
	(0.006)	(0.002)	(0.015)	(0.017)	(0.015)
N	2,610	8,567	1,851	278	149

In Table 11.6, we estimate logistic regressions relating care receipt for individuals with at least one ADL or IADL difficulty and socio-demographic characteristics, controlling for the number of ADL/IADL difficulties. Not surprisingly, this latter variable correlates positively and significantly with the probability that an individual receives any care. However, the strength of this correlation differs across countries. One more ADL/IADL difficulty is associated with a 14 percentage point increase in the likelihood of receiving care in Mexico, with about an 8 percentage point increase in China and Poland, with a 5 percentage point increase in India, and with only a 3 percentage point increase in Romania (significant at the 10% confidence level). Conditional on the number of ADL/IADL difficulties, relative to being 65-79 years, being aged 80 and over increases the probability of receiving any care from a minimum of 10 percentage points in India and Poland (not significant) to a maximum of 20 percentage points in Romania, with China and Mexico having more intermediate increases of 13 and 19 percentage points, respectively. Being female is associated with a 3 percentage point increase in the probability of receiving any care in India, but not in other countries. The effect of education varies significantly across countries. Relative to those with secondary education, individuals with a lower level of education are between 20 and 40 percentage points more likely to receive any care in Poland and Romania. In China, those with no education are 6 percentage points more likely to receive care relative to individuals with secondary education. In India and Mexico, there is no significant association between education and care receipt. A lower level of per-capita household income is associated with a lower probability of receiving care in China and India, while the income marginal effects for Mexico, Poland, and Romania are not statistically different from zero. Relative to individuals living with at least other two household members, those living alone are 12, 18, and 21 percentage points less likely to receive care in Mexico, India, and China, respectively.

TABLE 11.7 Marginal Effects From Logistic models of receiving formal care (Age 65+ having difficulty with an ADL or IADL)

	China	India	Mexico	Poland	Romania
Age (ref: Age 65-79)					
Age 80+	0.018*	0.002**	0.012	0.093	-0.017
	(0.010)	(0.001)	(0.009)	(0.058)	(0.045)
Gender (ref: Men)					
Women	-0.005	0.003**	0.006	-0.048	0.014
	(0.011)	(0.001)	(0.010)	(0.052)	(0.037)
Education (ref: Secondary or higher)					
No education	-0.005	-0.004**	-0.030*	0.105	0.000
	(0.016)	(0.002)	(0.016)	(0.092)	(.)
Primary education	-0.012	-0.002**	-0.008	-0.023	0.003
	(0.015)	(0.001)	(0.012)	(0.062)	(0.046)
Urban/rural (ref: Urban)					
Rural	-0.023**	-0.002	0.012	-0.014	-0.138***
	(0.010)	(0.001)	(0.011)	(0.049)	(0.045)
Household income per person (ref: High income)					
Low income	-0.005	-0.002	-0.033**	0.059	-0.193***
	(0.014)	(0.001)	(0.013)	(0.067)	(0.069)
Middle income	-0.025	-0.001	-0.029**	-0.002	-0.041
	(0.022)	(0.001)	(0.013)	(0.065)	(0.034)
Missing income	-0.002				
	(0.015)				

	China	India	Mexico	Poland	Romania
Living arrangement (ref: Lives with two or more)					
Lives alone	0.051***	0.003***	0.023	0.099	-0.001
	(0.017)	(0.001)	(0.015)	(0.065)	(0.042)
Lives with one other	0.021	0.000***	0.026	0.013	-0.054
	(0.014)	(0.000)	(0.016)	(0.065)	(0.040)
Count of ADL/IADLs	0.007***	0.000**	0.007***	0.023**	0.017**
	(0.002)	(0.000)	(0.003)	(0.010)	(0.008)
N	2,610	8,561	1,851	282	135

In Table 11.7, we estimate logistic regressions relating the probability of receiving formal care among individuals with at least one ADL or IADL difficulty to socio-demographic factors and the count of ADL/IADL difficulties. The prevalence of formal care receipt is low in all countries: 3 percent in China, less than 1 percent in India, 2 percent in Mexico, 15 percent in Poland, and 6 percent in Romania. Overall, the estimates do not identify very clear patterns across countries, partly due to the extremely low prevalence of formal care receipt in certain countries and, therefore, to the high selectivity of the group receiving formal care. As with the receipt of any care, the count of ADL and IADL difficulties correlates positively and significantly with the probability of receiving formal care. Specifically, in both China and Mexico each additional ADL or IADL difficulty is associated with a 1 percentage point increase in the probability of receiving formal care. In India, women and more educated individuals are more likely to receive formal care. Although significant, these estimated effects reflect tiny increases from an average probability of receiving formal care of less than 1 percent. Living in a rural area is associated with a 14 and 2 percentage point decrease in the likelihood of receiving formal care compared to living in an urban area in Romania and China, respectively. Low income is negatively and significantly associated with a lower likelihood of receiving formal care in Mexico and Romania, but not in other countries. Holding other factors constant, living alone increases the probability of receiving formal care in China and India, relative to living with two or more other people, by 5 and 1 percentage points, respectively.

A SUPPLY SIDE ASSESSMENT CURRENT LTC LANDSCAPE IN LMICS

As shown in the previous section on demand, across LMICs and MICs, familial (or informal) care remains the primary form of care for older persons. As publicly financed LTC is limited, paid care is primarily paid for by older persons and their families out-of-pocket. There is generally limited availability of and access to formal home care services, community-based services (such as adult daycare centers), and institutional services (such as nursing and residential care facilities). In this section, we briefly review and summarize existing evidence on the availability of formal LTC services and delivery systems in selected countries across Asia, Central and South America, Central and Southern Europe and Middle East, supplemented by some evidence from Sub-Saharan Africa.

Availability of LTC services

Asia. Asia is home to several LMICs that have the largest and fast-growing older populations in the world, including China, India, and Indonesia. To varying degrees, formal LTC services are emerging in these countries to fill the void of family based elder care. However, these services are still in the early stage of development, and, far too spotty and fragmented to meet the escalating care needs.

In China, the current LTC landscape, inclusive of public and private actors, has been shaped by government policies, consumer needs, market forces, and tradition. It is characterized by a fast growing residential (institutional) care sector, relatively slow and limited development of home- and

community-based services, shortage of well-trained professional LTC workforce, weak quality regulations, and a lack of organized financing (Feng et al. 2020). Public LTC financing is minimal and largely limited to supporting a narrowly defined group of welfare recipients and subsidizing the construction of residential care beds and operating costs. To address the gaps of unmet LTC needs among the majority of older people outside the means-tested social welfare system, China's primary strategy is to encourage entrance of the private sector in LTC service provision, consistent with the transition of the government's traditional role as direct provider to purchaser and regulator of LTC services (Feng et al. 2012). As of 2020, China had 8.21 million residential care beds registered, or 31 beds per 1,000 people ages 60 (Ministry of Civil Affairs 2021).

More recently, China started piloting public social insurance LTC financing models, and concurrently, programs for integrating healthcare and LTC services in selected locations across the country, though evaluation of the impact and viability of these pilot programs is lagging. The ongoing Long Term Care Insurance (LTCI) pilots signal China's move toward using public social insurance as the core financing strategy for LTC for the broad population, following the same strategy it adopts for financing healthcare. The shortage of well-trained LTC workers and allied health professionals is a major barrier for quality improvement and for effective integration of medical and LTC services (Feng et al. 2020).

In India, families assume the primary responsibility of caring for older people, which is codified in law, as in China. The Maintenance and Welfare of Parents and Senior Citizens Act (passed in 2007) obliges adult children to provide "maintenance"—including food, clothing, medical attendance and treatment—to their parents if in need, and those who do not fulfill this obligation can be prosecuted (Scheil-Adlung 2015). Few formal LTC services such as old age homes, day care centers, residential facilities and domiciliary care services are available, and these services are predominantly provided by private and not-for-profit organizations, although a few public facilities also exist (Rajagopalan et al. 2020). Currently, care homes and residential facilities are largely unregulated, with limited data available on their numbers and characteristics (Harbishettar et al. 2021). Some publicly support-ed LTC services exist but they are scanty and fragmented under the auspices of multiple government programs, such as the Integrated Program for Older Persons, National Program for Healthcare of Elderly, National Mental Health Program, and National Program for Palliative Care (Scheil-Adlung 2015). Public funding for LTC is limited, and as a result, out-of-pocket payment for LTC is the norm among the few who can afford it, leaving the vast majority of older people without access to LTC services.

In Indonesia, the government is responsible for LTC coordination and delivery, including home and community-based care (Asian Development Bank 2021). In 2016, the Indonesian government launched the National Strategic Plan, which stated that government-mandated community health centers were responsible for providing primary health care and LTC for older people, including providing free health check-ups and organizing social activities for older people (Dyer et al. 2019). However, LTC is not yet provided in an integrated and coordinated manner, the minimum requirements for care provision are not met at many state-funded community health centers, and local political commitment and resource availability have limited LTC delivery (Asian Development Bank 2021). There are approximately 277 residential homes for older people, with a capacity of 18,100 beds; of these facilities, 3 are run by the central government, 71 by local governments, and 189 are private (Asian Development Bank 2021). Only a few private organizations provide institutional LTC and some private companies supply day care and equipment services, estimated to support no more than a few thousand older people mainly in urban areas (Asian Development Bank 2021).

In Viet Nam, while the government has issued many policies to support older persons and ensures subsidies and health insurance for those aged 80 and over and for the vulnerable elderly, there is no com-prehensive LTC-based model or national integration of LTC service provision. While the Ministry of Health provides healthcare for the elderly in health-care facilities and communities, LTC service provision mainly supports family care with home-based services. Non-government organizations (NGOs) and the private sector also provide LTC, and paid home care is emerging for supporting older people without the means to pay for private care (Van, Tuan, and Oanh 2021). Residential aged care, including care centers, is not widely available. In 2015-2016, of residential care centers available, 36 percent were public, 36 percent were NGOs or religious providers, and 27 percent were private, of which 82 percent were licensed (Dyer et al. 2019). Nursing homes are mostly located in urban areas and mainly afforded

by the wealthy (Van, Tuan, and Oanh 2021). In Viet Nam, the government provides social assistance payments to older, poorer persons without close family or retirement pensions; however, the number of ben-eficiaries is limited (Dyer et al. 2019).

The LTC system in Thailand prioritizes aging in place and home and community-based care. The government has implemented, alongside local authorities, an integrated home and community-based care model (further described below). Residential LTC is available for those with complex care needs and insufficient caregiving support at home; services for dependent older persons are available at private nursing homes, private hospitals, government residential homes, and homes for poor older persons supported by charitable organizations (Asian Development Bank 2020). In 2016, there were 442 private facilities offering residential LTC services (Asian Development Bank 2020).

Central and South America. Across countries in Central and South America, comprehensive LTC policies and systems are essentially nonexistent. Public funding or direct provision of LTC services is scarce. The private market for senior care is emerging in some countries, with access limited by ability to pay for such care.

In Mexico, there is little public funding for LTC services, and the responsibility for service development rests with the states (OECD 2011). Health care for older people is provided through the Mexican Health System, which also covers all other age groups (Gutiérrez Robledo, López Ortega, and Arango Lopera 2012). The few government-provided services for the elderly that do exist are extensions of poverty reduction or other social service programs. There are few private (for profit and not-for-profit) institutions offering services such as adult daycare and institutional LTC for non-self-sufficient older people without family (OECD 2011).

In Costa Rica, recent policy efforts have attempted to formalize a national LTC system (Matus-Lopez and Chaverri-Carvajal 2022). The government has focused on facilitating access to services, such as long-term residential services, day centers and home care visits, using subsidies to families or non-profit service providers (Inter-American Development Bank 2020c). In 2010, Costa Rica's National Council for Older People established the Progressive Attention Network for Integral Elder Care, aimed at establishing community-based LTC networks nationwide to conduct activities such as training retired teachers to act as unpaid community volunteer pensioners(Lloyd-Sherlock et al. 2017). Private services are increasing but mostly limited to consumers with higher incomes (Inter-American Development Bank 2020c).

In Brazil, there is no federally mandated coverage for the aging population in need of LTC. Through a means-tested system, Brazil provides some public LTC services focused on sheltering people in economic deprivation (Giacomin et al. 2021). Brazil's LTC homes are scarce, public LTC expenditure per older adult is minimal, and it is estimated that at least 600,000 formal LTC workers are needed to fill the gap (Giacomin et al. 2021).

In Argentina, there is little public funding for LTC services. While the government does cover a range of publicly operated services for older persons, these services are fragmented and uncoordinated due to the overlapping of functions and services provided by national, provincial, and mu-nicipal actors (Inter-American Development Bank 2020a). Private schemes are estimated to cover no more than eight percent of older people with higher incomes who can afford access to services provided by private and civil society organizations such as LTC facilities, day centers, rehab centers, and home-care services (Dyer et al. 2019).

Similarly, in Chile, a variety of publicly supported LTC services, including residential care facilities, day centers, and home care, are offered but a nationally organized LTC system is absent (Inter-American Development Bank 2020b). Private services include those provided in residential care settings, home care and support services, day centers, and telecare services, with the non-profit sector, particularly religious organizations, playing a strong role in service provision (Inter-American Development Bank 2020b).

Central and Southern Europe and Middle East. Even though out of all MICs considered in the section on demand, Poland and Romania have the highest proportion of older people with ADLs and IADLs who use formal LTC services, traditional informal care by family members predominates in both countries. At the same time, in response to the growing care needs of the population, formal care organized by the state or private institutions is progressively supplementing traditional informal care provision. In Poland, delivery and financing of formal social care services is mainly the responsibility of local governments, which are obligated by the central government to finance and provide social care services from their local budgets, covering

institutional, community, and home-based care (while the authority representing the central government in local governments has supervisory powers over institutional services). Institutional care for older people is split between the health and social welfare branches. Financing of institutional medical care services provided to eligible individuals is the responsibility of the National Health Fund, while the provision is organized by various (public, as well as for- and not-for-profit) providers. The health and social brunches are not well integrated around the needs of old people or in terms of service provision or financing. Administrators and providers face incentives to transfer patients to the other part of the system (European Commission 2021). Romania has significantly increased its LTC capacity in the last seven years, which allowed local authorities to better identify, assess, and establish eligibility to support older people with care needs. Similar to Romania, it continues to have a fragmented LTC system. Both countries benefited from considerable European-level financial resources, which have been catalytic in encouraging the development of care capacity and supporting expansion into underserved communities. Most of this expansion occurred through private provi-ders entering the market (European Commission 2021).

Similarly, in the MENA region, there is evidence indicating increased demands for a formal LTC market and the emergence of aged care economies within relatively unregulated structures (Hussein 2022). In Türkiye, as in most of the MENA region, care for older people is primarily provided informally by the family and the community (Ismail and Hussein 2021). However, sociodemographic trends, such as changes in family structures, migration, and increases in women's formal employment, are undercutting the availability of such care. There exists LTC at home provided by informally employed domestic and migrant live-in care workers, funded either through cash-for-care schemes or out-of-pocket. Home care is viewed as a culturally appropriate option while residential care is stigmatized. In recent years, the Ministry of Family and Social Policy has piloted some new elderly care interventions such as shared living and elderly care centers, organized by the state for groups of older people to live together with support workers attending to their needs during the day. Since 2010, the Ministry of Health has implemented a new national community-based palliative care program in line with the National Turkish palliative care policy, making Türkiye the only country in the MENA region (besides Israel) to have such policies (Ismail and Hussein 2021).

In Greece, private formal (self-paid) care is widespread and is received by approximately 25 percent of people with needs (World Bank, 2021). Public formal services are also available—the publicly-provided "Help at Home" care is received by 9 percent of elderly with care needs and is increasing with time. Help at Home disproportionally serves the rural population (as compared to private care). About 41 percent of seniors with care needs utilize professional public or formal private care (in most cases in addition to informal care) and there has been an increase in the proportion of seniors who rely on a combination of informal and professional self-paid care (World Bank, 2021).

The Arab region is characterized as having primarily residual social welfare systems that rely heavily on family or community-based social support, especially for social care which has long been neglected in social policy in the region (Hussein and Ismail 2017). Policy attention to LTC needs is scant, given deeply rooted cultural norms emphasizing the role of the family (particularly women) in the elderly care provision and support system. Although informal LTC continues to dominate, there is evidence of increased use of formal care by older people, such as care homes or home care services, which are mostly initiated and covered by civil society and religious organizations, sometimes subsidized by public funds (Hussein and Ismail 2017).

Sub-Saharan Africa. In Sub-Saharan Africa, most organized care is provided in urban areas, and the two most common models for LTC delivery are through charitable organizations (faith-based, civil society or public welfare bodies) or private services for higher-income populations, provided mainly in residential homes (World Health Organization 2017). Institutional care is relatively new and often not available. In Kenya, there were approximately 16 LTC facilities in 2017 and the main providers were religious organizations (Dyer et al. 2019). In South Africa, limited publicly funded LTC exists. Residential care is provided mainly by NGOs or religious organizations, and only 2 percent by government (Dyer et al. 2019).

LTC delivery systems

A variety of LTC provision and delivery models are emerging in LMICs where some forms of formal LTC services exit. As described in the country examples below, these models may serve as useful examples for other countries looking to develop and integrate feasible LTC models.

In China, government-run social welfare homes and residential care facilities continue to function as the traditional safety net by providing housing, full costs of living and LTC services for individuals who qualify as welfare recipients—those who have no ability to work, have no source of income, and have no families or relatives to support them. In rural areas, these individuals are also known as *wubao* (which literally translates as "five guarantees"), for whom the local government guarantees food, clothing, housing, medical care, and burial expenses (Feng et al. 2020). While traditionally these public facilities exclusively served welfare recipients meeting stringent eligibility criteria, over time they have opened doors to private-paying individuals who have the means and who can no longer be cared for at home by family members. Indeed, nowadays private-paying customers make up the majority of the resident population in most government-run residential care facilities in urban areas, although the clientele of rural facilities continues to be dominated by *wubao* elders (Feng et al. 2012).

Over the past 20 years, the number of residential care facilities in the urban private sector has grown rapidly in China, in response to the surge of consumer demands for LTC services and policy support (Feng et al. 2020). This development has been driven by real estate developers, venture capitalists, investors, and other businesses interested in tapping China's booming senior care market. The government has leveraged various financial incentives (e.g., lump-sum subsidies for new constructions and recurrent subsidies for occupied beds) and other preferential policy treatments (e.g., tax breaks, land allotment or leasing, and reduced utility rates) to incentivize entry of the private sector. Ranging from senior apartments to assisted living facilities and retirement communities, these facilities provide various levels of personal care assistance and professional services. Virtually all residents in these facilities are paying privately for the services.

The Chinese national and local governments encourage various types of public-private partnership LTC service delivery models, whereby the government contracts with a competent private-sector company that delivers the desired services or operate a government-built facility, or both (Feng et al. 2020). A similar approach is used for government purchasing of home and community-based services, which are mostly operated by private-sector providers. Under the government-contractor model, resources for organizing in-home care services are allocated by various levels of government, including districts, subdistricts, and local communities. The services are provided to eligible older people residing in these settings, with various levels of government initiating, funding, and supervising these services. The providers are typically engaged through a government procurement process. Most of them are non-profit.

In other MICs, policy efforts and private sector initiatives have put an emphasis on fostering the development of home and community-based LTC services—aptly so to meet older people's needs and preference for such services. In Thailand, for example, through a pilot program established in 2016 and managed by the National Health Security Office and local authorities, the government is working to increase access to, and availability of, home and community-based services. The program operates through a care-management system, providing 2–8 hours of home-based care support a week, depending on need, through caregivers with 70 hours of training who are supervised by a care manager (Asian Development Bank 2020). Medical services, including preventive services and physiotherapy, are also available through the LTC pilot program and the Thailand universal health coverage package (Asian Development Bank 2020). Romania and Poland are also experimenting with expanding their community-based LTC services, with local authorities increasingly commissioning and purchasing services from the rapidly developing and growing private for-profit and not-for-profit sector (European Commission 2019).

Another community-based model of LTC provision and delivery is driven by organizations of older people. In Cambodia, China, India, Indonesia, Nepal, Sri Lanka, Myanmar, and Viet Nam, these are called Older People's Associations (OPAs), which are membership organizations led or managed by older people to facilitate activities and deliver services for older people. By partnering with government service providers, OPAs provide a social protection function which complements existing mechanisms (HelpAge International n.d.). OPAs have been involved in organizing medical check-ups, conducting home

visits, and providing health education for older people. Additionally, OPAs play an important role in campaigning and promoting the interests of older people to policy makers (Petsoulas 2019).

In Kenya, a private nursing agency provides individualized, in-home care from professionals to those who can afford to pay for such care or who have medical insurance that covers home-based care (Petsoulas 2019). While this type of private sector driven model is growing in popularity, gaps in access exist for older people without ability to pay or insurance.

In Tanzania, HelpAge International implemented the Better Health for Older People in Africa program (2014-2017), funded by the Department for International Development of the UK and aimed to improve access to home-based services for poor older people in need. The program, which supported approximately 4,500 older people, was delivered by 425 trained volunteers who were selected in consultation with the local community and supervised by registered nurses and clinical officers (Petsoulas 2019). Within this program, care plans are developed to assist with ADLs and social support programs are provided, such as programs to aid in socialization with other older people and workshops from volunteers to learn about topics such as nutrition (Petsoulas 2019).

The role of government policies

Government stewardship functions across LMICs vary as they are a result of the interaction of numerous factors, such as political and economic contexts, social and cultural factors, as well as existing health and social welfare system structures (Walker and Wyse 2021). The main functions of the government in LTC include policy planning and implementation, regulation through developing and monitoring quality standards and fostering the LTC market, and workforce development. Below, we briefly re-view these themes drawing on the limited experiences of LMICs, with occasional reference to those of HICs, as appropriate.

As noted above, comprehensive LTC policies and systems are not well developed in virtually all LMICs. Many of these countries struggle with a lack of a clear definition of the tasks, roles, and responsibilities of different ministries, agencies, and organizations in caring for older people. As a result, the inappropriate use of acute care hospital services and emergency departments is high among the elderly (Giacomin et al. 2021).

LTC policy planning can include many goals such as analyzing demand and supply, identifying necessary changes for improvements in the system and the reallocation of resources, containing care costs, and improving the quality of services. Described below are select country examples.

Asia. In many countries in Asia and the Pacific, the first legal mention o f LTC was through laws for older people, and several subsequent national policies or plans have used these laws as foundations (Walker and Wyse 2021). For example, in Mongolia, the revised Law for the Elderly in 2017 was the building block for the development of a draft Strategic Plan on Long-Term Care for Elderly led by the Ministry of Labor and Social Protection (Walker and Wyse 2021). In Singapore, LTC was originally included within aging laws covering social welfare, and the current LTC strategy is part of the Successful Ageing framework led by the Ageing Planning Office within the Ministry of Health (Walker and Wyse 2021).

To assist in policy development, governments utilize, to a certain extent, advisory groups and associations for input. In Cambodia, China, India, In-donesia, Nepal, Sri Lanka, Myanmar, and Viet Nam, Older People's Associations (OPAs) play an import-ant role in campaigning and promoting the interests of older people to policy makers (Petsoulas 2019).

In most countries of Asia and the Pacific, LTC is operated in a decentralized or partly decentralized system, and responsibilities for different elements of LTC are divided among national, provincial, city, and local levels (Walker and Wyse 2021). A key question for policymakers in these countries is whether to set up a standalone LTC system or cover LTC within the existing public health care systems (UNESCAP 2018).

Central and South America. In much of Central and South America, aging policy has followed a progression from a charity- to a rights-based approach (Calvo et al. 2019). In Argentina, Chile, and Costa Rica, with continued progress and success in the development of pensions as well as a growing emphasis on older people's rights, aging policy has begun to slowly make its way up the policy agenda (Calvo et al. 2019).

In Argentina, throughout the 2000s, the National Directorate of Policies for Older Adults (DI-NAPAM) was responsible for implementing and coordinating aging policies and supporting the training of aging professionals. The creation of a Federal Council of Older Adults encouraged older

adults' participation in policy design (Calvo et al. 2019). Chile's government followed a similar path. After success in implementing its national pension system in the 1980s, Chile created the National Service for Older Persons (SENAMA), a public, decentralized service located within the Social Development Ministry, responsible for promoting the health, quality of life, rights, and autonomy of older Chileans (Calvo et al. 2019).

Costa Rica is in the midst of creating and implementing a national LTC system and is one of the first middle-income countries to do so. Th e LTC system consists of three benefits, including c are services, cash for care (only in specific cases), and caregiver training (Matus-Lopez and Chaverri-Carvajal 2022). The Ministry of Human Development is responsible for establishing the guidelines and organizing the system while it is implemented by different public institutions working in social, health care, labor, and educational areas. The system is funded through general tax revenues and copayment and is centralized in that local governments do not participate in the design or financing of the program.

Central and Southern Europe and Middle East. Romania currently embarked on far-reaching reforms of LTC services with the main stated priority to develop home care and day care services at a community level and to increase the availability of public residential institutions. It is envisaged that the share of funds from the state budget provided to local authorities for social services for older people would increase and the flow of funds change according to the principle that funding follows beneficiaries. LTC reforms are part of a broader package to develop integrated community social services and ensure the availability of qualified social workers, especially in rural areas (World Bank 2022). Poland is making major strides in improving the quality of LTC (Ministry of Finance of Poland, 2021).

In the Middle East too, there has been some re-cent acknowledgement that policies and strategies should be put in place to address the need for for-mal LTC provision (Ismail and Hussein 2021, Hus-sein and Ismail 2017). Recent developments such as cash-for-care schemes and social assistance schemes are a result of these discussions. These efforts are framed mainly within the traditional family-based care structure with the goal of enabling the family to continue caring for older relatives. For example, Türkiye has developed plans to address LTC within the context of maintaining the family's central role and ensuring care delivery at home and in the community. The most recent aged care plan (2017) prioritized home-based care services with responsibilities at the municipal level (Ismail and Hussein 2021).

Sub-Saharan Africa. LTC policy development is lagging in Sub-Saharan Africa, relative to other parts of the world. However, countries in this region have begun to form a range of policy frameworks encompassing aspects of LTC, both directly and indirectly, including older person focused conditions in policies or constitutions, dedicated bills on older adults or, as in Tanzania and Zimbabwe, national strategies on healthy ageing (Aboderin 2019).

Examples of government mechanisms for quality monitoring from HICs include inspection, regulation, and/or reliance on market forces. England and Australia utilize inspection-based surveillance of LTC services against certain standards. The US and Canada utilize data measurement or public reporting as a driver of market forces to maintain quality. Across these countries, the main responsibility for regulating quality remains with government (Mor, Leone, and Maresso 2014).

Governments can play a multitude of roles in ensuring availability and accessibility of services. These include directly providing care, acting as a purchaser of services from qualified providers, and playing a role in fostering LTC markets (Walker and Wyse 2021). The capacity of governments to foster markets and develop public-private partnerships is dependent on their ability to develop contracts, set prices, and monitor and supervise private-sector providers (Block et al. 2009). Governments can also assist providers through subsidies and grants.

It is also important to strike a balance between the government function of regulation and regulation from market forces. In the US, the government plays a large role in regulation within the LTC industry to maintain a minimum level of quality of care and to provide incentives to improve quality, including regulations pertaining to receipt of payment, staffing requirements, and the monitoring and enforcement of care standards (Grabowski 2008). Simultaneously, public reporting of health care quality data can inform consumer choice. For example, Nursing Home Compare is a recognized resource that reports the ratings of nursing homes in the US; however, it has been subject to scrutiny due to reliance on self-reported data. As is the case in many European countries as well as in the US, public reporting mechanisms are more often focused on institutional care.

Another critical function of the government within LTC systems is to build and sustain workforce development. The success of LTC systems is, to a large extent, dependent on the capacity of the workforce and therefore investment in enhancing the skills of the workforce is imperative. The lack of a qualified and professional workforce in LTC is a common challenge across all LMICs. As is the case in China, there is an urgent need for the government to increase investment substantially in education and training programs not only to upgrade the skills of direct care workers on the frontline but also to produce a cadre of multidisciplinary professionals, such as geriatricians, pharmacists, therapists, dieticians, nurses, social workers, case managers, and LTC facility administrators (Feng et al. 2020).

DISCUSSION AND POLICY CONSIDERATIONS

Through presented analysis and review, we identify several prominent findings and themes concerning the current LTC landscape across LMICs. Below, we discuss them and suggest potential policy options for LTC policymakers in these countries to consider.

First, there is evidence of large gaps between rising LTC needs on the demand side and the lack of formal LTC provision on the supply side across LMICs, and it is imperative to increase government policy interventions to address these gaps. The prevalence of having difficulty with at least one ADL or IADL and therefore needing help varies across LMICs and MICs countries considered here, but nowhere is it below 15 percent of the 65 and older group. As data for more LMICs become available, future research should continue investigating the demand for LTC to better understand the needs and the gaps in low-income settings. It is evident from the presented analysis, however, that LTC pro-vision in LMICs has continually relied on the family as primary caregivers. On a broad scale, this has made sense and continues to make sense, given the lack of formal LTC infrastructure and support avail-able to the majority of older people and the fact that family members know their loved ones and their needs best. Some countries, including Algeria, Argentina, Brazil, Chile, China, India, Mexico, Russia, and Türkiye have gone as far as legalizing and man-dating adult children's responsibility of taking care of their elderly parents (Scheil-Adlung 2015). The issue with such mandates is that they do not always take into account the capacity of the family caregivers and may result in caregiver burden in the form of physical and emotional health, social life, and financial status, particularly for women. The enforce-ability of such laws is also questionable (Feng 2019).

The centrality of family caregiving is not exclusive to LMICs. Family caregiving is just as widespread in developed countries (European Commission and Zigante 2018), and indeed, it is an integral component of any LTC system (Villalobos Dintrans 2020). The difference though is that most developed countries provide some form of retirement incomes to finance elderly care and have policies to support caregivers as well as home and community-based services to alleviate part of the caregiver burden. In some developed countries, such as Germany, family caregiving has been integrated into the LTC insurance system. Family caregiving is undeniably an unreplaceable and effective method of caring for the elderly but LMICs must adopt policies to support caregivers so that family caregivers can continue to fulfill this role without having to sacrifice their own needs. Policymakers in LMICs should develop and implement policies to increase formal LTC service provision and support when family care is insufficient or absent.

Because the provision of elder care by family members is a feature of the intergenerational social contract deeply rooted in cultural values in most LMICs, public policies should not discourage it. Public policies should provide meaningful and affordable options to families so that they can decide whether elderly care will be supplied within the family or whether they will seek it in the market. This is especially important for the middle class because the poor can typically access last-resort and safety net programs, while the rich can afford to pay for high-end services. The middle-class, which represents the majority of the population, must often contend with the "missing market" of affor-dable quality care. The absence of affordable care can lead to spending down savings, the loss of market wages for care-givers, and an increased need for medical care for physical and mental illnesses for both the caregivers and care recipients. This is why having a LTC market with a continuum of care is important. Furthermore, government involvement in elderly care is necessary,

primarily through stewardship, including support to qualified service providers and subsidies to eligible care recipients. The actual provision of care can come from a combination of the private formal and semi-formal sectors as well as from family members.

Ultimately, a hybrid system of informal and formal LTC services would be ideal for LMICs. While informal caregiving can have negative effects on the labor market, the income-generating capacity of families, and the health of caregivers, informal caregivers also help contain the formal LTC system's costs (Villalobos Dintrans 2020). When designing the proper mix of formal and informal elements of LTC provision, policy-makers should seek information for guidance by approaching questions such as: what kinds of needs exist in the population and what kinds of services are in demand; how the system can take into account families' preferences; how much money is available to finance the system; and how the design of the LTC system affects caregivers' behaviors (Villalobos Dintrans 2020). Policy makers in LMICs should begin with a review of needs before developing a clear agenda of priorities and strive to create a balanced LTC system of mixed services that reflects older people's preferences and needs.

Second, it is necessary to engage the private sector in developing LTC services, markets, and delivery systems in LMICs; at the same time, it is essential to strengthen government stewardship for clear guidance on rules of engagement as well as quality assurance and the regulatory capacity to enforce them. Most countries, including HICs and LMICs, have opted to contract out LTC services fully or partially to private non-profit, or for-profit organizations. The global trend is a move away from direct public provision of services. Where public funding is involved, the public-private partnership is a commonly used mechanism for the engagement of private sector service providers in the LTC system, as is the case in China.

We suggest two concepts of LTC delivery models for policymakers in LMICs to consider, which are expected to alleviate financing and supply constraints for service provision. One is opening existing public welfare homes and residential aged care facilities to self-paying individuals and providing them with enhanced quality services. These public facilities will continue to serve their traditional clients (welfare recipients) and receive government support to do so while strengthening their revenue base through cross-subsidization from private-paying clients. This model is widely used in China and has recently been implemented in some facilities in Viet Nam. Another concept is utilizing government-owned buildings and other fixed assets to develop concessional arrangements with private providers contracted to operate them as aged care facilities. Providers would set prices, establish fees, and collect revenues from their clients. The government will use concession fees to in-fluence the pricing policies of these providers. These concessions can be leveraged to develop government assets as institutional care facilities with nursing, re-habilitation, palliative, or/and hospice services, which may also provide day services and home-based care for nearby communities. This model is widely used in Singapore and is increasingly visible in China. Because the bricks and mortars of these facilities are under the firm control of government ownership, this model has one distinct advantage of forestalling accurate estimate speculation for profiteering which is a longstanding concern in countries, such as the US, where private equity firms are actively involved in LTC facility ownership (Braun et al. 2021).

Given the increasing role of the private sector in the LTC system, policymakers in LMICs should be wary of the possible risk and unintended con-sequences coming with it. A trend observed in the US and in many European countries is the privatization of LTC provision (Bergman et al. 2016, Stolt, Blomqvist, and Winblad 2011, Polivka and Luo 2019), particularly in the nursing home industry. Privatization involves the move to private (most of-ten for-profit) delivery of services and managerial practices, as well as an increasing emphasis on "responsibilization"—a transfer of care responsibilities to individuals and their families (Armstrong, Arm-strong, and Bourgeault 2020). Privatization can have benefits, including prices being driven competitively in a free market economy rather than controlled by the government, resulting in higher spending but also greater investment in healthcare, providing potential for growth, development, and improved qual-ity (Donaldson 2018). The drawbacks of privatization can include higher costs, diminished access, less efficiency, the potential for lower quality of care, and loss of public control over vital services (Polivka and Luo 2019). Thus, it is crucial for the government to retain the supervising and stewardship responsibility while delegating the actual service provision and production activity to the private sector.

Developing effective regulatory frameworks takes time and resources. In LMICs, regulatory oversight is often lacking and constitutes a low pri-ority on the policy agenda. While the LTC infra-

structure and markets are emerging and growing fast in some countries like China, regulation is lagging behind. The development of regulatory frameworks can be helped with increased public financing of LTC services whereby the government, with a greater stake in the reimbursement system, can be better positioned to demand regulatory compliance and quality assurance from providers (Feng 2019). By playing an active role in purchasing services and allowing the private sector to be service providers, the government ensures that the private sector has some stake in ensuring quality of services as well.

Third, the lack of organized financing is a major impediment to both the development of and access to affordable LTC services in LMICs; policymakers in these countries should take steps aimed at establishing a systematic approach to public LTC financing, ideally following a broad-based social insurance model. In many LMICs, new forms of elder care options outside the familial sphere are emerging in the public sector and private market, but both access to and affordability for such options remain limited, largely due to the absence of organized financing, particularly public financing for LTC. As limited public support is available, in virtually all LMICs eligibility is narrowly defined and typically restricted to a small number of public welfare recipients who are poor and disabled, without family or otherwise among society's most vulnerable members, through strict means-tests. As such, insufficient public funding for LTC results in high private expenditure in the form of out-of-pocket payments, access gaps, and inequalities (Scheil-Adlung 2015).

When considering financing options, policy makers in LMICs should be aware that private or commercial LTC insurance plays a minimal (or supplemental at best) role even in HICs with mature LTC systems, so this is unlikely to be a viable option. Instead, they should aim to develop a systematic approach to public LTC financing, ideally following a broad-based, universal-coverage social insurance model similar to those adopted in Germany, Japan, and Korea (Feng and Glinskaya 2020). China's LTC insurance pilots will also offer important lessons as they develop. As with health care and income support for older people, this approach recognizes that LTC needs represent a normal life risk that the vast majority of people cannot address on their own. The guiding principles for building towards such a comprehensive financing model are equity, fiscal sustainability, and efficiency. Based on these principles, policy makers in LMICs could consider taking the following steps and strategies.

In the initial stages, financing from general tax revenue is sensible. These public funds should first finance programs that provide a safety net for older persons in need and programs for disease prevention and healthy aging. Once resources increase for the financing of services to help older adults needing assistance with ADLs and IADLs, these resources should be targeted at those with greater needs in terms of frailty and disability. Income considerations are also important, prioritizing those with lower income. Gradually, eligibility expansion can lead to coverage expansion.

An important issue in developing a robust public LTC financing system is the division of responsibilities between the central and local governments. A centralized system is best for ensuring horizontal equity but can be less responsive to local conditions, needs, and traditions. A more decentralized approach risks creating or institutionalizing disparities across regions and individuals and may result in inefficiencies as each geographic unit designs and manages its own system. On balance, a co-sharing arrangement between the national and local authorities is likely to prove most efficient and equitable.

On the supply side, public financing for the LTC system will also require supporting providers through subsidies. Furthermore, procuring their services through competitive bid processes will greatly improve the efficiency of both the overall system and of public expenditures. In designing financing of service providers, explicit linkages between financing and delivery models—in-home, community-based, and institutional—are critical. The gold standard is *aging in place*, but many countries face enormous residual challenges in containing public expenditures because they initially funded residential care facilities and beds, which heavily skewed their LTC systems toward institutional care rather than home or community-based services.

Demand-side subsidies (e.g., vouchers and cash allowances) are effective instruments for increasing purchasing capacity of the poor and those with greater needs. They are also compatible with promoting *aging in place*, for example, if vouchers can be redeemed for home- and community-based care. Financial incentives to promote *aging in place* can also include subsidies for informal care provision (e.g., respite care or vouchers that can be redeemed by family caregivers). Overall, the role of demand- and supply-side financing must be balanced. International experiences show that to develop an effi-

cient and equitable LTC market both are needed. The principle of "money following people" should be followed when channeling financing to providers, rather than subsidizing land, utilities, or beds.

LTC financing models should also encourage integration in service delivery across health and social services. It would be premature to include LTC in the package of basic health services because its coverage remains shallow in most LMICs. Instead, it is more realistic to initiate the development of a basic package of LTC services, and pilot it with external financing so as to develop a robust understanding of the implied costs and benefits.

In addition, cost sharing and private spending are important components of sustainable LTC financing in all countries. Private spending can play two important roles—providing additional resources to publicly funded services and growing the market share served by the private sector. Both should be encouraged by the government.

Lastly, drawing on the experiences of HICs, policy makers in LMICs should consider multipronged strategies to build and strengthen the LTC workforce and to support family caregivers. Some examples are discussed below.

Enacting policies to support training, including creating career pathways to allow workers to advance to positions of increased responsibility and higher wages. Many states in the US have implemented different workforce development policies tied to wage increases, including increasing wages if the worker obtains a specific number of hours of training and works in the field for a certain number of years. By giving them added responsibility and autonomy, workers may be motivated to remain in the job or encourage others to seek these positions (Stone and Wiener 2001). Germany has recently increased public funding for the third and last year of training of older workers who want to change career into LTC, where it previously only paid for the first two years (Colombo et al. 2011). In Japan, LTC training is free for job seekers and is organized through the Public Employment Services ("Hello Work"). It includes training at specialized private institutions or training schools. Even though LTC trainees constitute around 10 percent of total trainees, their employment in the LTC sector is high (Colombo et al. 2011).

Improving recruitment and retention of LTC workers. Issues with staffing shortages and high turnover are not unique to LMICs. Many OECD countries have developed and implemented measures to improve recruitment and retention in the LTC sector, including publicly funded training, increases in wages and benefits, and improvements in working conditions (Colombo et al. 2011). In Japan, for example, providers receive subsidies for introducing LTC equipment, such as lifts, that promote welfare and reduce the burden of care workers (Colombo et al. 2011).

Supporting informal caregivers. Monetary compensation or financial support to informal caregivers recognizes the value of informal care. Still, it should not be the only policy for caregivers as total reliance on informal caregiving may hinder professionalism or incentivize the creation of unregulated markets (Villalobos Dintrans 2020). Instead, these benefits should be combined with in-kind services, such as respite care and labor policies, to allow the participation of caregivers in the formal labor market (Villalobos Dintrans 2020). Supporting and increasing the capacity of informal caregivers should be a priority to address inequality and the disproportionate burden on women (World Health Organization 2020a). The need for supporting family caregivers for persons living with dementia is particularly acute, given the rapid increase of older people with Alzheimer's disease and related disorders in LMICs.

We conclude with a cautionary note that there never exists an ideal LTC system that works in all countries. However, to address impending aging and LTC policy challenges, there is much for policy makers in LMICs to learn from the LTC systems in HICs. The World Health Organization has recently promoted an integrated continuum of LTC framework to guide all countries toward establishing person-centered, primary health care driven, and integrated delivery systems encompassing the full range of acute, post-acute, and LTC services in a continuum (World Health Organization 2021a). The care continuum should also include palliative care and end-of-life care. Person-centeredness implies and requires the delivery of care and services at or near the place where older people live, consistent with their preference for *aging in place*. At present, such integrated LTC service provision and delivery models largely remain a concept in most LMICs. Nevertheless, aided by cross-country learning and a growing knowledge base from international LTC research, leapfrogging can be achievable through the adoption and adaptation of international best practices.

REFERENCES

1. Aboderin, Isabella. 2019. "Toward a Fit-for-purpose Policy Architecture on Long-term Care in Sub-Saharan Africa: Impasse and a Research Agenda to Overcome it." *Journal of Long-Term Care*:119–126.
2. Al-Janabi, Hareth, Fiona Carmichael, and Jan Oyebode. 2018. "Informal care: choice or constraint?" *Scandinavian Journal of Caring Sciences,* 32(1), 157–167. https://doi.org/10.1111/scs.12441
3. Allotey, Pascale, Tamzyn Davey, and Daniel D. Reidpath. 2014. "NCDs in low and middle-income countries - assessing the capacity of health systems to respond to population needs." *BMC Public Health* 14 Suppl 2:S1. doi: 10.1186/1471-2458-14-S2-S1.
4. Armstrong, Pat, Hugh Armstrong, and Ivy Bourgeault. 2020. "Privatization and COVID-19: A Deadly Combination for Nursing Homes." In *Vulnerable: The Policy, Law and Ethics of COVID-19*, edited by Colleen Flood, Vanessa MacDonnell, Jane Philpott, Sophie Thériault and Sridhar Venkatapuram, 447-462. University of Ottawa Press.
5. Asian Development Bank (ADB). 2020. Country Diagnostic Study on Long-Term Care in Thailand.
6. _____. 2021. Country Diagnostic Study on Long-Term Care in Indonesia.
7. Bergman, Mats A., Per Johansson, Sofia Lundberg, and Giancarlo Spagnolo. 2016. "Privatization and quality: Evidence from elderly care in Sweden." *J Health Econ* 49:109-19. doi: 10.1016/j.jhealeco.2016.06.010.
8. Block, Miguel Angel, Adetokunbo Lucas, Octavio Gomez-Dantes, and Julio Frenk. 2009. "3.3 Health policy in developing countries." In *Oxford Textbook of Public Health*, edited by Roger Detels, Robert Beaglehole, Mary Ann Lansang and Martin Gulliford. Oxford University Press.
9. Braun, Robert Tyler, Hye-Young Jung, Lawrence P. Casalino, Zachary Myslinski, and Mark Aaron Unruh. 2021. "Association of Private Equity Investment in US Nursing Homes With the Quality and Cost of Care for Long-Stay Residents." *JAMA Health Forum* 2 (11):e213817-e213817. doi: 10.1001/jamahealthforum.2021.3817.
10. Calvo, Esteban, Maureen Berho, Mónica Roqué, Juan Sebastián Amaro, Fernando Morales-Martínez, Emiliana Rivera-Meza, L M Robledo, Elizabeth Caro López, Bernardita Canals, and Rosa Kornfeld. 2018. 2019. "Comparative analysis of aging policy reforms in Argentina, Chile, Costa Rica, and Mexico." *J Aging Soc Policy* 31 (3):211-233. doi: 10.1080/08959420.2018.1465797.
11. Carretero, Stephanie, Jorge Garcés, Francisco Ródenas, and Vicente Sanjosé. 2009. "The Informal Caregiver's Burden of Dependent People: Theory and Empirical Review." *Archives of Gerontology and Geriatrics* 49 (1): 74–79. https://doi.org/10.1016/j.archger.2008.05.004.
12. Chauhan, Shekhar, Shubham Kumar, Rupam Bharti, and Ratna Patel. 2022. "Prevalence and determinants of activity of daily living and instrumental activity of daily living among elderly in India." *BMC Geriatr* 22 (1):64. doi: 10.1186/s12877-021-02659-z.
13. Clark, Robert L., Richard V. Burkhauser, Marilyn Moon, Joseph F. Quinn, and Timothy Smeeding. 2004. *The Economics of an Aging Society*. Wiley-Blackwell.
14. Colombo, Francesca, Ana Llena-Nozal, Jérôme Mercier, and Frits Tjadens. 2011. "Help Wanted? Providing and Paying for Long-Term Care." OECD Health Policy Studies. Paris: OECD Publishing.
15. Dominguez, Jacqueline, Leo Jiloca, Krizelle Cleo Fowler, Ma. Fe De Guzman, Jhozel Kim Dominguez-Awao, Boots Nativ-idad, Jeffrey Domingo, et al. 2021. "Dementia Incidence, Burden and Cost of Care: A Filipino Community-Based Study." *Frontiers in Public Health* 9 (May). https://doi.org/10.3389/fpubh.2021.628700.
16. Donaldson, Benjamin S. 2018. "The Financial Ethics of Healthcare Privatization: United States vs. the United Kingdom." *Moral Cents* 7 (2):13-26.
17. Dyer, Suzanne M., Madeleine Valeri, Nimita Arora, Tyler Ross, Megan Winsall, Dominic Tilden, and Maria Crotty. 2019. *Review of International Systems for Long-Term Care of Older People: Report prepared for the Royal Commission into Aged Care Quality and Safety: Research Paper 2*. Adelaide, Australia: Flinders University.
18. Edemekong, Peter F., Deb L. Bomgaars, Sukesh Sukumaran, and Shoshana B. Levy. 2020. "Activities of Daily Living." PubMed. Treasure Island (FL): StatPearls Publishing. 2020. https://pubmed.ncbi.nlm.nih.gov/29261878/.
19. European Commission 2019 Joint *Report on Health Care and Long-Term Care Systems and Fiscal Sustainability – Country Documents 2019 Update* . https://economy-finance.ec.europa.eu/publications/joint-report-health-care-and-long-term-care-systems-and-fiscal-sustainability-country-documents-2019_en.
20. European Commission. 2021. *Long-term care report : trends, challenges and opportunities in an ageing society. Volume I*. Luxembourg: Publications Office.
21. European Commission, and V Zigante. 2018. Informal care in Europe: Exploring formalisation, availability and quality. European Commission, Directorate-General for Employment, Social Affairs and Inclusion.
22. Feng, Quishi, Zhihong Zhen, Danan Gu, Bei Wu, Pamela W. Duncan, and Jama L. Purser. 2013. "Trends in ADL and IADL disability in community-dwelling older adults in Shanghai, China, 1998-2008." *J Gerontol B Psychol Sci Soc Sci* 68 (3):476-85. doi: 10.1093/geronb/gbt012.
23. Feng, Zhanlian. 2017. "Filial piety and old-age support in China: tradition, continuity, and change." In *Handbook on the Family and Marriage in China*, edited by Xiaowei Zang and Lucy Xia Zhao, 266-285. Edward Elgar Publishing.
24. Feng, Zhanlian. 2019. "Global Convergence: Aging and Long-Term Care Policy Challenges in the Developing World." *J Aging Soc Policy* 31 (4):291-297. doi: 10.1080/08959420.2019.1626205.
25. Feng, Zhanlian, and Elena Glinskaya. 2020. "Aiming Higher: Advancing Public Social Insurance for Longterm Care to Meet the Global Aging Challenge Comment on "Financing Long-term Care: Lessons From Japan."" *Int J Health Policy Manag* 9 (8):356-359. doi: 10.15171/ijhpm.2019.121.
26. Feng, Zhanlian, Elena Glinskaya, Hongtu Chen, Sen Gong, Yue Qiu, Jianming Xu, and Winnie Yip. 2020. "Long-term care system for older adults in China: policy landscape, challenges, and future prospects." *The Lancet* 396 (10259):1362-1372.
27. Feng, Zhanlian, Chang Liu, Xinping Guan, and Vincent Mor. 2012. "China's rapidly aging population creates policy challenges in shaping a viable long-term care system." *Health Aff (Millwood)* 31 (12):2764-73. doi: 10.1377/hlthaff.2012.0535.
28. Ferri, Cluesa P., and K. S. Jacob. 2017. "Dementia in low-income and middle-income countries: Different realities mandate tailored solutions." *PLoS Med* 14 (3):e1002271. doi: 10.1371/journal.pmed.1002271.
29. Giacomin, Karla Cristina, Paulo José Fortes Villa Boas, Marisa Accioly Rodrigues da Costa Domingues, and Patrick Alexan-

der Wachholz. 2021. "Caring throughout life: peculiarities of long-term care for public policies without ageism." *Geriatr Gerontol Aging* 15:e0210009. doi: https://doi.org/10.5327/Z2447-21232021EDITESP.
30. Grabowski, David C. 2008. "The market for long-term care services." *Inquiry* 45 (1):58-74.
31. Gutiérrez Robledo, Luis Miguel, Mariana López Ortega, and Victoria Eugenia Arango Lopera. 2012. "The State of Elder Care in Mexico." *Current Geriatrics Reports* 1 (4):183-189. doi: 10.1007/s13670-012-0028-z.
32. Gyasi, Razaq M., and David R. Phillips. 2020. "Aging and the Rising Burden of Noncommunicable Diseases in Sub-Saharan Africa and other Low- and Middle-Income Countries: A Call for Holistic Action." *Gerontologist* 60 (5):806-811. doi: 10.1093/geront/gnz102.
33. Harbishettar, Vijaykumar, Mahesh Gowda, Saraswati Tenagi, and Mina Chandra. 2021. "Regulation of Long-Term Care Homes for Older Adults in India." *Indian J Psychol Med* 43 (5 Suppl):S88-S96. doi: 10.1177/02537176211021785.
34. HelpAge International. n.d. "Older People's Association (OPAs): Strengths and Key Factors for Sustainability and Replication." HelpAge Briefing. Thailand: HelpAge International. https://www.helpage.org/silo/files/older-people-s-associations-in-asia--strengths-and-key-factors-for-sustainability-and-replication.pdf.
35. Holmes, Wendy. 2021. Projecting the Need for and Cost of Long-Term Care for Older Persons. In *ADB Sustainable Development Working Paper Series (No. 74)*: Asian Development Bank.
36. Hu, Jianhui. 2012. "Old-Age Disability in China: Implications for Long-Term Care Policies in the Coming Decades." Pardee RAND Graduate School.
37. Hussein, Shereen and Mohamed Ismail. 2017. "Ageing and Elderly Care in the Arab Region: Policy Challenges and Opportunities." *Ageing Int* 42 (3):274-289. doi: 10.1007/s12126-016-9244-8.
38. Hussein, Shereen. 2022. Ageing Demographics in the Middle East and North Africa: Policy Opportunities and Challenges. Report prepared for the World Bank.
39. Inter-American Development Bank (IDB). 2020a. Panorama of Aging and Long-Term Care: Argentina.Washington, D.C.: Inter-American Development Bank.
40. _____. 2020b. Panorama of Aging and Long-Term Care: Chile. Washington, D.C.: Inter-American Development Bank.
41. _____. 2020c. Panorama of Aging and Long-term Care: Costa Rica. Washington, D.C.: Inter-American Development Bank.
42. Ismail, Mohamed, and Shereen Hussein. 2021. "An Evidence Review of Ageing, Long-Term Care Provision and Funding Mechanisms in Turkey: Using Existing Evidence to Estimate Long-Term Care Cost." *Sustainability* 13 (11):6306.
43. Kazibwe, Joseph, Phuong B. Tran, and Kristi S. Annerstedt. 2021. "The household financial burden of non-communicable diseases in low- and middle-income countries: a systematic review." *Health Res Policy Syst* 19 (1):96. doi: 10.1186/s12961-021-00732-y.
44. Kedare, Jahnavi, and Chetan Vispute. 2016. "Research priorities for cognitive decline in India." *Journal of Geriatric Mental Health* 3 (1):80-85. doi: 10.4103/2348-9995.181923.
45. Lestari, Septi K., Nawi Ng, Paul Kowal, and Ailiana Santosa. 2019. "Diversity in the Factors Associated with ADL-Related Disability among Older People in Six Middle-Income Countries: A Cross-Country Comparison." *Int J Environ Res Public Health* 16 (8). doi: 10.3390/ijerph16081341.
46. Li, Jia, and Yajun Song. 2019. "Formal and Informal Care." In Encyclopedia of Gerontology and Population Aging, edited by Danan Gu and Matthew E. Dupree, 1–8. Springer, Cham. https://doi.org/10.1007/978-3-319-69892-2_847-1
47. Li, Chaofan, Rui Zhou, Nengliang Yao, Thomas Cornwell, and Shuangshuang Wang. 2020. "Health Care Utilization and Unmet Needs in Chinese Older Adults With Multimorbidity and Functional Impairment." *J Am Med Dir Assoc* 21 (6):806-810. doi: 10.1016/j.jamda.2020.02.010.
48. Lloyd-Sherlock, Peter, Anne M. Pot, Siriphan Sasat, and Fernando Morales-Martinez. 2017. "Volunteer provision of long-term care for older people in Thailand and Costa Rica." *Bull World Health Organ* 95 (11):774-778. doi: 10.2471/BLT.16.187526.
49. Lloyd-Sherlock, Peter. 2014. "Beyond Neglect: Long-term Care Research in Low and Middle Income Countries." *International Journal of Gerontology* 8 (2):66-69.
50. Matus-Lopez, Mauricio, and Alexander Chaverri-Carvajal. 2021. "Population with Long-Term Care Needs in Six Latin American Countries: Estimation of Older Adults Who Need Help Performing ADLs." *Int J Environ Res Public Health* 18 (15). doi: 10.3390/ijerph18157935.
51. _____. 2022. "Progress Toward Long-Term Care Protection in Latin America: A National Long-Term Care System in Costa Rica." *J Am Med Dir Assoc* 23 (2):266-271. doi: 10.1016/j.jamda.2021.06.021.
52. Ministry of Civil Affairs. 2021. "Statistical Communique on the Development of Social Services: 2020." National Bureau of Statistics of China. February 28, 2021.
53. Ministry of Finance of Poland. 2021 "National Plan for Reconstruction and Resilience." Government of Poland. April 30, 2021. https://www.gov.pl/web/planodbudowy/kpo-wyslany-do-komisji-europejskiej.
54. Mitra, Sohie, and Usha Sambamoorthi. 2014. "Disability prevalence among adults: estimates for 54 countries and progress toward a global estimate." *Disabil Rehabil* 36 (11):940-7. doi: 10.3109/09638288.2013.825333.
55. Mor, Vincent, Taziana Leone, and Anne Maresso (editors). 2014. *Regulating long term care quality: An international comparison*. Cambridge, UK: Cambridge University Press.
56. Ndubuisi, Nweke E. 2021. "Noncommunicable Diseases Prevention In Low- and Middle-Income Countries: An Overview of Health in All Policies (HiAP)." *Inquiry* 58:46958020927885. doi: 10.1177/0046958020927885.
57. Organization for Economic Cooperation and Development (OECD). 2011. Mexico: Long-term Care. May 18, 2011. https://www.oecd.org/mexico/47877877.pdf
58. Oyebode, Oyinlola, Ngianga-Bakwan Kandala, Peter J. Chilton, and Richard J. Lilford. 2016. "Use of traditional medicine in middle-income countries: A WHO-SAGE study." *Health Policy and Planning*, 31(8), 984-991.
59. Petsoulas, Christina. 2019. "Thinking about Long-term Care in a Global Context – A Literature Review." Green Templeton College, Oxford.
60. Polivka, Larry and Baozhen Luo. 2019. "Neoliberal Long-Term Care: From Community to Corporate Control." *Gerontologist* 59 (2):222-229. doi: 10.1093/geront/gnx139.
61. Rajagopalan, Jayeeta, Saadiya Hurzuk, Faheem Arshad, Premkumar Raja, and Suvarna Alladi. 2020. "New country report: The COVID-19 Long-Term Care situation in India." International Long-Term Care Policy Network, CPEC-LSE, 30th May 2020. https://ltccovid.org/wp-content/uploads/2020/05/LTC-COVID-situation-in-India-30th-May-1.pdf.
62. Scheil-Adlung, Xenia. 2015. "Long-term care protection for older persons: A review of coverage deficits in 46 countries." In *ILO Extension of Social Security Working Paper No. 50*. Geneva,

Switzerland: International Labour Office.
63. Siop, Sidiah, Lois M. Verbrugge, and Tengku Aizan Hamid. 2008. "Disability and Quality of Life Among Older Malaysians." Paper presented at the 2008 Population Association of America (PAA) Annual Meeting, April 17-19, 2008. New Orleans. https://paa2008.populationassociation.org/papers/80962.
64. Stolt, Ragnar, Paula Blomqvist, and Ulrika Winblad. 2011. "Privatization of social services: quality differences in Swedish elderly care." *Soc Sci Med* 72 (4):560-7. doi: 10.1016/j.socscimed.2010.11.012.
65. Stone, Robyn I., and Joshua M. Wiener. 2001. "Who Will Care for Us? Addressing the Long-Term Care Workforce Crisis."Washington, D.C.: US Department of Health and Human Services.
66. Thakur, Rp, A. Banerjee, and Vb Nikumb. 2013. "Health problems among the elderly: a cross-sectional study." *Ann Med Health Sci Res* 3 (1):19-25. doi: 10.4103/2141-9248.109466.
67. United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). 2018. "Financing for Long-term Care in Asia and the Pacific." Social Development Policy Brief No. 2018/01. Thailand: United Nations Economic and Social Commission for Asia and the Pacific.
68. United Nations, Department of Economic and Social Affairs (UNDESA), Population Division. 2017. World Population Prospects: The 2017 Revision.
69. United Nations. 2019. "World Population Prospects 2019." United Nations, Department of Economic and Social Affairs, Population Division. https://population.un.org/wpp/.
70. Van, Phan H., Khuong A. Tuan, and Tran T.M. Oanh. 2021. "Older Persons and Long-term Care in Viet Nam." In *Coping with Rapid Population Ageing in Asia*, edited by Osuke Komazawa and Yasuhiko Saito. Jakarta: Economic Research Institute for ASEAN and East Asia (ERIA).
71. Villalobos Dintrans, P. 2020. "Designing Long-Term Care Systems: Elements to Consider." *J Aging Soc Policy* 32 (1):83-99. doi: 10.1080/08959420.2019.1685356.
72. Walker, Wendy, and Meredith Wyse. 2021. "Leadership and Governance of Long-Term Care Systems in Asia and the Pacific". ADB Brief No. 198. Manilla, Phillipines: Asian Development Bank (ADB).
73. Wang, Li-li. 2013. "A Study on the Demand,Supply and Utilization of Home-Based Care Services for the Elderly Based on the Theory of "Services Chain"." *Population Journal* 35:49-59.
74. Weber, Daniela and Sergei Scherbov. 2020. "Prospects of activity limitations among older adults in 23 low and middle income countries." *Sci Rep* 10 (1):10442. doi: 10.1038/s41598-020-67166-4.
75. Wijesiri, H. S. Maliga S. K., Sudharshani Wasalathanthri, SH De Silva Weliange, and Chandrika N. Wijeyaratne. 2021 "The Prevalence and Correlates of Activity Limitations Among the Elderly in Informal Caregiving Settings in Colombo District, Sri Lanka: A Community Based Cross-Sectional Study." *International Journal of Caring Sciences* 13 (3):1568-1577.
76. World Bank. 2021. Technical report with an assessment of demand for and supply of elderly care in Greece Part I: Overview of demand for and supply of home-based care in Greece: an empirical investigation based on Survey of Health, Ageing and Retirement in Europe (SHARE).
77. _____. 2022. Toward Developing a Long-Term Care Strategy for Older People in Romania, mimeo.
78. World Health Organization (WHO). 2017. Towards long-term care systems in sub-Saharan Africa. In *WHO series on long-term care*. Geneva, Switzerland: World Health Organization.
79. _____. 2020a. "Decade of Healthy Ageing 2021–2030." Geneva, Switzerland: World Health Organization. https://www.who.int/initiatives/decade-of-healthy-ageing.
80. _____. 2020b. "Decade of Healthy Ageing: Baseline Report." Geneva, Switzerland: World Health Organization.
81. _____. 2021a. "Framework for Countries to Achieve an Integrated Continuum of Long-term Care." Geneva, Switzerland: World Health Organization.
82. _____. 2021b. "Global Status Report on the Public Health Response to Dementia." Geneva, Switzerland: World Health Organization.
83. World Health Organization, and World Bank. 2021. "Tracking Universal Health Coverage 2021 Global Monitoring Report." CONFERENCE EDITION.
84. Zarzycki, Mikolaj, Val Morrison, Eva Bei,and Diane Seddon. 2022. "Cultural and Societal Motivations for Being Informal Caregivers: A Qualitative Systematic Review and Meta-synthesis". *Health Psychology Review*, 1–30. https://doi.org/10.1080/17437199.2022.2032259.
85. Zhu, Haiyan. 2015. "Unmet needs in long-term care and their associated factors among the oldest old in China." *BMC Geriatr* 15:46. doi: 10.1186/s12877-015-0045-9.

Social Protection and Jobs

Chapter 12
Exploring the Labour Market Outcomes of the Risk Factors for Non-communicable Diseases: A Systematic Review

Chapter 13
Productive Longevity: What Can Work in Low- and Middle-Income Countries?

Chapter 14
Adequacy Pensions and Access to Health Care: Maintaining Human Capital during Old Age



12

Exploring the labour market outcomes of the risk factors for non-communicable diseases

A systematic review

Debapriya Chakraborty [a], *Daphne Wu* [a], *Prabhat Jha* [a]

[a] Centre for Global Health Research, Unity Health Toronto, University of Toronto, Canada

INTRODUCTION

Globally, 41 million people die from non-communicable diseases (NCDs) every year (World Health Organization 2022a). This accounts for approximately 74 percent of all deaths (World Health Organization 2022a). Many NCDs, including hypertension, overweight/obesity, type 2 diabetes, and hyperlipidaemia, can be prevented by reducing the four major NCD risk factors — tobacco use, harmful use of alcohol, physical inactivity, and unhealthy diet (World Health Organization 2022b). NCDs not only increase the risk of premature mortality, but they also carry a tremendous financial burden. In the next two decades, NCDs are estimated to result in US$47 trillion output loss globally (Bloom et al. 2011). For example, as compared to people with healthy body weight, studies in the USA, Canada, and Australia have shown that those with obesity have 30 percent higher medical expenditures (Withrow and Alter 2011). In the USA, obesity has an annual cost of US$ 113.9 billion in direct medical costs and studies have shown that compared to children with healthy body weight, children with obesity incur US$ 19,000 incremental lifetime direct medical costs (Bleich et al. 2018; Finkelstein, Graham, and Malhotra 2014). In the UK, cardiovascular diseases cost the healthcare system £ 7.4 billion a year and come with an overall economic burden of £ 15.8 billion per year (Public Health England 2019).

NCDs disproportionately affect populations in low- and middle-income countries (LMICs): of the total deaths due to NCDs globally, about 77 percent occur in LMICs (World Health Organization 2022a). Using health expenditure data from 18 countries, one study found that compared with households without NCDs, the risk difference for catastrophic spending among households with NCDs is 1.7 percent in lower-middle-income countries, 0.8 percent in upper-middle-income countries, and 7.5 percent in China (Murphy et al. 2020). NCDs also exacerbate susceptibility to communicable diseases, as evidenced by the recent COVID-19 pandemic. This leads to an increased burden on health systems that are usually inadequate or fragmented in LMICs.

In addition to the adverse health systems outcomes, NCDs and their risk factors adversely affect the labour and employment sectors. Reduced workforce participation, lower overall income, and earlier retirement are some labour market outcomes that have been observed. Productivity levels are low and work absenteeism is high for employees suffering from obesity and type 2 diabetes due to ensuing health issues (e.g., arthritis or fatigue) (Segal et al. 2021; Pedron et al. 2019). The Healthy Longevity Initiative (HLI), based on the framework by O'Keefe and Haldane (2024), is a strategy adopted by the World Bank to take a lifecycle and whole of society approach to NCD prevention and management. This review is tied to that agenda because it attempts to parse out the cause and effect of phenomena that are, ultimately, interrelated. This work builds on former studies that have looked at the different risk factors and their effects on labour market outcomes separately and attempts to bring them together in a coherent narrative.

This is a unique piece of work because it looks at multiple risk factors of NCDs, their metabolic/physiological consequences, and a wide range of labour market outcomes, whereas previous studies have been focused on fewer exposures and outcomes. We also want to establish if there are any obvious gender differences in the association of labour market outcomes with the known risk factors for NCDs and comment on any policy implications that might result from the data derived. Therefore, this review focuses on some of the major behavioural risk factors for NCDs (smoking, heavy alcohol consumption), key physiological changes resultant of the risk factors (overweight and obesity, hypertension, type 2 diabetes), major depressive disorder, and their accompanying labour market outcomes by looking at the differential impacts on the population at all life stages. Although preventing all-cause mortality is a critical public health issue, increasingly the focus must shift to a more fulsome approach, which is healthy longevity of the population.

METHODS

We conducted a systematic literature review using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (Page et al. 2021).

Search strategy

Literature searches for all peer-reviewed studies published before July 2022 were performed in July 2022. The following databases were searched: MEDLINE (Ovid), Embase (Ovid), EconLit (EBSCO), EconPapers, and Cochrane Database of Systematic Reviews. The search strategy included keywords relating to the adult population, labour market outcomes, and risk factors for non-communicable diseases. No limits were placed on language, location, or publication date. The search terms used for MEDLINE are included in the Annex.

Eligibility criteria

We studied labour market outcomes, such as employment status, probability of being employed, weeks in labour force, job tenure, job search duration, wages, productivity loss, disability pension, early retirement, absenteeism, and sickness absence. The exposures of interest in this review are: smoking (defined as having smoked more than 100 cigarettes or bidis during the lifetime; we excluded vaping, second-hand smoke and cigar smoking); binge alcohol consumption (defined as 5 or more standard drinks on one occasion for men and 4 or more standard drinks on one occasion for women (Centers for Disease Control and Prevention 2022)); heavy alcohol consumption (defined as 15 or more standard drinks per week for men and 8 or more standard drinks per week for women (Centers for Disease Control and Prevention 2019)); overweight (body mass index (BMI) > 25kg/m^2) or obesity (BMI > 30kg/m^2); hypertension (blood pressure over 140mmHg/90mmHg; history of being diagnosed as hypertensive by a physician); type 2 diabetes (history of being diagnosed with type 2 diabetes by a physician); and major depressive disorder (MDD) (diagnosed by a physician or experiencing persistent and intense symptoms of MDD for a sustained period of time, usually 2 weeks or longer). Studies focusing on the risk factors of obesity, such as sedentary behaviour or consumption of unhealthy foods and beverages, were excluded. Study designs included cohort and longitudinal, and those excluded were systematic reviews, cross-sectional studies, modelling studies, and qualitative studies not focused on intervention design or evaluation. There were no restrictions placed on country, language of publication, race, or socioeconomic groups. To make it generalizable, we excluded studies on specific populations such as patient populations or populations in specific occupations.

Selection process

All titles and abstracts were screened in Covidence by two independent reviewers (DC and DW) and conflicts were resolved after discussion. If there were uncertainties, the paper(s) were included for full text review. Full texts were reviewed by two independent reviewers (DC and DW) and conflicts were resolved by consensus.

Data extraction and synthesis

Data were independently extracted from each study by two reviewers (85% by DC and 15% by DW) in Microsoft Excel. The key information retrieved was first author's name, title of article, publication year, language of publication, country or setting, World Bank region and income group, period of surveillance (number of years or actual years between which data was captured), study design, sample size, whether or not data was stratified by biological sex, whether socioeconomic status or ethnicity were captured, exposures targeted, outcomes measured, any biases or confounding factors identified, and summary of the findings. The data extraction tool was pilot tested on a small sample of sources before being revised and finalised for the data extraction process from each included source. Any discrepancies were resolved through discussion.

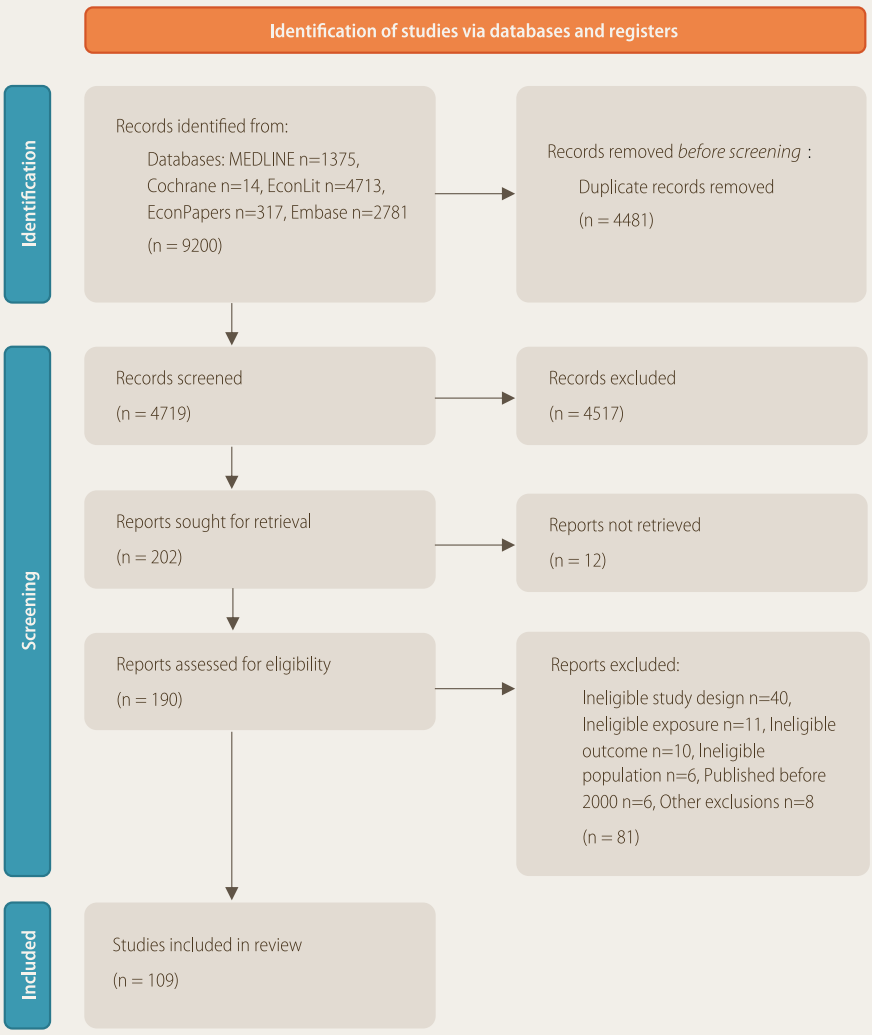
RESULTS

The selection process resulted in 109 eligible studies that are included in this review. The majority of the studies are from Europe and Central Asia. The search results are discussed below.

Studies included

After screening five databases, 9,200 records were identified. Figure 12.1 shows the number of articles included and excluded in each step of the review. After removing duplicates, 4,719 titles and abstracts were screened. From these, 4,517 articles were excluded, the majority of which examined NCD outcomes of labour market exposures. 190 full texts were screened for eligibility (12 full texts were not available through the institution libraries). After reviewing the full texts based on our inclusion and exclusion criteria, 131 were deemed eligible to be included in the review. After discussion within the review team (DC, DW, and PJ), studies published prior to 2000 were excluded due to concerns of suitability, and reviews were excluded because relevant studies within were captured in our scope or would be used in guiding the discussion of the results. 109 studies were included in this review.

FIGURE 12.1 PRISMA flow diagram in search and selection of records



Location of the studies

All studies captured were published in English language; 96.3 percent of them (105/109) were conducted in high-income countries and the rest (3.7% or 4/109) were conducted in upper-middle-income countries. In terms of region, studies from Europe and Central Asia constituted the highest proportion of studies (64%), followed by North America (25%), and East Asia and Pacific (10%) (Figure 12.2). Only one study was found from Latin America & the Caribbean, while none were found from Middle East and North Africa, South Asia, and Sub-Saharan Africa (Figure 12.2). A breakdown of the studies, by country, is provided in Supplementary Material, Table S1. Eighty percent of the studies were conducted in only eight countries – USA, Sweden, Finland, Denmark, Norway, Republic of Korea, UK, and Germany.

FIGURE 12.2 Proportion of studies by World Bank Regions (World Bank 2022)

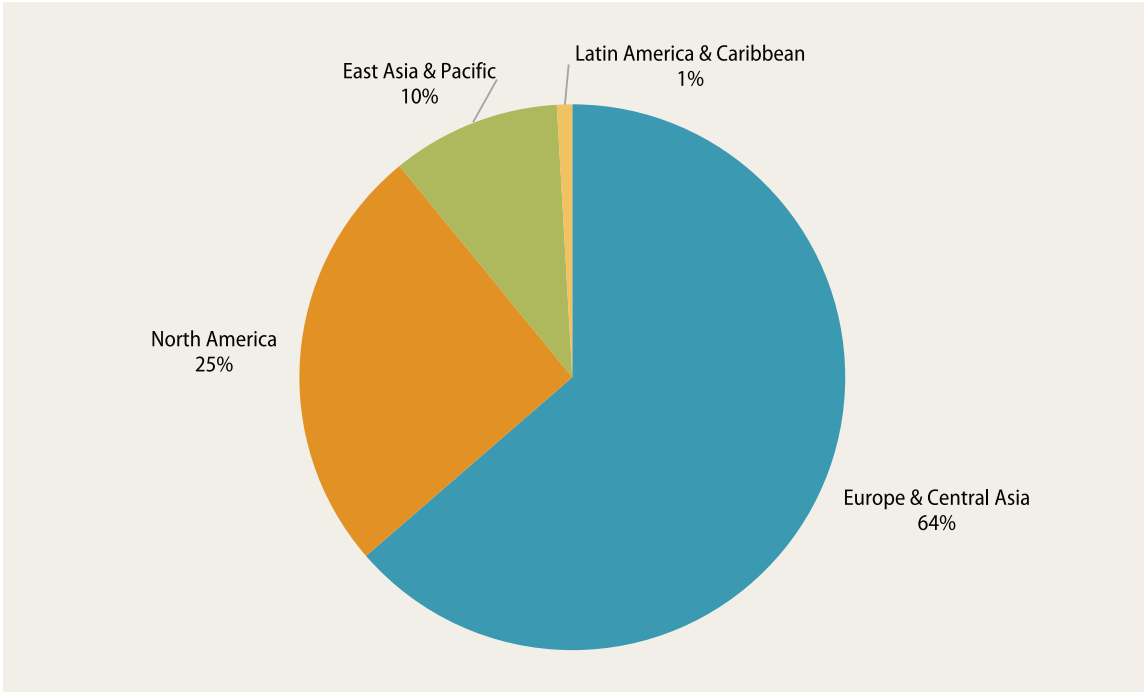


Table 12.1 enumerates key demographic and economic characteristics of the eight countries that reported the highest number of studies. They are all high-income countries with a current health expenditure, as percentage of GDP, between 8 and 17 percent, and universal health coverage (UHC) greater than 80 percent. However, in these countries, the proportion of the population facing catastrophic health expenditures (spending on health greater than 10 percent of total household budget) ranges from 2 to 12 percent.

Characteristics of included studies

Of the included studies, 64 percent (70/109) were longitudinal, followed by cohort studies (36/109 or 33%). Within the longitudinal studies, there were some twin studies (Laine and Hyytinen 2022; Helgadottir et al. 2019; Bockerman et al. 2018; Lang and Nystedt 2018; Bockerman, Hyytinen, and Maczulskij 2016, 2017; Ostby et al. 2016), but they were collapsed into one broad category (Georgia State University 2022). Sixty-nine percent (75/109) of the studies reported socioeconomic status of study participants; ethnicity was reported by 24 percent.

Number of studies on each exposure and outcome

Tables 12.2 and 12.3 present the frequency of exposures and outcomes examined in the studies included. Many of the studies looked at a combination of exposures. High BMI (overweight or obesity) was the most frequently studied (50/109 or 46%), followed by harmful alcohol use (29/109 or 27%). In

terms of labour market outcomes, income/earnings (36/109 or 33%), sickness absence (35/109 or 32%), and employment status (33/109 or 30%) were most commonly studied.

Direction of outcome

Out of the 109 studies included in this review, 100 (92%) reported adverse effects of the exposures, of which 84 studies reported significant results with p-value < 0.05 (Supplementary Material, Table S3). Seven studies (6%) did not report any detectable effects between the exposures and outcomes, while two studies (2%) reported that depression and heavy episodic drinking have protective effects on labour market outcomes. However, the protective effects were not significant at 95% confidence.

Table 12.4 presents a subset of the total number of studies looking at the combination (five or more observed) of the targeted exposures and the different outcomes. The associations most frequently studied were the effects of overweight/obesity on income/earnings (21/109 or 19%), followed by the effects of overweight/obesity on sickness absence (17/109 or 16%), and the effects of alcohol use on employment status (13/109 or 12%).

TABLE 12.1 Total number of studies by countries + characteristics of 8 countries which produced the highest number of studies

Country	Number of studies	%	Median year of study and range	Population (millions, 2021) (World Bank 2021c)	GDP per capita, PPP (current international $, 2021) (World Bank 2021a)	Current health expenditure (% of GDP, 2019) (World Bank 2019)	Labour force participation rate, female (% of female population ages 15+) (national estimate, 2021) (World Bank 2021b)	Population with household spending on health greater than 10% of total household budget (SDG 3.8.2, reported data) (%) (World Health Organization 2022c)	UHC Service Coverage Index (SDG 3.8.1) (2019, %) (World Health Organization 2021)
USA	25	22.9	2010 (2002-2018)	331.9	69,287.5	17	56	4 (2019)	83
Sweden	15	13.8	2015 (2001-2020)	10.4	59,324.0	11	63	6 (1996)	87
Finland	14	12.8	2017 (2002-2022)	5.5	55,006.6	9	57	7 (2016)	83
Denmark	9	8.3	2019 (2003-2021)	5.8	64,651.2	10	58	3 (2010)	85
Norway	9	8.3	2016 (2010-2021)	5.4	79,201.2	11	61	5 (1998)	86
Republic of Korea	7	6.4	2018 (2016-2020)	51.7	46,918.5	8	54	12 (2018)	87
UK	4	3.7	2009 (2007-2018)	67.3	49,675.3	10	59	2 (2018)	88
Germany	4	3.7	2014 (2013-2018)	83.1	57,927.6	12	56	2 (2010)	86
All others	22	20.2							
TOTAL:	109	100							

TABLE 12.2 Frequencies of risk factors studied in included studies

Risk factors studied	Number of studies = 109
Overweight or obesity	50
Alcohol use	29
Smoking	19
Depressive disorders	18
Diabetes	17
Hypertension	3

TABLE 12.3 Frequencies of outcomes identified in included studies

Outcomes studied	Number of studies = 109
Income/Earnings	36
Sickness Absence	35
Employment Status	33
Pension	18
Other economic outcomes (work ability, job hunt duration, etc.)	11
Early retirement/Working life expectancy	9
Other social outcomes (education, marriage, etc.)	11

TABLE 12.4 Frequency of studies associated with different combinations of exposures and outcomes

Exposure	Outcome	Total number of studies	Number of studies that found adverse effects	Number of studies that found no or protective effects
BMI	Income/Earnings	21	18	3
	Sickness absence	17	16	1
	Employment status	11	9	2
	Pension	7	7	0
	Early retirement/Working life expectancy	5	5	0
	Other economic outcomes (work ability, job hunt duration, etc.)	5	4	1
Alcohol use	Employment status	13	12	1
	Income/Earnings	8	7	1
	Sickness absence	7	7	0
Smoking	Sickness absence	6	6	0
Depressive disorders	Sickness absence	6	5	1
	Employment status	5	5	0
	Pension	5	5	0
Diabetes	Sickness absence	9	8	1

Impact of obesity

Of the 21 studies looking at the association between BMI and income, 18 showed adverse effects and three showed either no significant or protective effects. Finnish women who are overweight earn 30% less ($p < 0.05$) in the long term and work fewer hours than those who were never overweight (Laine and Hyytinen 2022), and Taiwanese women with obesity earned up to 20 percent less ($p < 0.05$) when compared to their healthy weight counterparts (Huang and Chen 2019). Swedish men with obesity incur an income penalty of 9.6 percent ($p < 0.01$) when compared to their healthy weight counterparts (Dackehag, Gerdtham, and Nordin 2015). We also found that the impact of overweight and obesity on income differs by ethnicity. In the USA, Moreau et al. (2004) found an 8 percent (white males) to 16 percent (Hispanic females) reduction in earnings with every two standard deviation increase in BMI (Slade 2017). However, amongst Black males, increase in BMI was found to be associated with an increase in wages earned (Slade 2017). In the Republic of Korea, the relationship between high BMI and income or earnings was protective for men. Men with overweight or obesity earned 6.8 times higher monthly wages and were 1.46 times more likely to be placed in professional jobs as compared to those without overweight or obesity (Ahn, Kim, and Han 2019; H. Lee et al. 2019).

Seventeen studies examined overweight/obesity as the exposure and sickness absence as the outcome. Of them, 16 showed adverse effects and one showed either no or protective effects. In Belgium, high BMI was an independent predictor of sick leave – ranging from 31 percent ($p < 0.001$) increase for men to 47 percent ($p < 0.001$) increase for women (Moreau et al. 2004). In the UK, overweight and obesity were associated with a 13 percent ($p < 0.05$) and 51 percent ($p < 0.05$) increase, respectively, of long term sickness absence compared to healthy BMI (Ferrie et al. 2007). In the USA, individuals with obesity experience a 4.6 percent ($p < 0.001$) higher rate of absenteeism compared with those with healthy weight (6.6 ± 1.1 sick days with obesity vs. 3.2 ± 1.2 sick days with healthy weight) (VanWormer et al. 2012). In Germany, there was a significant ($p < 0.01$) gender difference in sick leave incidence (27% increase in women with obesity compared to 15% decrease (not significant) in men), and long-term absenteeism (41% increase in women with overweight compared to 16% decrease (not significant) in men) (Reber, Konig, and Hajek 2018). Of the 11 studies that looked at the combination of BMI and employment status, nine showed adverse results while two showed protective or no discernible effects. In Denmark, compared to those with healthy weight, those with obesity and severe obesity were 18 and 27 percent, respectively, more likely to be unemployed (Bramming et al. 2019). In Republic of Korea, employment probability decreased by 2.81 percent (with job hunting experience) or 4.78 percent (with

no job-hunting experience) per week for women with overweight and obesity (Ahn, Kim, and Han 2019). All the included studies that looked at the relationship between BMI and pension, and between BMI and early retirement or working life expectancy, showed adverse effects. There was 1.94 times to 3.45 times the probability of all-cause disability retirement associated with severe obesity and obesity, respectively, in Finland (Roos et al. 2013). In Sweden, the probability of receiving disability pension increased from 1.36 times (for overweight) to 3.04 times (for severe obesity) (M. Neovius, Kark, and Rasmussen 2008). In the Republic of Korea, there was a 60 percent increased risk of early exit from work due to unhealthy BMI (W. Lee et al. 2018). Of the five studies that looked at BMI and other economic outcomes (such as work ability, job hunt duration, etc.), four found adverse effects.

Impact of harmful alcohol use

Of the 13 studies looking at the association of harmful alcohol use and employment status, 12 showed adverse effects. In Sweden, heavy alcohol use is associated with a 28 percent - 48 percent increase in unemployment rates (Jorgensen et al. 2017). In Norway, heavy alcohol consumption was predictive of 17 percent - 32 percent increased rate of unemployment (Kaspersen et al. 2016). In Russia, a longitudinal study linked excessive drinking to up to three times the rate of unemployment in working age men (Cook et al. 2014). Black men in the USA had a 47 percent lower probability of being employed in their mid-life if they were heavy drinkers (Sloan et al. 2011). Of the eight studies that looked at the association of alcohol use and income, seven found adverse effects. A Swedish cohort found that alcohol use disorder in men predicted a decrease of income by 0.24 standard deviations (Kendler et al. 2017). All seven studies that looked at the association between alcohol use and sickness absence showed adverse effects. In Finland, binge drinking was associated with 21 percent - 62 percent increase in working days lost (Shiri et al. 2021; Ervasti et al. 2018).

Impact of smoking

Of the eight studies looking at the association between smoking and sickness absence, all found adverse effects. In Finland, smoking is associated with a 19 percent (past smokers) to 30 percent (current smokers) increase in working days lost (Shiri et al. 2021). Also in Finland, smoking and obesity together were associated with a 2.23 and 2.69 times higher probability among women and men respectively, of going on medically certified sick leave compared to their non-smoking, non-obese counterparts (Roos et al. 2017). In Sweden, daily smoking was associated with a 30 percent long term sick listing (Vingard et al. 2005).

Impact of depression

Of the six studies examining the association between depressive disorders and sickness absence, five found adverse effects. In Norway, people with MDD were 30 percent as likely to go on all-cause sick leave as those without MDD (Torvik et al. 2016). Five studies looked at the combination of depression and employment status and another five at depression and pension. All found adverse effects. In the Netherlands, depression was associated with a higher risk of early work exit (hazard ratios between 3.30 - 5.56) (De Breij et al. 2020). In Australia, depression leads to 25.6 percent - 34.2 percent increase in unemployment rates for men (Bubonya, Cobb-Clark, and Ribar 2019). In the USA, those experiencing symptoms of depression are 60 percent more likely to face unemployment as compared to those without depression (Whooley et al. 2002). In Norway, depressed men and women are 2.4 to 2.9 times and 1.6 times, respectively, as likely to go on disability pension as those without depression (Lassemo et al. 2016; Knudsen et al. 2010).

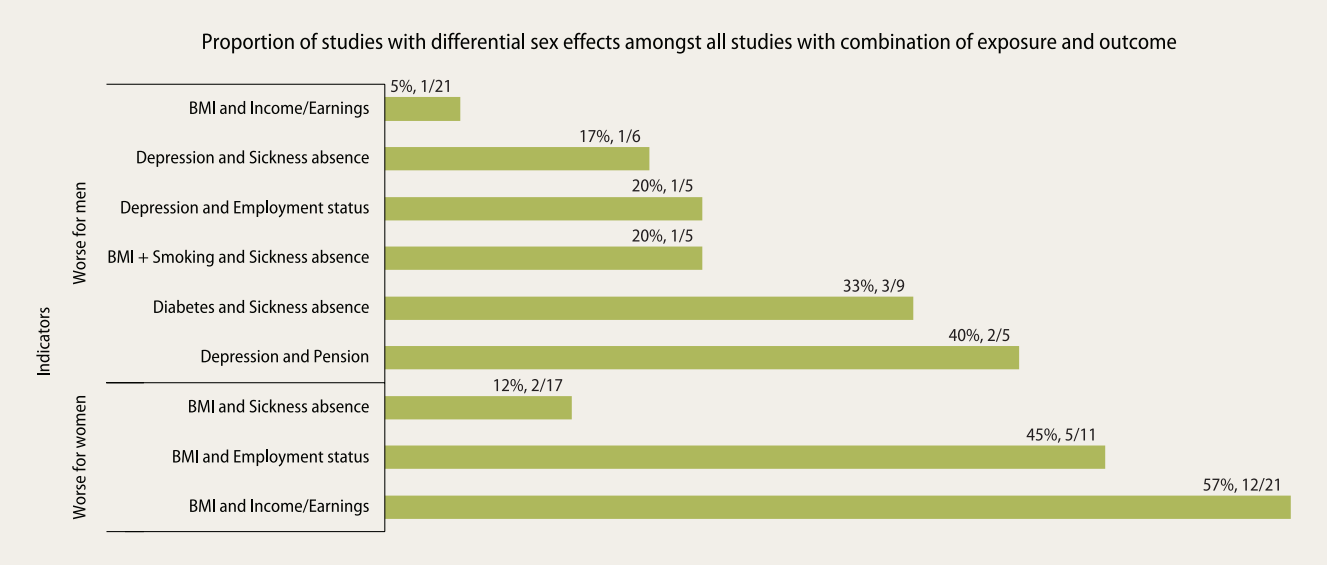
Impact of diabetes

Of the nine studies that looked at the association of type 2 diabetes and sickness absence, eight found adverse effects. In Denmark, men with diabetes (64%) were more likely to go on sick leave than women with diabetes (46%) when compared with those without diabetes (Nexo et al. 2020). In France and Finland, there was a 33 percent increase in work disability days for those with diabetes when compared to those without (Virtanen et al. 2015).

Sex differences in association between exposure and outcome

Most of the studies stratified their results by biological sex (69/109 or 63%) (see Supplementary Material, Table S2). There is evidence suggesting that biological sex may be an effect modifier in the relationship between certain combinations of exposures and outcomes. For example, of the 21 studies looking at the association between high BMI and income/earnings, 12 (or 57%) indicated overweight and obesity affect income of females more adversely than that of males (Figure 12.3).

FIGURE 12.3 Differences in outcomes identified by biological sex



DISCUSSION

Main findings

Socioeconomic status (SES) and social determinants of health (SDHs) are strong predictors for NCDs (Marmot 2005; World Health Organization 2022d). Health equity is influenced by SDHs such as income and social protection, unemployment and job insecurity, and working life conditions (World Health Organization 2022d). Generally, individuals in lower SES groups are more vulnerable to NCDs due to lack of monetary resources, which limits access to healthy and nutritious foods; lack of quality education that would teach people about health literacy and good dietary behaviours and the benefits of regular physical activity; and psychosocial factors arising from deprivation such as mental stress, control of life and finances, and social isolation (Marmot 2005). We were interested in exploring the contrasting reverse causality – how the incidence of risk factors and certain NCDs affect people's labour market outcomes – to better understand the societal impacts of NCDs globally.

This review includes several studies that have shown statistically significant associations between risk factors of NCDs and common labour market outcomes. We found that individuals exposed to overweight or obesity, diabetes, hypertension, depressive disorders, excessive alcohol use, and cigarettes are more likely to have lower rates of employment, lower income, and higher rates of sickness absence and disability pension. This association is corroborated by previous studies which found high BMI to be a risk factor of low income/earnings (Kim and Han 2017; Reiband, Heitmann, and Sorensen 2020), higher probability of unemployment (Reiband, Heitmann, and Sorensen 2020), greater sickness absence (Amiri and Behnezhad 2019; K. Neovius et al. 2009; Schmier, Jones, and Halpern 2006; Trogdon et al. 2008; van Duijvenbode et al. 2009), and the likelihood of obtaining disability pension (K. Neovius et al. 2008). There are a couple of notable exceptions to this, especially amongst black and Korean men where higher BMI was not penalised (Slade 2017; Ahn, Kim, and Han 2019; H. Lee et al. 2019). Possible explanations for this are that males with larger body sizes are idealised or less stigmatised compared to females. Additionally, there are cultural and racial factors to consider where particular groups have history of widespread poverty and therefore larger body sizes are associated with wealth (Slade 2017).

Stigma could explain why those with overweight or obesity earn less than those without. One study found that women with persistent obesity earned 20 percent less than their healthy weight counterparts (Huang and Chen 2019). For exam-

ple, those with obesity are perceived to be undisciplined, unwilling to work, weak-willed, and lazy (Puhl and Heur 2009, 2010). This negative perception is self-actualised in many instances after society has reinforced it with actions such as making hiring decisions based off someone's weight or their mental health diagnosis (Puhl and Brownell 2003; Puhl and Heur 2009). Studies have shown that weight discrimination in the United States has significantly increased (66%, $p < 0.01$) over a decade, from 7 in 1995/96 to 12 percent in 2004/06 (Andreyeva, Puhl, and Brownell 2008). A survey of over two thousand women with overweight or obesity found that 25 percent of them reported experiencing discrimination in their workplace due to their weight (Puhl and Heur 2009). Further, 54 percent experienced stigma from their colleagues and 43 percent experienced the same from their employers or supervisors (Puhl and Heur 2009). In the USA and other Western settings, studies have shown that differential treatment, derogatory humour and pejorative comments, being passed over for promotions, or even being fired are some examples of experiences of weight stigma in the workplace (Puhl and Brownell 2003; Puhl and Heur 2009). In general, cultivation theory suggests that thinner women are idealised more so than men, and this could explain the gender differences when it comes to the stronger association for women with BMI and income/earnings than for men.

Furthermore, smoking is a strong predictor of being a recipient of a disability pension (Amiri and Behnezhad 2020) and sickness-related absence (Weng, Ali, and Leonardi-Bee 2013), and depression was shown to be associated with sickness absence (McIntyre, Liauw, and Taylor 2011). These results indicate that prioritising NCD prevention should not only be a health sector priority but be at the top of the agenda for the economic and fiscal growth sectors, as well. This is why the HLI framework, which represents a multifactorial agenda of healthy longevity, inclusive growth, and wellbeing throughout a person's life course through a combination of behavioural and environmental policy implementations, is key in prevention and effective management of NCDs (O'Keefe and Haldane 2024).

Even among the studies that displayed statistically significant results, there is variability in the quality of the study and the combinations of exposures targeted and outcomes observed, which makes it a challenge to pool the results into a meta-analysis. Causality between overweight/obesity and income/earnings were the most prevalent in the studies captured. Furthermore, women who suffered from overweight or obesity were more likely to earn less than men with overweight or obesity.

Strengths and limitations of this review

Some strengths of this study include the scale – it is a global review with no limitations placed on language or location, which casts a wide net and captures a myriad of NCD risk factors and labour market outcomes. Although no language restriction was placed, only English articles were retrieved. This could be because of the databases that were used for the search. Due to the heterogeneity of the studies, variability in study design, methodology, and differing effect size measurements, we were unable to undertake a formal meta-analysis. Additionally, there is the potential for publication bias since all studies were in English and most of the studies (96.3%) were conducted in high-income country settings.

Conclusions

All the longitudinal or cohort studies included in this review that looked at plausible causal relationship between NCD risk factors and labour market outcomes were from high-income and upper-middle-income countries – particularly the USA; northern European countries like Sweden, Finland, Denmark, and Norway; and South Korea – where there has been a long tradition of registry-based epidemiological studies. Based on these studies at least, we find that individuals with overweight or obesity, diabetes, hypertension, depressive disorders, excessive alcohol use, and cigarette use are more likely to have lower rates of employment, lower income, and higher rates of sickness absence and disability pension. Going forward, more studies done outside of the context of high-income countries looking at how the growing NCD burden is affecting the employment sector, with particular attention to curbing the risk factors as a key prevention priority, are required. Additionally, prevention of these adverse labour market outcomes requires multi-sectoral efforts.

REFERENCES

1. Ahn, R., T. H. Kim, and E. Han. 2019. "The Moderation of Obesity Penalty on Job Market Outcomes by Employment Efforts." *Int J Environ Res Public Health* 16 (16). https://doi.org/10.3390/ijerph16162974.
2. Amiri, S., and S. Behnezhad. 2019. "Body mass index and risk of sick leave: A systematic review and meta-analysis." *Clin Obes* 9 (6): e12334. https://doi.org/10.1111/cob.12334.
3. -_____. 2020. "Smoking and disability pension: a systematic review and meta-analysis." *Public Health* 186: 297-303. https://doi.org/10.1016/j.puhe.2020.04.013.
4. Andreyeva, Tatiana, Rebecca M. Puhl, and Kelly D. Brownell. 2008. "Changes in Perceived Weight Discrimination Among Americans, 1995–1996 Through 2004–2006." *OBESITY* 16 (5): 1129-1134. https://doi.org/10.1038/oby.2008.35.
5. Bleich, Sara N, Kelsey A Vercammen, Laura Y Zatz, Johannah M Frelier, Cara B Ebbeling, and AnnaPeeters. 2018. "Interventions to prevent global childhood overweight and obesity: a systematic review." *The Lancet Diabetes & Endocrinology* 6 (4): 332-346. https://doi.org/https://doi.org/10.1016/S2213-8587(17)30358-3.
6. Bloom, D.E., E.T. Cafiero, E. Jané-Llopis, S. Abrahams-Gessel, L.R. Bloom, S. Fathima, A.B. Feigl, T. Gaziano, M. Mowafi, A. Pandya, K. Prettner, L. Rosenberg, B. Seligman, A.Z. Stein, and C. Weinstein. 2011. *The Global Economic Burden of Noncommunicable Diseases. Geneva: World Economic Forum.*
7. Bockerman, P., A. Hyytinen, J. Kaprio, and T. Maczulskij. 2018. "If you drink, don't smoke: Joint associations between risky health behaviors and labor market outcomes." *Soc Sci Med* 207: 55-63. https://doi.org/10.1016/j.socscimed.2018.04.039.
8. Bockerman, P., A. Hyytinen, and T. Maczulskij. 2016. "Devil in disguise: Does drinking lead to a disability pension?" *Prev Med* 86: 130-5. https://doi.org/10.1016/j.ypmed.2016.03.008.
9. ---. 2017. "Alcohol Consumption and Long-Term Labor Market Outcomes." *Health Econ* 26 (3): 275-291. https://doi.org/10.1002/hec.3290.
10. Bramming, M., M. B. Jorgensen, A. I. Christensen, C. J. Lau, K. K. Egan, and J. S. Tolstrup. 2019. "BMI and Labor Market Participation: A Cohort Study of Transitions Between Work, Unemployment, and Sickness Absence." *Obesity (Silver Spring)* 27 (10): 1703-1710. https://doi.org/10.1002/oby.22578.
11. Bubonya, M., D. A. Cobb-Clark, and D. C. Ribar. 2019. "The reciprocal relationship between depressive symptoms and employment status." *Econ Hum Biol* 35: 96-106. https://doi.org/10.1016/j.ehb.2019.05.002.
12. Centers for Disease Control and Prevention (CDC). 2019. "What is Excessive Alcohol Use?". Last Modified December 30. Accessed November 8, 2022. https://www.cdc.gov/alcohol/onlinemedia/infographics/excessive-alcohol-use.html#:~:text=Heavy%20drinking%3A%20For%20women%2C%20heavy,drinks%20or%20more%20per%20week.
13. _____. 2022. "Binge Drinking." Last Modified January 6. Accessed November 8, 2022. https://www.cdc.gov/alcohol/fact-sheets/binge-drinking.htm#:~:text=Binge%20drinking%20is%20defined%20as,a%20severe%20alcohol%20use%20disorder.
14. Cook, S., B. L. DeStavola, L. Saburova, and D. A. Leon. 2014. "Acute alcohol-related dysfunction as a predictor of employment status in a longitudinal study of working-age men in Izhevsk, Russia." *Addiction* 109 (1): 44-54. https://doi.org/10.1111/add.12329.
15. Dackehag, M., U. G. Gerdtham, and M. Nordin. 2015. "Productivity or discrimination? An economic analysis of excess-weight penalty in the Swedish labor market." *Eur J Health Econ* 16 (6): 589-601. https://doi.org/10.1007/s10198-014-0611-7.
16. De Breij, S., J. Macken, J. Y. Qvist, D. Holman, M. Hess, M. Huisman, and D. J. H. Deeg. 2020. "Educational differences in the influence of health on early work exit among older workers." *Occup Environ Med* 77 (8): 568-575. https://doi.org/10.1136/oemed-2019-106253.
17. Ervasti, J., M. Kivimaki, J. Pentti, J. I. Halonen, J. Vahtera, and M. Virtanen. 2018. "Changes in drinking as predictors of changes in sickness absence: a case-crossover study." *J Epidemiol Community Health* 72 (1): 61-67. https://doi.org/10.1136/jech-2017-209777.
18. Ferrie, Jane E., Jenny Head, Martin J. Shipley, Jussi Vahtera, Michael G. Marmot, and Mika Kivimäki. 2007. "BMI, Obesity, and Sickness Absence in the Whitehall II Study." *OBESITY* 15 (6): 1554-1564.
19. Finkelstein, Eric Andrew, Wan Chen Kang Graham, and Rahul Malhotra. 2014. "Lifetime Direct Medical Costs of Childhood Obesity." *Pediatrics* 133 (5): 854-862. https://doi.org/10.1542/peds.2014-0063.
20. Georgia State University. 2022. "Literature Reviews: Types of Clinical Study Designs." Last Modified March 11. Accessed November 10, 2022. https://research.library.gsu.edu/litrev.
21. Helgadottir, B., L. Mather, J. Narusyte, A. Ropponen, V. Blom, and P. Svedberg. 2019. "Transitioning from sickness absence to disability pension-the impact of poor health behaviours: a prospective Swedish twin cohort study." *BMJ Open* 9 (11): e031889. https://doi.org/10.1136/bmjopen-2019-031889.
22. Huang, C. Y., and D. R. Chen. 2019. "Association of weight change patterns in late adolescence with young adult wage differentials: A multilevel longitudinal study." *PLoS One* 14 (7): e0219123. https://doi.org/10.1371/journal.pone.0219123.
23. Jorgensen, M. B., L. C. Thygesen, U. Becker, and J. S. Tolstrup. 2017. "Alcohol consumption and risk of unemployment, sickness absence and disability pension in Denmark: a prospective cohort study." *Addiction* 112 (10): 1754-1764. https://doi.org/10.1111/add.13875.
24. Kaspersen, S. L., K. Pape, G. A. Vie, S. O. Ose, S. Krokstad, D. Gunnell, and J. H. Bjorngaard. 2016. "Health and unemployment: 14 years of follow-up on job loss in the Norwegian HUNT Study." *Eur J Public Health* 26 (2): 312-7. https://doi.org/10.1093/eurpub/ckv224.
25. Kendler, K. S., H. Ohlsson, K. J. Karriker-Jaffe, J. Sundquist, and K. Sundquist. 2017. "Social and economic consequences of alcohol use disorder: a longitudinal cohort and co-relative analysis." *Psychol Med* 47 (5): 925-935. https://doi.org/10.1017/S0033291716003032.
26. Kim, T, and E Han. 2017. "Entry Body Mass and Earnings: Once Penalized, Ever Penalized?" *Biodemography Soc Biol* 63 (4): 332-346. https://doi.org/10.1080/19485565.2017.1403302.
27. Knudsen, A. K., S. Overland, H. F. Aakvaag, S. B. Harvey, M. Hotopf, and A. Mykletun. 2010. "Common mental disorders and disability pension award: seven year follow-up of the HUSK study." *J Psychosom Res* 69 (1): 59-67. https://doi.org/10.1016/j.jpsychores.2010.03.007.

28. Laine, L. T., and A. Hyytinen. 2022. "Temporary and persistent overweight and long-term labor market outcomes." *Int J Health Econ Manag* 22 (2): 181-203. https://doi.org/10.1007/s10754-021-09315-4.
29. Lang, E, and P Nystedt. 2018. "Blowing up money? The earnings penalty of smoking in the 1970s and the 21st century." *J Health Econ* 60: 39-52. https://doi.org/10.1016/j.jhealeco.2018.05.003.
30. Lassemo, E., I. Sandanger, J. F. Nygard, and K. W. Sorgaard. 2016. "Predicting disability pension - depression as hazard: a 10 year population-based cohort study in Norway." *Int J Methods Psychiatr Res* 25 (1): 12-21. https://doi.org/10.1002/mpr.1473.
31. Lee, H., R. Ahn, T. H. Kim, and E. Han. 2019. "Impact of Obesity on Employment and Wages among Young Adults: Observational Study with Panel Data." *Int J Environ Res Public Health* 16 (1). https://doi.org/10.3390/ijerph16010139.
32. Lee, W., J. H. Yoon, J. W. Koo, S. J. Chang, J. Roh, and J. U. Won. 2018. "Predictors and estimation of risk for early exit from working life by poor health among middle and older aged workers in Korea." *Sci Rep* 8 (1): 5180. https://doi.org/10.1038/s41598-018-23523-y.
33. Marmot, Michael. 2005. "Social determinants of health inequalities." *The Lancet* 365 (9464): 1099-1104. https://doi.org/10.1016/s0140-6736(05)71146-6.
34. McIntyre, Roger S., Samantha Liauw, and Valerie H. Taylor. 2011. "Depression in the workforce: the intermediary effect of medical comorbidity." *Journal of Affective Disorders* 128: S29-S36. https://doi.org/10.1016/s0165-0327(11)70006-4.
35. Moreau, M., F. Valente, R. Mak, E. Pelfrene, P. de Smet, G. De Backer, and M. Kornitzer. 2004. "Obesity, body fat distribution and incidence of sick leave in the Belgian workforce: the Belstress study." *Int J Obes Relat Metab Disord* 28 (4): 574-82. https://doi.org/10.1038/sj.ijo.0802600.
36. Murphy, A., B. Palafox, M. Walli-Attaei, T. Powell-Jackson, S. Rangarajan, K. F. Alhabib, A. J. Avezum, K. B. T. Calik, J. Chifamba, T. Choudhury, G. Dagenais, A. L. Dans, R. Gupta, R. Iqbal, M. Kaur, R. Kelishadi, R. Khatib, I. M. Kruger, V. R. Kutty, S. A. Lear, W. Li, P. Lopez-Jaramillo, V. Mohan, P. K. Mony, A. Orlandini, A. Rosengren, I. Rosnah, P. Seron, K. Teo, L. A. Tse, L. Tsolekile, Y. Wang, A. Wielgosz, R. Yan, K. E. Yeates, K. Yusoff, K. Zatonska, K. Hanson, S. Yusuf, and M. McKee. 2020. "The household economic burden of non-communicable diseases in 18 countries." *BMJ Glob Health* 5 (2): e002040. https://doi.org/10.1136/bmjgh-2019-002040.
37. Neovius, K., K. Johansson, M. Kark, and M. Neovius. 2009. "Obesity status and sick leave: a systematic review." *Obes Rev* 10 (1): 17-27. https://doi.org/10.1111/j.1467-789X.2008.00521.x.
38. Neovius, K., K. Johansson, S. Rossner, and M. Neovius. 2008. "Disability pension, employment and obesity status: a systematic review." *Obes Rev* 9 (6): 572-81. https://doi.org/10.1111/j.1467-789X.2008.00502.x.
39. Neovius, M., M. Kark, and F. Rasmussen. 2008. "Association between obesity status in young adulthood and disability pension." *Int J Obes (Lond)* 32 (8): 1319-26. https://doi.org/10.1038/ijo.2008.70.
40. Nexo, M. A., J. Pedersen, B. Cleal, and J. B. Bjorner. 2020. "Increased risk of long-term sickness absence, lower rate of return to work and higher risk of disability pension among people with type 1 and type 2 diabetes mellitus: a Danish retrospective cohort study with up to 17 years' follow-up." *Diabet Med* 37 (11): 1861-1865. https://doi.org/10.1111/dme.14203.
41. O'Keefe, Philip, and Victoria Haldane. 2024. "Towards a framework for impact pathways between non-communicable diseases, human capital and healthy longevity, economic and wellbeing outcomes," in Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative. Washington D.C.: World Bank.
42. Ostby, K. A., N. Czajkowski, G. P. Knudsen, E. Ystrom, L. C. Gjerde, K. S. Kendler, R. E. Orstavik, and T. Reichborn-Kjennerud. 2016. "Does low alcohol use increase the risk of sickness absence? A discordant twin study." *BMC Public Health* 16 (1): 825. https://doi.org/10.1186/s12889-016-3502-2.
43. Page, Matthew J, Joanne E McKenzie, Patrick M Bossuyt, Isabelle Boutron, Tammy C Hoffmann, Cynthia D Mulrow, Larissa Shamseer, Jennifer M Tetzlaff, Elie A Akl, Sue E Brennan, Roger Chou, Julie Glanville, Jeremy M Grimshaw, Asbjørn Hróbjartsson, Manoj M Lalu, Tianjing Li, Elizabeth W Loder, Evan Mayo-Wilson, Steve McDonald, Luke A McGuinness, Lesley A Stewart, James Thomas, Andrea C Tricco, Vivian A Welch, Penny Whiting, and David Moher. 2021. "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews." *BMJ* 372: n71. https://doi.org/10.1136/bmj.n71.
44. Pedron, Sara, Karl Emmert-Fees, Michael Laxy, and Lars Schwettmann. 2019. "The impact of diabetes on labour market participation: a systematic review of results and methods." *BMC Public Health* 19 (25): 1-13.
45. Public Health England. 2019. "Health matters: preventing cardiovascular disease." Last Modified 14 February. Accessed November 8, 2022. https://www.gov.uk/government/publications/health-matters-preventing-cardiovascular-disease/health-matters-preventing-cardiovascular-disease.
46. Puhl, R. M., and K. D. Brownell. 2003. "Psychosocial origins of obesity stigma: toward changing a powerful and pervasive bias." *obesity reviews* 4: 213-227.
47. Puhl, R. M., and C. A. Heur. 2009. "The stigma of obesity: a review and update." *Obesity (Silver Spring)* 17 (5): 941-64. https://doi.org/10.1038/oby.2008.636.
48. ---. 2010. "Obesity Stigma: Important Considerations for Public Health." *American Journal of Public Health* 100, no. Framing Health Matters (6): 1019-1028.
49. Reber, K. C., H. H. Konig, and A. Hajek. 2018. "Obesity and sickness absence: results from a longitudinal nationally representative sample from Germany." *BMJ Open* 8 (6): e019839. https://doi.org/10.1136/bmjopen-2017-019839.
50. Reiband, H. K., B. L. Heitmann, and T. I. A. Sorensen. 2020. "Adverse labour market impacts of childhood and adolescence overweight and obesity in Western societies-A literature review." *Obes Rev* 21 (8): e13026. https://doi.org/10.1111/obr.13026.
51. Roos, E., M. Laaksonen, O. Rahkonen, E. Lahelma, and T. Lallukka. 2013. "Relative weight and disability retirement: a prospective cohort study." *Scand J Work Environ Health* 39 (3): 259-67. https://doi.org/10.5271/sjweh.3328.
52. Roos, E., T. Lallukka, E. Lahelma, and O. Rahkonen. 2017. "The joint associations of smoking and obesity with subsequent short and long sickness absence: a five year follow-up study with register-linkage." *BMC Public Health* 17 (1): 978. https://doi.org/10.1186/s12889-017-4997-x.
53. Schmier, J. K., M. L. Jones, and M. T. Halpern. 2006. "Cost of obesity in the workplace." *Scand J Work Environ Health* 32 (1): 5-11. https://doi.org/10.5271/sjweh.970.
54. Segal, A. B., M. C. Huerta, E. Aurino, and F. Sassi. 2021. "The impact of childhood obesity on human capital in high-in-

come countries: A systematic review." *Obes Rev* 22 (1): e13104. https://doi.org/10.1111/obr.13104.
55. Shiri, R., A. Hiilamo, O. Rahkonen, S. J. W. Robroek, O. Pietilainen, and T. Lallukka. 2021. "Predictors of working days lost due to sickness absence and disability pension." *Int Arch Occup Environ Health* 94 (5): 843-854. https://doi.org/10.1007/s00420-020-01630-6.
56. Slade, P. 2017. "Body mass and wages: New evidence from quantile estimation." *Econ Hum Biol* 27 (Pt A): 223-240. https://doi.org/10.1016/j.ehb.2017.07.001.
57. Sloan, F, P.R. Costanzo, D. Belsky, E. Holmberg, P.S. Malone, Y. Wang, and S. Kertesz. 2011. "Heavy drinking in early adulthood and outcomes at mid life." *J Epidemiol Community Health* 65 (7): 600-5. https://doi.org/10.1136/jech.2009.102228.
58. Torvik, F. A., T. Reichborn-Kjennerud, L. C. Gjerde, G. P. Knudsen, E. Ystrom, K. Tambs, E. Roysamb, K. Ostby, and R. Orstavik. 2016. "Mood, anxiety, and alcohol use disorders and later cause-specific sick leave in young adult employees." *BMC Public Health* 15: 702. https://doi.org/10.1186/s12889-016-3427-9.
59. Trogdon, J. G., E. A. Finkelstein, T. Hylands, P. S. Dellea, and S. J. Kamal-Bahl. 2008. "Indirect costs of obesity: a review of the current literature." *Obes Rev* 9 (5): 489-500. https://doi.org/10.1111/j.1467-789X.2008.00472.x.
60. van Duijvenbode, D. C., M. J. Hoozemans, M. N. van Poppel, and K. I. Proper. 2009. "The relationship between overweight and obesity, and sick leave: a systematic review." *Int J Obes (Lond)* 33 (8): 807-16. https://doi.org/10.1038/ijo.2009.121.
61. VanWormer, J. J., J. A. Linde, L. J. Harnack, S. D. Stovitz, and R. W. Jeffery. 2012. "Weight change and workplace absenteeism in the HealthWorks study." *Obes Facts* 5 (5): 745-52. https://doi.org/10.1159/000345119.
62. Vingard, E., P. Lindberg, M. Josephson, M. Voss, B. Heijbel, L. Alfredsson, S. Stark, and A. Nygren. 2005. "Long-term sick-listing among women in the public sector and its associations with age, social situation, lifestyle, and work factors: a three-year follow-up study." *Scand J Public Health* 33 (5): 370-5. https://doi.org/10.1080/14034940510005860.
63. Virtanen, M., M. Kivimaki, M. Zins, R. Dray-Spira, T. Oksanen, J. E. Ferrie, A. Okuloff, J. Pentti, J. Head, M. Goldberg, and J. Vahtera. 2015. "Lifestyle-related risk factors and trajectories of work disability over 5 years in employees with diabetes: findings from two prospective cohort studies." *Diabet Med* 32 (10): 1335-41. https://doi.org/10.1111/dme.12787.
64. Weng, S. F., S. Ali, and J. Leonardi-Bee. 2013. "Smoking and absence from work: systematic review and meta-analysis of occupational studies." *Addiction* 108 (2): 307-19. https://doi.org/10.1111/add.12015.
65. Whooley, Mary A., Catarina I. Kiefe, Margaret A. Chesney, Jerome H. Markovitz, Karen Matthews, and Stephen B. Hulley. 2002. "Depressive Symptoms, Unemployment, and Loss of Income: The CARDIA Study." *Arch Intern Med.* 162: 2614-2620.
66. Withrow, D., and D. A. Alter. 2011. "The economic burden of obesity worldwide: a systematic review of the direct costs of obesity." *obesity reviews* 12: 131–141. https://doi.org/10.1111/j.1467-789X.2009.00712.x.
67. World Bank. 2019. "Current health expenditure (% of GDP)." Accessed November 4, 2022. https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS.
68. _____. 2021a. "GDP per capita, PPP (current international $)." Accessed November 4, 2022. https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD.
69. _____.. 2021b. "Labor force participation rate, female (% of female population ages 15+) (national estimate)." Accessed November 4, 2022. https://data.worldbank.org/indicator/SL.TLF.CACT.FE.NE.ZS.
70. _____.. 2021c. "Population, total." Accessed November 9, 2022. https://data.worldbank.org/indicator/SP.POP.TOTL.
71. _____. 2022. "The World by Income and Region." World Development Indicators. Accessed September 30, 2022. https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html.
72. World Health Organization (WHO). 2021. "UHC Service Coverage Index (SDG 3.8.1)." THE GLOBAL HEALTH OBSERVATORY. Last Modified November 19. Accessed November 4, 2022. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/uhc-index-of-service-coverage.
73. _____.. 2022a. "Noncommunicable diseases." Last Modified 16 September. Accessed September 30, 2022. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases#:~:text=Noncommunicable%20diseases%20(NCDs)%20kill%2041,%2D%20and%20middle%2Dincome%20countries.
74. _____. 2022b. "Noncommunicable diseases: Risk factors." Accessed November 15, 2022. https://www.who.int/data/gho/data/themes/topics/noncommunicable-diseases-risk-factors.
75. _____.. 2022c. "Population with household expenditures on health greater than 10% of total household expenditure or income (SDG 3.8.2) (%)." THE GLOBAL HEALTH OBSERVATORY. Last Modified September 13. Accessed November 4, 2022. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/population-with-household-expenditures-on-health-greater-than-10-of-total-household-expenditure-or-income-(sdg-3-8-2)-(-).
76. _____. 2022d. "Social determinants of health." Accessed November 28. https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1.

ANNEX 12.1

Search strategy

TABLE 12A.1 Search strategy for Ovid (MEDLINE) Sample

Results: 1375, Database: All Ovid Medline <1946 – July 21, 2022>

1	exp alcohol-related disorders/ or alcoholism/	119218
2	alcoholism.ti,ab,kf.	30918
3	alcoholic*.ti,ab,kf.	74549
4	exp drinking/	14671
5	exp drinking behavior/ or exp alcohol drinking/	82568
6	(body weight and measures).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	16664
7	body weight/ or overweight/ or obesity/	391203
8	exp body fat distribution/ or exp body mass index/ or *body weight/ or *sagittal abdominal diameter/ or *waist circumference/ or *waist-height ratio/ or *body surface area/ or *waist-hip ratio/	182219
9	(obesit: or obese).ti,ab,kf.	356663
10	Weight Prejudice/	113
11	exp Smoking/	158043
12	(cigaret* or cigarette* or cigar* or pipe or smoke or smoking or tobacco).ti,ab,kf.	356387
13	exp Depressive Disorder/	118465
14	(depressed or depression).ti,ab,kf.	455150
15	("mood disorder:" adj3 depression).ti,ab,kf.	1442
16	exp Diabetes Mellitus/	482733
17	(diabetes or diabetic).ti,ab,kf.	720699
18	or/1-17	2248946
19	exp economic status/	429
20	Employment/ec, sn [Economics, Statistics & Numerical Data]	9285
21	personal earnings.tw.	23
22	Personal wealth.tw.	37
23	financial security.ti,ab,kf.	610
24	financial status.ti,ab,kf.	1222
25	*income/ or *pensions/ or *remuneration/	13030
26	income.ti,ab,kf.	156936
27	salary.ti,ab,kf.	5086
28	net worth.af.	189
29	19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28	176716
30	18 and 29	37006
31	18 and 25	1375

13

Productive Longevity

What can work in low- and middle-income countries?

Sara Johansson de Silva [a] *and Indhira Santos* [b]

[a] Human Capital Project, World Bank
[b] Human Development, Eastern Europe and Central Asia, World Bank

INTRODUCTION

The world's population is aging at a dramatic speed, raising concerns for how to maintain income and productivity growth, improve the welfare of older people, and help them contribute to society. By 2050, one in six members of the world's population will be at least 65 years of age, compared to fewer than one in 10 today. Nearly four out of five of these seniors will be living in what are currently low- and middle-income countries (LMICs) (United Nations 2019). Aging will imply shrinking working populations relative to dependents, which will reduce economic growth if other factors—particularly productivity and employment rates—do not change. Aging is also likely to require higher public and private expenditures for health and long-term care (LTC) services. These demographic tides prompt a need for policies that can sustain welfare levels and ensure that welfare is equitably distributed across generations and socioeconomic groups. Labor market policies that help extend productive working lives and increase the labor force participation and productivity of older workers – "productive longevity" – are part of this important agenda. This chapter identifies a set of labor market-related policies that can address key constraints to productive longevity in LMICs and provides some preliminary evidence on their effectiveness.

Policies supporting aging populations in remaining healthy, skilled, and economically active have positive impacts across generations. Seniors who are in good physical and mental health and remain in the labor force help maintain the size of the workforce and prevent labor dependency ratios – the ratio of the population not working to that of the population working – from increasing. Harnessing the productivity of these mature workers boosts the pool of human capital, that is, the health and skills that ensure productive work. The gains can be substantial: estimates suggest that Greece could increase GDP by a staggering 23 percent by increasing employment levels of the 55+ age group to those of New Zealand (PwC 2018). And productive longevity does not appear to crowd out younger workers from labor markets, what economists refer to as the "lump of labor fallacy." Looking at Organization for Economic Cooperation and Development (OECD) countries, higher employment rates for seniors in fact coincide with higher employment rates for youth (Böheim and Nice 2019, Gruber et al. 2009, and Munnell and Wu 2013), and there is some evidence from the United States and Japan that higher senior employment is correlated with higher wages for younger workers (Kalwij et al. 2010). At firm level, mixed-age teams have been shown to have higher productivity than age-homogenous teams, supporting the notion that older and younger workers are, on average, complements rather than substitutes (Göbel and Zwick 2013). Conversely, if seniors leaving employment deplete the market of relevant skills, skill shortages may lead firms to automate production processes to a higher degree, which could instead lead to job destruction across generations (Acemoglu and Restrepo 2022).

Supporting productive longevity can also help individuals increase their healthy years of living. At the individual level, there is substantial evidence that working in older age, in the right circumstances, can create a virtuous circle of healthy living and productive work. Research focused on high-income countries (HICs) shows that opportunities for voluntary part-time paid work, as well as volunteering activities, can contribute to strengthening physical and mental health at older age, including for people over 80 years of age (Staudinger et al. 2016). The Gallup World Poll shows that working full-time or voluntarily part-time in older age, as opposed to being retired, is correlated with higher levels of reported happiness.[1]

Policies focusing on productive longevity are part of a broad policy agenda addressing aging and welfare challenges. First, actions across many different policy areas will be needed to boost growth, inclusive job opportunities, and social protection, while managing macroeconomic and fiscal conditions. These include policies relating to education and lifelong learning, health and care systems, labor migration and labor market regulations, social protection systems, taxation policy, innovation policy, and more. Second, policies also need to target all generations: promote longer working lives for those able to work productively, invest in younger generations to raise productivity over entire working lives, and enhance social protection for those who can no longer work. This is particularly the case in LMICs, where human capital levels are lower and intergenerational human capital gaps across generations larger, compared to HICs. Investing at scale in low-productivity mature

1 https://www.brookings.edu/blog/up-front/2014/03/28/why-aging-and-working-makes-us-happy-in-4-charts/

workers would likely be very costly compared to investing in children and youth. Today's adults are tomorrow's elderly, and early investment in skills development is associated with a strong positive impact on health, which in turn contributes to later retirement.[2]

While recognizing the need for broad policy packages, the chapter is focused on policies that enable and incentivize older workers in LMICs to remain active, and that can raise the productivity of their work further. As will be discussed in more detail below, in LMICs, many older people, often even the majority, work for themselves or their families in the informal sector, in low-productivity employment and without social security. Raising their productivity and providing protection are critical challenges. Given largely underdeveloped social protection systems in low-income countries (LICs) and many middle-income countries (MICs), policies relating to taxation, labor regulations, and formal social protection programs have limited reach. For the group of relatively better-off workers, often in the formal sector, different labor market policies and social security system incentives and barriers can matter, however. A focus on this group is likely to yield greater results for this set of policies, as it is arguably less expensive and easier to extend working lives than renew or start working lives at mature ages, particularly after a long period of absence from the labor market. In what follows, we will refer to "mature workers" approaching retirement as the target age group. We do not consider a precise age cut-off to define old age, seniority, elderly or mature workers. Typically, the interventions we look at would be relevant for people aged 55 years and above. Policy initiatives may differ depending on the particular age group involved, however.

There are specific growth and employment opportunities associated with aging. Low aggregate labor demand in the formal sector, including for older workers, is often a critical problem to productive employment growth in many LMICs. Aggregate demand-side constraints limit the reach of supply-side policies aiming at incentivizing productive employment, for older workers and others. This said, the nature of labor demand is changing globally, affecting demand for mature workers, and will also impact labor markets in LMICs, albeit to a varying degree. Aging can itself generate demand for products and services, thus generating jobs in the so-called "silver economy."

The remainder of the chapter is organized as follows: The next section describes the labor policy agenda for aging, highlighting the commonalities and diversity of policy needs and options between HICs and LMICs as well as within LMICs. The following section presents some stylized facts regarding the nature of work for older adults. The next section after this presents a conceptual framework around the main constraints to longer productive working lives. Based on this framework, the proceeding section looks at the available evidence on what works, drawing where possible on evidence from LICs and MICs. The final section concludes with some meta-lessons and points to the important research agenda that lies ahead.

A GLOBAL POLICY AGENDA FOR AGING

Aging is a global phenomenon, and all countries will need to consider how to optimize policy to address the impact of older populations. Old-age dependency ratios are already high in many LMICs (particularly in East Asia and Eastern and Central Europe) and increasing rapidly in others (Latin America and the Middle East and North Africa). The share of persons above 65 years of age reaches 18 percent both in rich East Asian countries and in the OECD but is below 5 percent in Sub-Saharan Africa, the Middle East and North Africa, and South Asia. (Figure 13.1). In most of Latin America and Eastern Europe and Central Asia, fertility rates have already dropped below replacement levels, which means that the population will also be shrinking. Whereas most countries in South Asia and Sub-Saharan Africa still have relatively young populations, old-age populations are increasing rapidly in absolute numbers, and many Southeast Asian countries have already undergone a significant demographic transition in a very short period. Based on current trends, fertility rates will be below replacement levels in almost all Asian countries within 20 years.[3] Many of these countries risk experiencing a slowdown in growth and thus "getting old before getting rich." As the demographic window of opportunity is closing, sustaining welfare levels will require significant reforms, also in countries where social protection and skills-development systems are still developing.

2 Allel et al. (2021) show that, in Mexico, more access to formal education during childhood and adolescence is associated with a long-term positive effect on health and later retirement.

3 https://www.csis.org/analysis/will-many-developing-countries-get-old-they-get-rich

Globally, women's life expectancy at birth exceeds that of men by nearly five years, and the gap persists into older ages. The gender longevity gap is highest in Latin America, Europe, and Eastern and South-Eastern Asia. This gender gap suggests that productive aging policies need to pay specific attention to skills and labor market constraints for women, and health constraints for men.

The priorities and space for reforms will differ between less and more advanced economies, reflecting different contexts of aging and productive work. Most analysis and evidence on aging societies and the relationship with longer working lives is based on HICs. Much can be learned from these experiences, but there are important differences between less and more advanced economies that affect priorities as well as the available and desirable set of policy instruments that can support longer and more productive working lives. These include, *inter alia*, labor market structure, access to social protection, human capital levels across generations, norms, and the technical capacity and political space for reform. Nevertheless, countries that are now building up their education, labor, and social protection systems can also learn not to repeat errors made by more advanced economies. The experience from HICs and some MICs shows that the cost of putting in place inadequate solutions can be substantial. Unsustainable pension systems or insufficient attention to skills development for older generations have long-term repercussions that can be very difficult (politically and technically) to undo. Poorer countries need to avoid costly mistakes, such as entrenching costly future pension payment contingencies in social protection design, or ignoring human capital investments, the effects of which will manifest themselves in decades to come.

The dual labor market structure of most LMICs presents a particular dilemma for policymakers. The International Labor Organization (ILO) estimates that, on average, about 70 percent of the employed workforce is informally employed in developing countries.[4] On the one hand, high informality and low-productivity work mean that policies focusing on formal workers and formal firms will be less effective in changing aggregate outcomes, despite promising evidence in some areas that policy can affect old-age productivity and employment decisions. On the other hand, many workers in the informal sector—given the lack of access to social protection and overall low levels of private savings—arguably already work too late in life, caught in a vicious circle of ill-health and low productivity and straining work, leading to even worse physical and mental health.

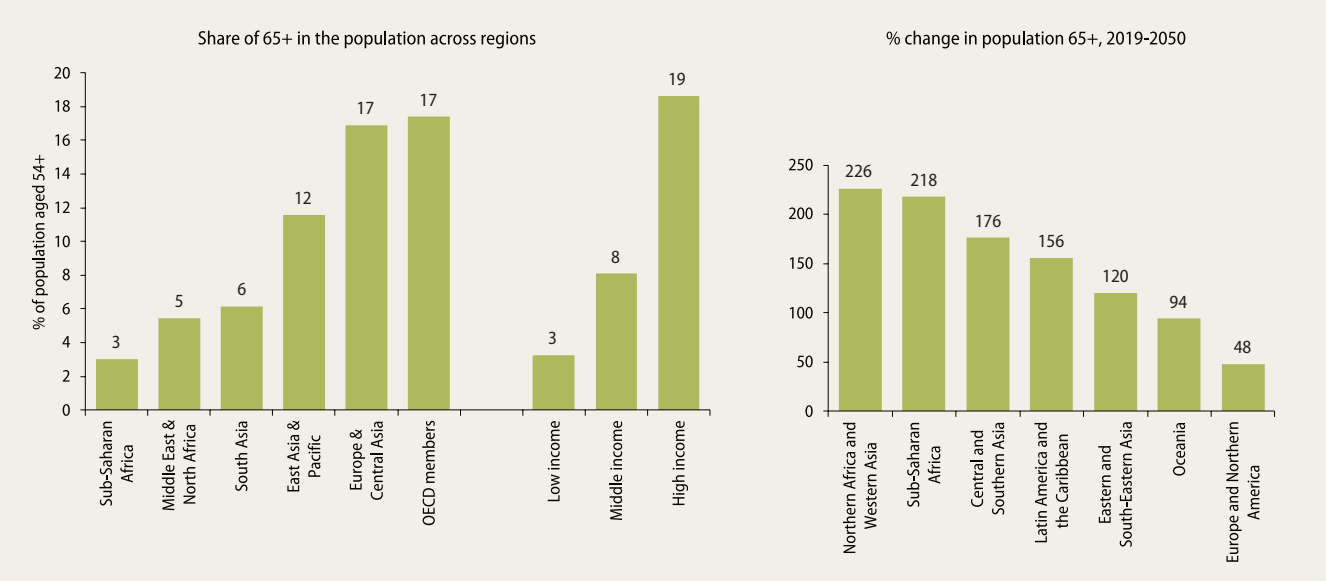
Increasing the productivity of low-productivity mature workers in LMICs would likely be difficult, given health and education gaps and lower life expectancy. As access to education and health has expanded over the past decades, inter-generational gaps in education and health are also significant. In a country like Viet Name, which has undergone a remarkable upskilling effort in past decades, over 60 percent of those over age 60 have only completed primary education, whereas the vast majority of young people have at least higher secondary education (World Bank 2021a). In many LMICs, human capital levels in the younger generations, while increasing, remain insufficient and need to increase substantially, however, raising the urgency of investing in children and youth who make up the future workforce.

Despite these caveats, there are strong reasons to form productive longevity policies for workers who have higher human capital levels and resources to retire. This group always exists: in many LICs, likely represented by public sector workers; in MICs, a larger share is likely to come from the formal private sector. For this group, the policy agenda could more closely follow that of advanced economies and focus on extending working lives. Although early investment is critical, fostering skills development throughout working lives may be more efficient than has previously been considered, not least because a person over her lifetime generally spends much more time at work than in school. Research shows that returns to work experience may explain as much of the income gap between HICs and LMICs as gaps in education: workers in LMICs develop less human capital on the job than do workers in HICs (Jedwab et al. 2021). In addition, the hiring rate of mature workers may in fact be higher in LMICs than in HICs.5 This higher dynamism suggests significant pay-offs to investing in human capital and adequate employment transition.

4 Based on statistics for 61 developing countries, from Elgin et al. 2021.

5 Annex Table 13A.1 shows that in several middle-income countries (Brazil, Colombia), the hiring rate of 55-64 year olds is much higher (34 and 24 percent respectively) than in EU27 or OECD countries (6 and 8 percent).

FIGURE 13.1 Demographic changes differ across regions, but aging is coming everywhere



Source: World Development Indicators (left), UN 2019 (right).

LMICs hence face a more comprehensive policy agenda than HICs, with both opportunities and risks. A significant part of the challenge of productive aging in LMICs is clearly about investing in children and youth and increasing productivity and boosting social protection and health support among older workers, often in informal, low-productivity employment. But there are also opportunities for developing policies addressed to mature workers. In this paper, we discuss the evidence for measures that aim to extend working lives though policy instruments that apply mostly to formal work as well as for measures that can support more productive employment in both the formal and informal sectors. In doing so, we recognize that the profile and context for mature workers today is different from those of the past and certainly likely to differ from those of tomorrow. Policy evidence reported should be considered in this light.

WORK IN OLD AGE: SOME STYLIZED FACTS

This section presents some stylized facts regarding the nature of work among mature workers, looking at participation patterns and trends and the development of human capital - in the form of access to good health and the means to adapt to a labor market with rapidly changing skills needs – elements that determine the ability to work into old age and influence worker productivity.[6]

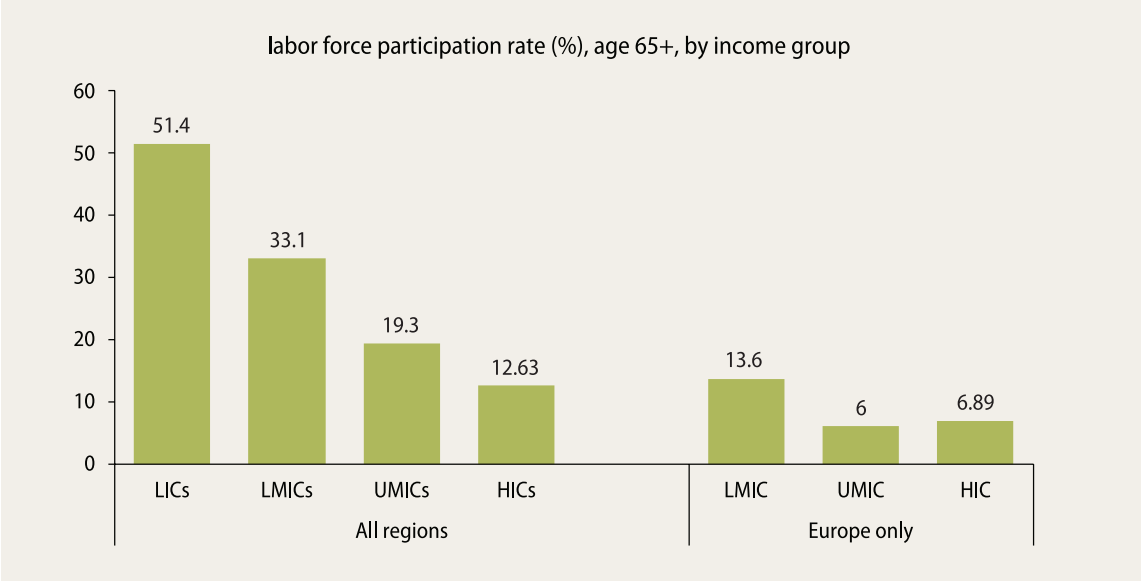
The nature of work among older adults

Old-age labor force participation is generally lower, the higher a country's average income level. In the average LIC, more than half of the 65+ population is active in the labor market (Figure 13.2). Moving up through country income groups, participation rates fall systematically. In lower middle-income countries (LMICs), 33 percent of the 65+ population is active, and in upper middle-income coun-

6 A complete assessment of labor market conditions for mature workers is outside of the scope of this paper. However, several World Bank country-level or regional studies provide more comprehensive overviews of labor market conditions for older workers including sector and occupations analysis, for example for Thailand (World Bank 2021b), Viet Nam (World Bank 2021a), East Asia and the Pacific (World Bank 2016), Malaysia (World Bank 2020), Russia (Levin 2015).

tries (UMICs) and HICs, this rate falls to 19 and 13 percent, respectively. Across income groups, European countries are outliers, with significantly lower participation rates than other regions. High labor force participation in poor countries largely reflects a need to work. In Thailand, for example, 31 percent of people above age 60 report that labor income is their main source of income, which is much higher than the share reporting pensions (5 percent) or elderly allowance (17 percent) – (World Bank 2021b).

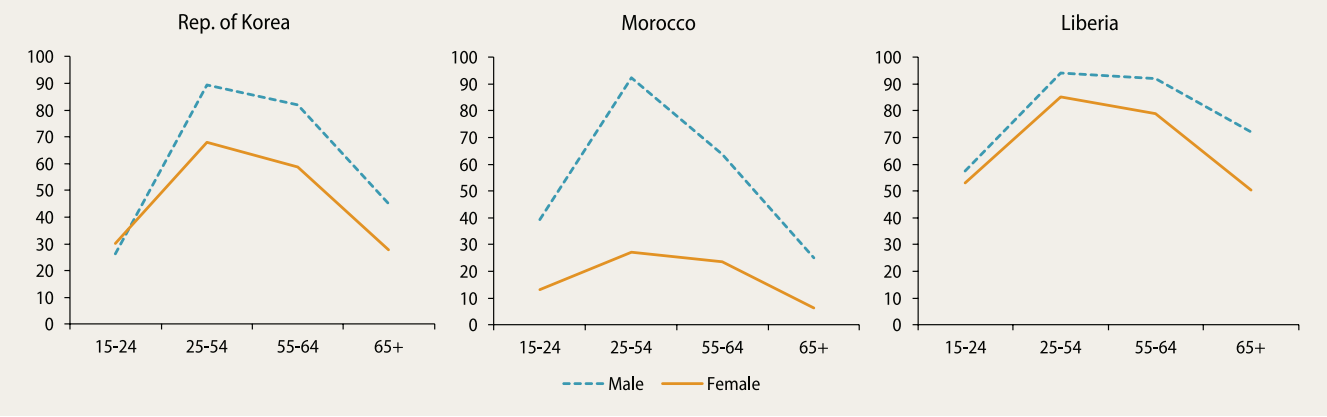
FIGURE 13.2 Labor force participation for older workers falls with a country's income



Source: Estimates based on Staudinger et al. 2016. Refers to 2013 data.

The pattern of participation over the life cycle is similar across country income levels, despite very different levels of participation. Figure 13.3 presents three cases as an illustration: low-income Liberia, middle-income Morocco, and the high-income Republic of Korea. Across these very different countries, labor force participation falls after age 55, for both women and men. In Morocco, where female labor force participation is very low, the pattern for male participation is nonetheless similar to that of both richer and poorer countries, and even among women, there is an inverse u-shape between participation and age. Globally, patterns of age-related change in the balance between paid work, unpaid work (including care for others), personal care (for oneself), and leisure is surprisingly consistent across countries (Ferranna et al. 2022).

FIGURE 13.3 Labor force participation patterns are similar over the life cycle across richer and poorer countries

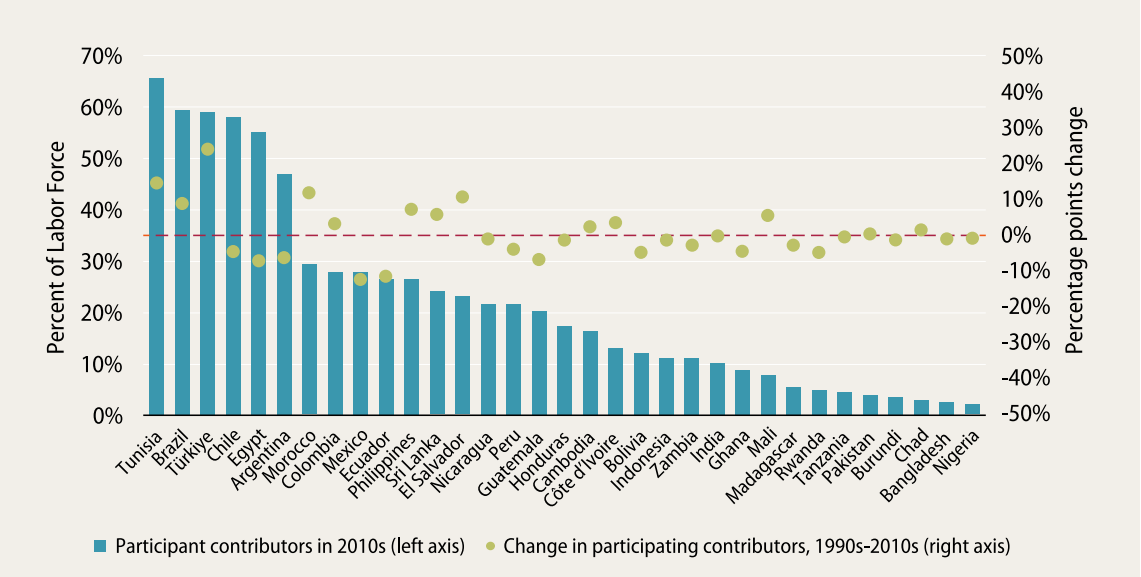


Source: Estimates based on ILO data. Refers to 2019 data.

Gender-gaps among mature workers appear more important in MICs than in HICs. Based on a comparison of a set of middle-income countries with the European Union (EU) and OECD, mature workers in the developing world (i) have higher gender employment gaps and (ii) exit the labor force later, but (iii) with earlier exit for women relative to men (Annex 13.1). The gender gap in labor force participation rates for workers aged 65+ is below 10 percentage points in Canada, Germany, and the United Kingdom, but above 30 for Chile, Malaysia, Mexico, and Türkiye (World Bank 2020). For LICs, the gender gaps are not likely to be quite as dramatic. The poorer the country, the higher the chances that women also have to work as they age. Lacking social protection, many mature workers in LMICs continue working to secure their livelihoods. Data on social insurance in LICs are scarce, but what is available suggests that only a few percent of the population are covered. In MICs, rates of coverage are in double digits but rarely exceed 30 per-cent (Figure 13.4). In some countries, particularly in rapidly transforming economies such as Viet Nam, informality is significantly more prevalent among mature workers than among younger adults (Lam and Elsayed 2021). Even for those covered, adequacy of pension benefits is often low, raising incentives to continue to work informally. Consider Georgia, where the universal pension amounts to 17 percent of the average wage and is projected to fall to as little as 6 percent by 2050 (World Bank 2022a). In a study of mature workers in Argentina, 70 percent of persons receiving a benefit and working reported doing so because their pensions were insufficient to cover needs (Barrientos 2011). In Malaysia, 40 percent of the population are not covered by pensions, and among those covered, many continue to work in old age as their contribution history is insufficient to ensure adequate pensions (World Bank 2020). In a set of Latin American countries, 18 percent of those who receive a pension still work, and their working hours approach full-time and are only marginally lower than those of persons who do not receive a pension (Eclac/ILO 2018). In a global study involving consultations with older persons in LMICs, one-third of participants reported working for pay. What is more, twice as many were willing to work for pay if given the opportunity (UNFPA 2012).

Better-off workers are also considering continuing working later in life, whether to top up retirement income or for other benefits, such as social connections. According to a 2012 Eurobarometer Survey focused on Active Aging, one-third of Europeans would like to continue working after retirement age and two-thirds would welcome opportunities for partial retirement (European Commission 2012). Labor supply elasticities seem to increase significantly over the lifecycle (based on data from the United States) – (French and Jones 2012), showing that incentives can matter greatly for participation.

FIGURE 13.4 In MICs, pension coverage remains low



Source: Rutkowski 2018, reproduced in World Bank 2022b.
Note: The figure shows participation rates in contributory pension schemes from the 1990s to the 2010s. The dashed horizontal line represents no change in rates of contribution over time.

Old-age labor force participation and education interact differently across countries. For HICs, levels of education are a strong determinant for labor force participation at older ages, likely reflecting that education gives access to fulfilling work opportunities and is not associated with physically straining labor (Boissonneault et al. 2020). In poorer countries, however, more highly educated persons are more likely to have access to pensions and/or accumulated private savings that make retirement possible, whereas less-educated persons are more likely to be obliged to work in older age.

Globally, self-employment is more common among older workers than other age groups. Across countries, the 55-64 age group often has the highest rate of self-employment in the working age population (15-64). Compared to EU and OECD countries, mature workers in MICs are more likely to be self-employed.[7] In East and Southeast Asian countries, self-employment rates are nearing 90 percent for older rural men and women; even in urban areas, the share of the self-employed increases as of age 60, reflecting that the self-employed are more likely to stay in the labor market, whereas employees, at least from the formal sector, retire (World Bank 2016). In HICs, self-employment can represent "opportunity" entrepreneurship, a desire to use experience to run a business or lead a more flexible working life. In the United States, the rate of new entrepreneurs is significantly higher in the age group 55-64 than in the age group 20-34 (0.37 vs 0.23 percent). The share of older adults among new entrepreneurs also increased from 15 percent in 1996 to 26 percent in 2018, and older adults are more likely than other age groups to be opportunity driven (Farlie et al. 2019). However, higher rates of self-employment among older workers in LMICs often signal "push factors," such as lack of wage-work opportunities, with higher informality and overall, more precarious employment. In Thailand, for example, informality rates are below 50 percent for workers aged 35-44, but they are nearly 80 percent for those aged 55-64 and over 90 percent for workers aged 65 or more (World Bank 2021b).

Earnings generally increase with age, all else equal, but patterns vary and may depend on age cohort characteristics. A recent global study finds that returns to work experience are significant, at around 2 percent globally, and that education cannot easily substitute for experience. There is significant variation across countries, however. First, as mentioned above, there are higher returns to experience for workers in HICs compared to LMICs. The authors hypothesize that this gap occurs as workers in HICs are more likely to be able to accumulate human capital over time; however, the higher returns could also reflect more access to formal and regulated employment with automatic wage increases that are unrelated to human capital or productivity, or to a higher likelihood of working in firms that are richer in physical capital which can also boost productivity among complementary factors of production. Second, in economies transitioning out of state-led economic systems (former communist economies), skill sets have become obsolete more rapidly than in other countries, and so returns to experience have been lower for specific older cohorts.[8]

In advanced economies, the labor market participation of older workers has increased in the past few decades. In 1996, the average worker in an OECD country could expect to exit the labor force at approximately 62 years of age; in 2016, the age of exit had increased by two years, to 64 (Boissonneault et al. 2020). Between 2002 and 2017, the participation rate for workers between 55 and 74 years increased by 9 percentage points across OECD countries, reversing a decline that had taken place since the 1970s (Geppert et al. 2019). These trends have occurred across OECD countries, across genders, and across socioeconomic groups.

In contrast to trends over the past 20 years, the COVID-19 pandemic has resulted in a significant withdrawal of older workers from the labor market, however. Data from Australia, Austria, China, and the United Kingdom show that older workers were worse hit in the labor market than younger workers by the COVID-19 pandemic, both in terms of quality of work, and in loss of work (Pit et al. 2021). In the United Kingdom and the United States, the largest cuts in total employment were due to older workers (55 and over) who dropped out of the labor market during the height of the pandemic. Many of these workers have not (yet) returned to work and may never do so - once out of the labor

7 See Table 13A.1

8 Jedwab et al. 2021. Chernina and Gimpelson (2022) show, for Russia, that when time, cohort and experience effects are separated, the cohort and experience factors work in opposite directions, reflecting the massive depreciation of skills.

force, older workers are more likely to remain inactive than their younger counterparts (Pizzinelli and Shibata 2022). A study of interstate informal sector migrant workers in India showed a strong and positive correlation between age and income losses during the COVID-19 pandemic (Guha et al. 2020). These outcomes stand in contrast to the Global Financial Crisis, which did not result in a sustained reduction in older workers' participation in labor markets (OECD 2013).

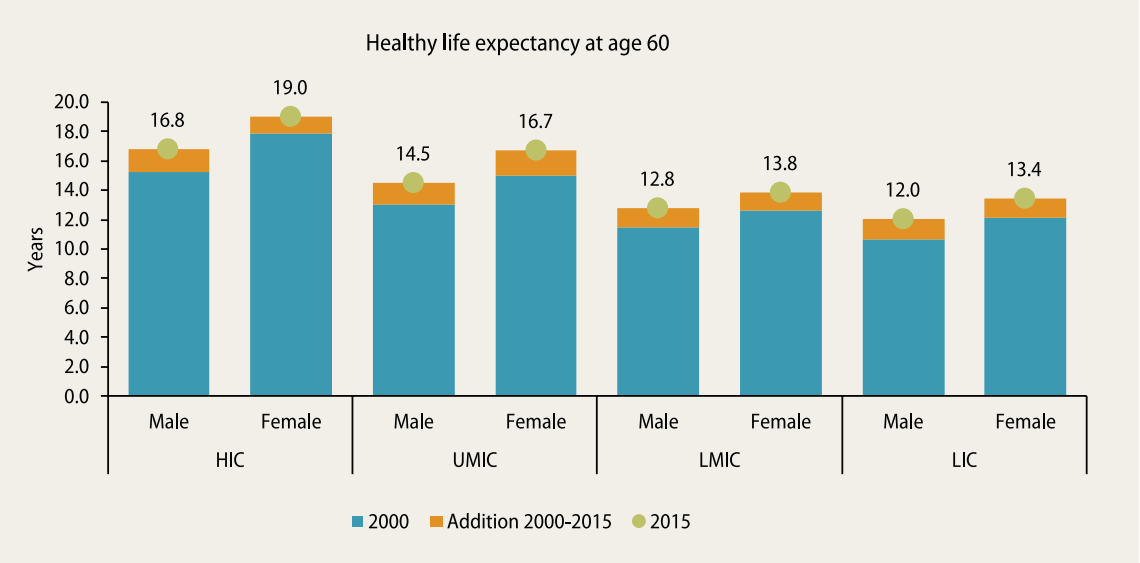
The changing nature of work may be contributing to more age-friendly jobs. Technology is enabling automation of many tasks, but also raises demand for skills that are (still) complementary to technology, such as creativity, problem solving, and socio-emotional competencies (World Bank 2019). Globally, fast-aging countries are seeing higher rates of automation, driven by skills gaps related to specific cohorts (manual production skills) – (Aceɛ moglu and Restrepo 2022). At the same time, in the United States, in parallel to the automation process, jobs have become more "age-friendly": less physically demanding, more flexible, or involving autonomous and team work, for example. These jobs are not necessarily taken by mature workers, however, although they are more adapted to their needs and preferences (Acemoglu et al. 2022).

Human capital and productive longevity

Health and skills – human capital – are central to productive longevity. The increase in labor force participation observed in OECD countries in the past decades can largely be attributed to higher life expectancy and educational attainment, whereas changes to statutory retirement age accounted for less than 10 percent of changes (Geppert et al. 2019).

Before the COVID-19 pandemic, healthy life expectancy had been increasing globally, prolonging the physical and mental ability to work. A strong relationship can be found between health and work in old age.[9] In the past two decades, health-adjusted or healthy life expectancy (HALE)[10] has increased by 5.4 years, from 58.3 in 2000 to 63.7 in 2019 (Figure 13.5). Healthy additional life years have increased across all country income groups, although there are still gaps between advanced and developing countries. By 2015, a woman aged 60 living in an UMIC, could expect to live nearly 17 additional years in good health, all else equal, an increase by 21 months compared to 2000. LMICs and LICs have also seen increases in HALE, albeit somewhat smaller, and women aged 60 can now expect to live in good health for another 14 years. There are significant gender gaps, however: men can expect two

FIGURE 13.5 Healthy life expectancy has been increasing across the globe



Source: Estimates based on WHO statistics.

9 For example, Giles et al. 2012.

10 HALE is the average number of years that a person can expect to live in "full health" by taking into account years lived in less than full health due to disease and/or injury. https://www.who.int/data/gho/indicator-metadata-registry/imr-details/66

fewer years of healthy life than women in HICs and UMICs. These statistics point to a gendered work, life, and health challenge: whereas women are more likely to live longer than men, especially in HICs and MICs, they are less likely to participate in work, especially in MICs.

Working longer can in fact create a virtuous circle of health and work at older age, but the outcome likely depends on the nature of work and employment conditions. Age-related physical and psychological changes can be moderated with physical and intellectual activity and other lifestyle factors (Crawford et al. 2009). Work can bring cognitive stimulation and social interaction, which contribute to continued mental and physical agility. Social interactions at work, which are likely to demand constant adaptation, have been shown to be particularly important to maintain brain capacity (Staudinger et al. 2016). However, prolonging work in (predominantly low-skill) jobs that provide limited stimulation, jobs that cause undue stress, and jobs that are physically straining with high risk of occupational disorders, is bad for healthy longevity (Staudinger et al. 2016, Prinz et al. 2018). The overall employe ment situation also matters, as job insecurity in old age can in fact lead to deteriorating mental health (Gutierrez and Michaud 2019).

Beyond health, skills investments are also critical as demographic patterns shift, since the nature of jobs is also changing, raising the importance of continuous skills development. Across the globe, there is substantial evidence that jobs are becoming more intense in cognitive, analytical tasks. Technological change is resulting in higher demand for technology-complementary skills, both higher-order cognitive skills as well as socio-emotional skills (World Bank 2019). Accessing productive work, hence, increasingly requires a more complex set of skills and adaptive capacity. Evidence from the EU shows that the productivity decline often observed among older workers is more likely due to skills obsolescence than to age itself; in Mexico, wages of college-educated workers have fallen due to a fall in wages of mature rather than young workers, pointing to a similar potential effect (Mayhew and Rijkers 2004).

The aging process need not prevent older people from working productively and learning new things; depending on the task, aging may even be helpful. Aging inevitably involves some cognitive decline. However, both the timing and extent of decline vary significantly across individuals, and the overall rate of decline can, as mentioned, be moderated. Moreover, not all cognitive abilities necessarily decline during aging, at least not before 80 years of age, and some even improve at older ages (Spotlight 13.1). The ability to develop new skills is critical to retaining productivity, however. Whereas improved health is increasing the potential years of work, the shelf-life of skills is falling.11 The evidence on capacity to learn at older age suggests that older adults' learning process is different from that among younger people, but not necessarily less efficient (Picchio 2021; Thomas et al. 2020). In fact, workers can continue to contribute significantly to workplace productivity at older ages, drawing on experience and capacity for judgement. Whereas they may be somewhat slower to complete some tasks, they compensate for lack of speed by executing them better (Backes-Gellner et al. 2011).

Mature workers may also have stronger socio-emotional skills that are in increasing demand. Contrary to common perceptions, mature workers score higher than younger colleagues on broad concepts of job performance, including on reducing counterproductive work behaviors, workplace aggression, and tardiness, all of which are important factors affecting overall productivity. Moreover, mature workers are not necessarily less innovative in the workplace than younger workers (Ng and Feldman 2008). A meta-study found that mature workers generally function equally well or even slightly better than young workers on emotional competencies, which are specifically important for the growing services sector (and arguably for the broader economy, as well) – (Doerwald et al. 2016). A study of German workers in the services sector showed that older workers were more engaged with their work, more confident in their abilities to do the job, and less prone to burnout than younger employees (Johnson et al. 2017).

11 https://www.weforum.org/agenda/2017/07/skill-reskill-prepare-for-future-of-work/

SPOTLIGHT 13.1 Ok, Boomer! The aging brain and implications for work

Brain plasticity - the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions, or connections – declines with age. However, the evidence from neuroscience research on the impact of the aging brain and cognitive decline is mixed, at least for ages up until the 70s. The brain changes, but different functions combine and collaborate and can, in some circumstances, compensate for the reduction in brain plasticity. For example, the ability to receive information declines relatively early, but the capacity to direct information and act on the information (orienting and executive functions) can in fact increase, well into the 70s. Changes in cognitive skills are hence not uniform over a lifetime. Whereas some skills such as verbal memory and perceptual speed peak relatively early in adulthood, other skills such as verbal ability or auditory comprehension, which draw on orienting and executive functions, peak much later, often after 50 years of age. As a result, the aging brain may in fact retain a high degree of functionality.

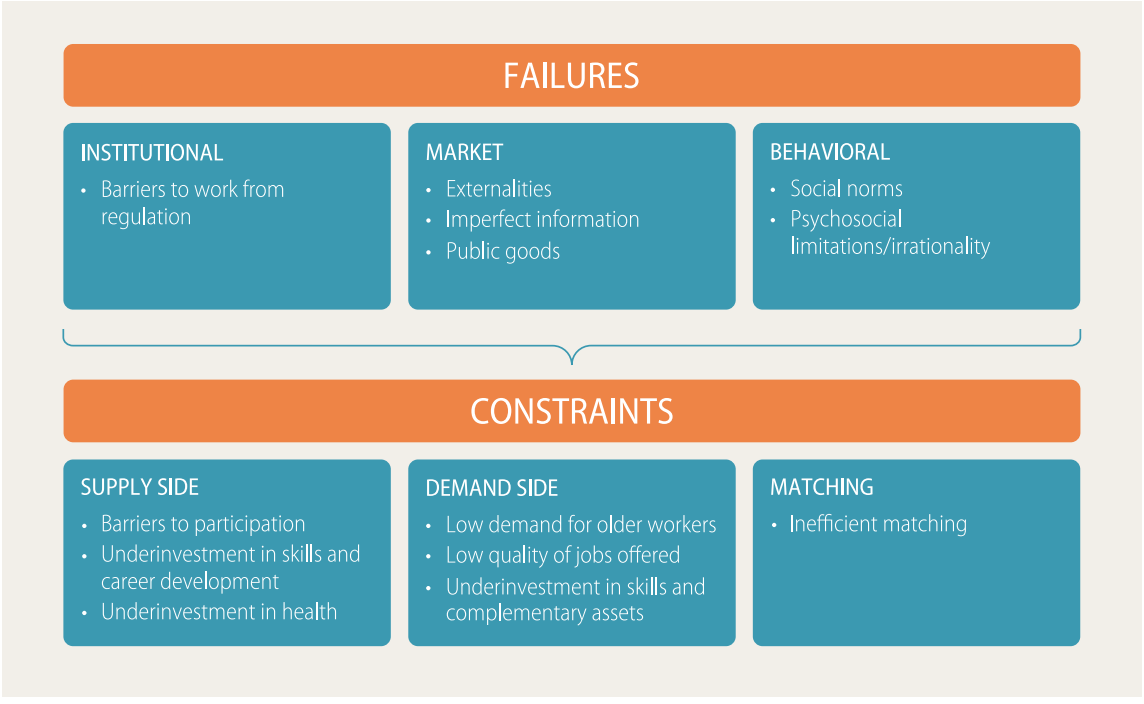
There is conclusive evidence that promoting mental and physical health as well as continuous brain exercise helps in slowing cognitive decline. Individuals who follow healthy diets and practice physical training, social activities, and education and training see slower decline in cognitive capacity and higher subjective well-being. This creates a positive feedback loop, as a workplace may be an effective mechanism to retain cognitive status with Intellectual engagement and cognitive stimulation.

Source: Veríssimo et al. 2022; Desjardins and Warnke 2012.

WHAT HOLDS BACK PRODUCTIVE LONGEVITY?

What can be done to promote longer and more productive working lives? Several factors can constrain mature workers' participation in the labor market and their productivity at work. This section presents a framework highlighting constraints that can affect mature workers' incentives and ability to work and do so productively, employers' incentives to hire or retain them and invest in their human capital, and matching between demand and supply (Figure 13.6). Throughout the remainder of the chapter, we try to identify LMIC dimensions where possible.

FIGURE 13.6 A policy framework for longer and more productive working lives



Source: Original figure for this publication.

Institutional, market, and behavioral failures create constraints for mature workers and the firms that may employ them. *Institutions* and *policy and regulatory frameworks* affect incentives and opportunities for workers to engage, and for firms to hire them. Examples include labor regulations and social protection, including pensions. *Market failures* include missed-out externalities from more skills development or better public services (including care services), imperfect information about workers' ability, or the public-good nature of some investments in health or education. Finally, *behavioral constraints* include social norms around who works, or internalized ageism – prejudice or discrimination on the grounds of a person's age.

Supply-side constraints: Incentives and ability to work productively

To extend working lives with productive employment, workers need to (i) have the incentives to work, with institutions and regulatory frameworks that allow for it and do not discourage it, including in ways that accommodate changing preferences; and (ii) the skills and health necessary to be employable, particularly in the context of a rapidly changing world of work. We discuss these two areas in turn.

Labor regulations, tax systems, and social welfare systems can significantly influence or outright dictate opportunities for work beyond retirement, with both positive and negative effects. Mandatory retirement ages, legal impediments to partial retirement, or unfavorable regulations for part-time work or flexible work arrangements or pay may outright prohibit or make it less attractive for workers to continue. China's retirement rules still oblige men to retire at 60 and women at 55, or 50 for specific, physically more burdensome jobs (OECD 2019a). Almost half of the world's countries, the vast majority LMICs, have limits on the use of fixed-term contracts.[12] On the other hand, employment protection legislation favoring tenure may allow workers to stay on the job and retain their wages. Taxation of earned income in addition to pensions and second-earner taxation tend to rapidly increase the implicit tax rate on work with age (Butrica et al. 2006). Taxation appears particularly important for groups with higher inactivity rates (and thus a larger labor supply reserve), including women and low-skilled workers, and for populations with highly elastic labor supply, which includes many older workers (Meghir and Phillips 2010).

Social welfare systems, including the level and structure of pension benefits as well as unemployment or disability pensions, can further affect incentives to work. In many countries, formal sector workers enjoy relatively generous early retirement rules, creating incentives to retire early (Bussolo et al. 2015, World Bank 2016). In East Asia and Pacific countries, retirement ages in national pension schemes are relatively low compared with life expectancy at age of retirement (World Bank 2016). The design of other social welfare programs also matters. If mature workers are eligible for prolonged unemployment benefits, or if the requirements for job search in unemployment or disability-benefit programs are waived for them, are too lax, or are weakly enforced, alternative pathways to leaving the labor force without jeopardizing retirement benefits open (Ahlqvist and Boren 2017; Kyyrä and Ollikainen 2008). Such loopholes can hence reduce the impact of pension reforms aimed at increasing retirement ages.[13]

Pension income, whether through contributory or noncontributory systems, can be an important factor in determining workers' participation choices in middle-income countries. Analysis of the impact of the early retirement age in Central Europe and the Western Balkans shows that pension receipts are significantly and negatively associated with labor force participation (Bussolo et al. 2015, Gragnolati et al. 2011). In Argentina, widening the eligibility for noncontributory pensions lowered labor force participation rates by 5 percentage points and increased informal work (Bosch and Guajardo 2012). The South African social pension program has been shown to reduce employment among the elderly (Baird et al. 2018[14]). These experiences appear consistent with historical evidence from more advanced economies. The introduction of a social pension from age 70 in the United Kingdom, some 100 years ago, lowered labor force participation rates by 6 percent, even with a very low adequacy

12 Data from World Bank Employing Workers Database. The median limit is three years (36 months) for cumulative contracts.

13 Pension reform during recession in Germany resulted in alternative pathways pushed by employers - unemployment and partial retirement (Lorenz et al. 2020).

14 The paper shows that cash transfers in general do not lower aggregate labor force participation, however.

of benefits (Gisecke and Jäger 2021). As systems expand, it is important to make sure that programs remain incentive-compatible.

Information gaps due to limited financial literacy can also impact retirement choices for those covered by pension systems. Understanding the expected level of benefits and how that will impact welfare in older age is a prerequisite for making rational labor market decisions. Surveys in Sweden and Ireland show that knowledge of future pension benefits is at best limited, and that the most economically vulnerable groups know the least about their future benefits (Elinder et al. 2020, Barrett et al. 2015).

In addition to rethinking pension systems, flexible work arrangements may be needed to accommodate work preferences that change with age. There is evidence that mature workers need and value flexible work arrangements, including both those related to flexible time schedules and changes in work roles and assigned tasks, and that providing such arrangements serves to delay retirement (Atkinson and Sandiford 2016). Particularly in HICs but also in some middle-income countries, COVID-19 has given rise to structural changes in the organization of work, with a rapid move towards more home-based and flexible solutions for many white-collar jobs, as well as a shift to independent work, that over the long run may benefit working conditions for mature workers (McKinsey Global Institute 2021).

Family and the availability of care services also matter for labor market participation, especially for women. Grandmothers all over the world hold a central responsibility for the care of their grandchildren, and hence support the labor market participation of the parents of these children. Towards the end of working life, many are also caring for elderly parents or even their spouse. In Europe, one-third of grandparents provide regular care and women who do are also less likely to be working (Backhaus and Barslund 2021). Care obligations are even more prevalent in LMICs, where three in four elderly people live in the same household with members of younger cohorts, compared to one in four in HICs, and where formal care services are often lacking in supply and quality (UN 2007). A study of time use allocation in a set of OECD countries, China, and India, showed that the time share allocated to paid work fell successively as of age 45-50 across the sample, whereas unpaid work was highest when people were in their late 30s (likely related to childbearing and rearing), and again increased after age 60 (Ferranna et al. 2022). In countries with significant outmigration, whether international or intranational, grandparents may be the main caregivers in so-called "skipped-generation" households consisting of only older people and children (UNFPA 2012). Studies from Brazil, Mexico, and Thailand show that grandmothers' care obligations affect both their participation and hours worked negatively (Attanasio et al. 2022, Paweenawat and Liao 2021).[15] Since families are often formed relatively early in life, many of these grandmothers in LMICs often have significant potential working years ahead when they leave the workforce, reduce hours, or move to less-demanding activities. Spouse employment is also generally positively correlated: to retire is a joint decision, made with a view to spending time together (Giles et al. 2012). A study from Russia showed that having a working wife is associated with a 13 percentage point increase in the probability that a pension-age husband will still be employed (Levin 2015). In urban China, a working spouse is associated with as much as 40 percent and 58 percent increases in the probability of men and women working, respectively (World Bank 2016).

Lack of safe and reliable transportation systems affects mature workers' access to productive opportunities. More care responsibilities, lower stamina and physical strength, and related vulnerability to crime means that mature workers depend heavily on quality transportation services. A survey of senior workers in the United States suggested that lack of reliable transportation was a somewhat serious or very serious obstacle to working for 82 percent of respondents (NCST 2011). Research on the impact of safe, affordable, reliable, and effective transport systems for elderly is lacking. However, limited access to safe transportation is estimated to be a major constraint for women's participation in labor markets, reducing their participation probability by 17 percent (ILO 2017). Underdeveloped transport systems in LMICs are likely to similarly reduce access to work for the older population.

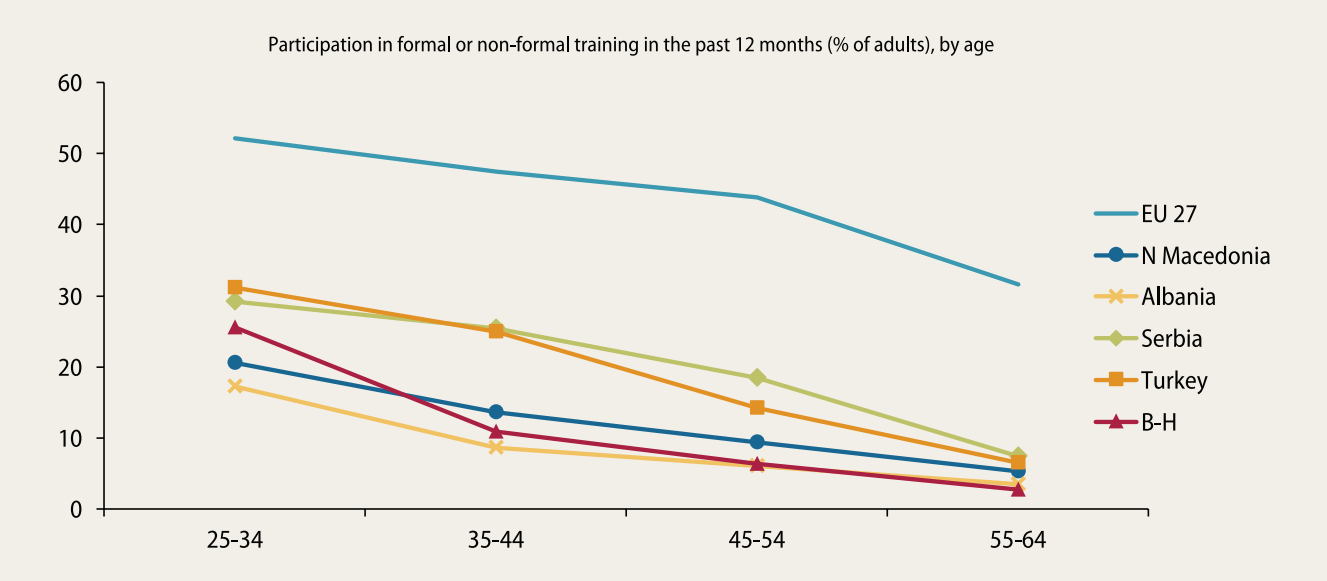
Psychosocial factors may generate additional disincentives for work. If individuals internalize social norms and stereotypes around age versus capa-

15 A study from Mexico also showed that female labor participation of a mother was not negatively correlated with more children, but that co-habitation with grandmothers increased in response to more children (Schmieder 2021).

bilities, responsibilities, and work, their incentives and even capacity to work may be reduced. Individuals who self-identify as being older risk considering that they are too old for certain jobs, for changing jobs, for promotion, or for developing their skills further, and that they should not crowd out the younger generation (Vickerstaff and Van der Horst 2021). There is evidence, for example, that "health pessimistic" individuals prefer exiting the labor force earlier than others, even when actual health levels are not different from other workers. Unsurprisingly, those with higher education and income appear to have more positive self-perceptions of aging than people with lower incomes and education (WHO 2021). Gender and social class also influence own perceptions of optimal exit age (van der Horst 2019).

Beyond issues of regulations, incentives, and other barriers, mature workers often underinvest in skills development in ways that hamper their labor market prospects and lower the opportunity cost of retiring. Although skills upgrading is essential to remaining relevant in labor markets, participation in adult learning is low overall, especially for mature workers and in LMICs. Figure 13.7 shows, for EU member countries as well as five European MICs, that (i) training is lower in the European MICs than in the EU HICs, but (ii) the incidence of training monotonically falls with age across all countries. Low incidence of training is partly due to underdeveloped labor market and career guidance information systems and services and limited and fragmented markets for training (including for firm-provided training, discussed below). However, even where subsidized adult training programs are provided, take-up is often low (World Bank 2019), and there is some evidence that the mature workers who would be most in need of upskilling – those with lower levels of education and lower wages – may also be the least interested in or able to participate in training (Generation 2021). Workers may lack information on the value of training, what skills to acquire, or what training opportunities are available. Retraining at older ages may also seem more challenging, discouraging take-up. Workers may choose to not invest in training if they will not receive fair remuneration for their higher productivity (Almeida et al. 2012). Lack of training is arguably particularly problematic in LMICs, where human capital among workers is lower overall and intergenerational human capital gaps are high. Since skills development is often cumulative and skills demand can change quickly, the skills gap is likely to compound over time.

FIGURE 13.7 Participation in formal or non-formal training, by age



Source: Estimates based on Eurostat data. Refers to 2016 data.

Poor health is also reducing both participation and productivity among mature workers. Good health is a critical asset for productive work and a central component of human capital. Healthy older people are more likely to participate in the labor market, although again, in poorer countries, those in poor health may still be obliged to work to the extent they can. Health is not the focus of this chapter and is not reviewed in detail here. It is worth noting, however, that health interventions may be included among low-hanging fruit for addressing productivity constraints in low- and middle-income settings. One area is nutritional deficiencies occurring as seniors need fewer calories but more nutrient-rich meals with age; other areas are broader lifestyle choices that influence later development of non-communicable diseases (NCDs). The compression of morbidity and the extension of good health into later years permits longer returns to continuous investment in education.

Demand-side constraints: Incentives and ability to hire and invest in mature workers

This section looks at employers' incentives to retain or hire mature workers and adapt working situations to increase their productivity. Factors that constrain relevant opportunities include informal and formal institutions governing employment and wages, market failures that restrict the quantity and quality of training, and psychosocial and normative barriers to employers' recognizing the potential of older workers.

Regulations and informal institutions around wage setting may raise labor costs for mature workers above productivity and hence lower their attractiveness to employers. There is significant evidence that job tenure or seniority leads to higher wages in ways that may be disconnected from productivity increases. In OECD countries, 10 additional years spent in a job with the same employer increase wages by nearly 6 percent on average, all else equal (OECD 2019b). Wages appear to rise even more sharply with tenure in at least some LMICs, compared to HICs (Donovan et al. 2020). A study of seniority wage setting and firm-level productivity among Brazilian firms showed that wages were in fact unrelated to productivity; a study in the Netherlands found a similar disconnect between wage levels and performance (Rocha 2017, Dohmen 2003). In many East Asian countries, the seniority wage-setting practice is strong, and performance-based pay practices are not implemented (World Bank 2016). Wages that rise above productivity levels risk lowering the competitiveness of mature workers. Analysis of firm-level data in East Asian countries shows that seniority wage practices indeed are strongly and negatively correlated with hiring workers in the age group 50-64.[16]

Formal regulations also matter for labor costs and may shift these above mature workers' productivity levels. First, social contributions increase with wages. This can contribute significantly to raising labor costs, as in some countries social insurance contributions are very high – e.g., 45 and 36 percent of wages in Argentina and Brazil, respectively.[17] Especially in the presence of asymmetric information, the cost of hiring older workers may therefore be higher (OECD 2019b). If productivity does not increase in parallel with social contributions, unit labor costs for mature workers increase. A survey of UK employers suggested that pension costs were the main deterrent to hiring mature workers – more important than the limited time frame for return on investments in skills, or any perceived lack of skills (Auer and Fortenu 2000). Similarly, employment protection legislation (EPL) can increase the costs of labor adjustments, as many regulations imply higher costs with longer job tenure. Globally, the average number of weeks' pay required as severance in the case of dismissal increases from three for workers with one year of tenure, to 21 for workers with 10 years of tenure. In Indonesia, a worker with 10 years of service receives an average severance payment equal to 22 *months* of wages.[18] Strict EPL may be one of the reasons for not hiring mature workers (Bussolo et al. 2015).

"Ageism" and social norms, including those reinforcing age stereotypes, also make the hiring of older workers more difficult. The assumptions that mature workers are frail, stubborn, less capable of learning, and technologically challenged can result

16 At the same time, seniority wages may have other underlying rationales, as firms may purposedly set wages below productivity levels for younger workers and above productivity levels for older workers, to foster firm fidelity (Zwick 2009).

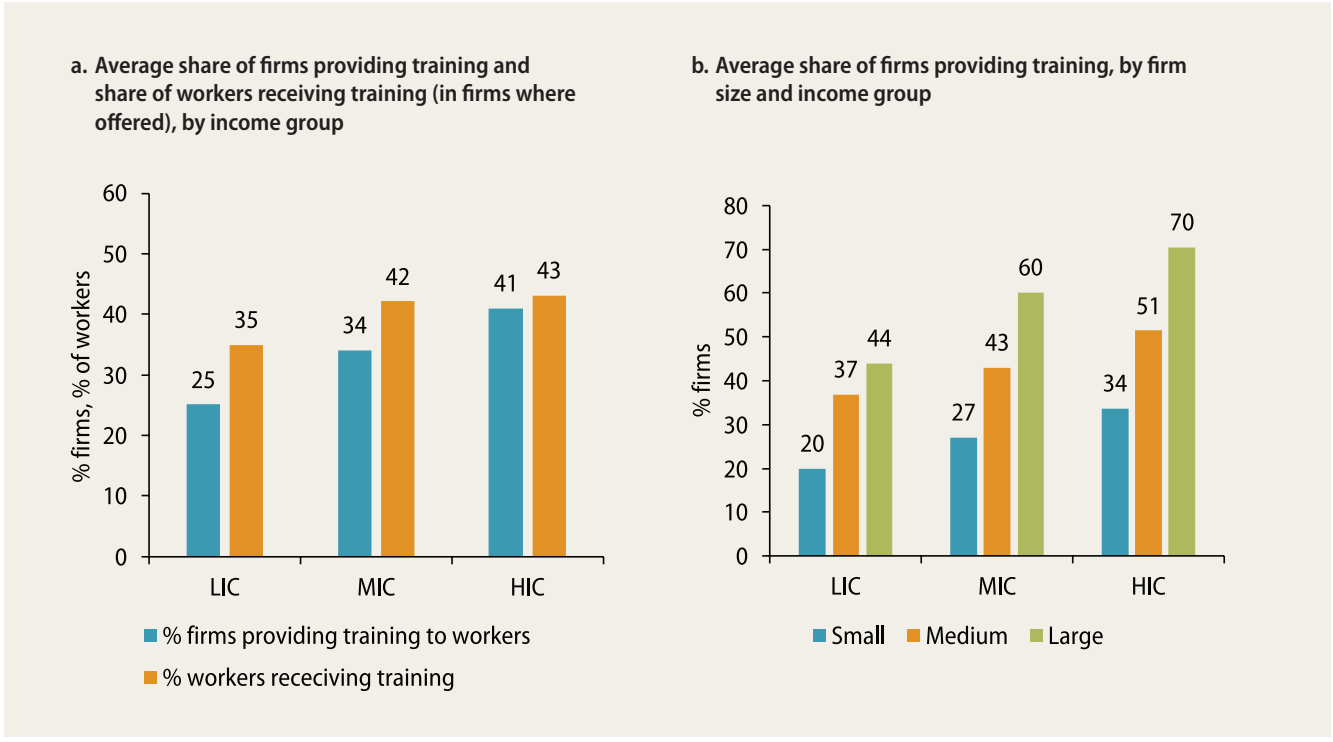
17 https://iuslaboris.com/insights/comparing-social-security-contributions-rates-across-latin-america/

18 Estimates based on Employing Workers Database, https://www.worldbank.org/en/research/employing-workers

in age-stereotyped hiring practices and workforce management practices that reduce the productivity of mature workers—for example, if mature workers feel insecure about their jobs and thus invest less in skills (Jin and Baumgartner 2019). There is significant evidence of biased perceptions and management practices with respect to older workers within firms. A survey by Generation 21 across Brazil, India, Italy, Singapore, Spain, the United Kingdom, and the United States showed that 38 percent of managers considered mature workers unwilling to take up new technology, 27 percent considered them unable to learn new skills, and 21 percent answered that mature workers did not work well with other generations. Yet, when hiring workers, the same managers valued experience above all (Generation 2021). In countries lacking age discrimination legislation, practices such as defining upper age limits for job vacancies – and to some extent mandatory retirement ages – outright discriminate against mature workers (OECD 2019b). A survey in EU countries found that a majority of respondents thought that being over 55 years of age put job applicants at a disadvantage (European Commission 2015). An experimental study in Sweden showed significant and independent negative correlation between being older and the chances of being called for an interview, and callback rates began to decline for workers already in their early 40s (Carlsson and Eriksson 2019). A similar approach for the United States provided robust evidence of age discrimination against older women, but not against older men (Neumark et al. 2015). In Deloitte's 2018 Global Human Capital Trends report, 20 percent of business leaders viewed older workers as a competitive disadvantage, and in countries such as the Netherlands, Russia, and Singapore, this percentage was far higher; some 15 percent also felt the older employees to be blocking rising (young) talent (Deloitte 2018).

Firms—particularly small and microenterprises— generally invest little in skills development for their workforces, despite the importance of skills for firm productivity. Individuals' low investment in their skills development is thus mirrored in underinvestment by employers. The World Bank's enterprise surveys show that only one-third of firms offer training to their workforce, and those that do, invest in a minority of their workers (Figure 13.8a and b). Across country income groups, small and micro-firms are the least likely to offer training, and firms in LMICs are less likely to offer training compared to firms in HICs, for each size class of firms.

FIGURE 13.8 Access to training through employers is limited, especially in LMICs



Source: Estimates based on World Bank Enterprise Surveys.

Several market failures may help explain firms' underinvestment in skills beyond formal education.[19] Firms may underinvest because training to some extent is a public good, and they risk losing the returns to investment if other firms "poach" the skilled workers, and more generally due to high worker turnover. Managers may lack accurate information about what skills will be needed, the value of training for productivity, earnings, and employability, or what training opportunities are available (Almeida et al. 2012). Financial institutions that likewise lack understanding about training and the impact on productivity can restrict credit for training purposes. Coordination failures arise when firms cannot find productive workers and therefore cannot increase pay, whereas workers underinvest in skills because they will not be rewarded, and the training offer remains underdeveloped. In principle, the time horizon for reaping the benefits of skills investments by firms is shorter for mature workers, which may also create disincentives to invest in their skills.

Firms may also underinvest in other complementary strategies that are valuable to increase the productivity of older workers. Relevant technology tools, more ergonomic working conditions, health literacy, and other health interventions, as well as organizational changes such as multi-age teams or flexible working arrangements may be needed. As in the case of skills, firms may lack the knowledge or resources for such investments (Söderbacka et al. 2020, EU-OSHA 2016).

Intermediation: Effective matching services for mature workers

Even when mature workers have the necessary skills and health, and firms are prepared to hire them, the search and matching process between jobs and workers in the labor market may be costly and lengthy, particularly for older workers.

Public and private employment services may have limited capacity to serve older workers. Public employment services exist in most developing countries (nearly 80 percent in 2020), and a majority provide both job placement, counseling, and training services.[20] However, official retirement age is often set as the upper age limit for program eligibility, excluding older workers. Moreover, services such as job search support or training may be poorly adapted to older workers. Caseloads for employment service case workers often exceed the levels recommended by the ILO (1:100), suggesting limited capacity to provide tailored services to a group with specific training and other needs. The increase in e-government services in high- and middle-income countries needs careful design and outreach efforts to reach mature workers. A study of employment services' self-service tools in the United States found that these features were least used by mature workers precisely because of lower digital skills (D'Amico et al. 2009). The risk of exclusion may be even higher in LMIC settings, given lower levels of education and skills. Digital gaps are likely to have worsened the impact of COVID-19 on mature workers' employability as employment support often moved online.

Lack of job and career search skills among mature workers may also be holding back matching opportunities. Digital skills are increasingly important in identifying and applying for job opportunities (as well as increasingly important for the job itself). However, globally, digital literacy is lower in the older generation (ITU 2021) and the gaps are likely to be higher in LMICs, where age-related gaps in literacy and education are also higher.

19 See the framework presented in Almeida et al. 2012.

20 Estimates based on World Bank Unemployment Protection and Employment Services Database.

PRODUCTIVE LONGEVITY: WHAT COULD WORK IN LMICS?

This section presents evidence for interventions directed at individuals and families (supply side), at firms (demand side), and at employment services in charge of labor market intermediation. Across these dimensions, we identify policies that could raise incentives and remove barriers to accessing work, and those that could foster productivity by raising human capital and especially skills (there is limited evidence on health). Policies aimed at increasing labor force participation are largely focused on formal sector workers, for whom regulatory reform is relevant. Formal sector workers are more likely to have resources (and thus incentives) to retire, but at the same time are more able to continue working and with higher productivity, than workers in informal, low-productivity jobs. Human capital policies, by contrast, are also relevant for the informal sector.

In identifying relevant literature, we have given priority to studies that present results for LICs or MICs and to rigorous evaluations, to the extent possible. However, the policy agenda focusing on productive longevity is relatively recent and the evidence on policy effectiveness limited, especially for LMICs. Where evidence for mature workers in LMICS is scarce, we focus on the impact of similar interventions for other groups, or for HICs, and discuss potential differences that would need to be considered when drawing lessons from these experiences.

Supply-side interventions: Improve incentives and remove barriers to work while investing in skills development

This section discusses evidence on regulatory reforms to improve work incentives and make work pay for mature workers, along with improvements in services and skills development aimed at increasing the ability and capacity of mature workers to work longer and more productively.

Reforming social insurance and labor taxation

Reforms to social insurance focused on increasing retirement age and reducing work disincentives in the design of pension schemes can play a role in extending working lives for formal sector workers. Across OECD countries, comprehensive social security reforms of contributions, benefits, and retirement ages are planned or have already been implemented (Boissonneault et al. 2020). Raising retirement ages has resulted in postponed retirement and higher employment rates among mature workers. Raising retirement ages in Austria and Germany, for example, resulted in increases in employment by nearly 10 percentage points for the affected groups (Riphahn and Schrader 2021; Staubli and Zweimuller 2013). Many middle-income countries in East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, and the Middle East and North Africa have also reformed their pension systems. The objective has primarily been to increase financial sustainability, and labor market impacts have not been systematically studied, however.

Pension reforms require careful attention to the entire social insurance system. As discussed above, increasing retirement age may also result in a more intensive use of alternative pathways into inactivity, such as unemployment, disability support, or partial retirement – especially for low-wage and less healthy workers, and especially during recessions. In the studies of Germany and Austria cited above, for example, some mature workers transitioned into other forms of social insurance support. Countries have consequently embarked on a parallel set of reforms to close loopholes, including abolishing the right of older unemployed persons to waive job search requirements when accessing unemployment benefits (Ardito 2021; Lorenz et al. 2020; Staubli and Zweimuller 2013).

Relaxing partial retirement rules is a commonly proposed reform to retain workers, but when designing and implementing such policies, it is also important to consider potential negative impacts. Studies show that flexible working arrangements giving workers choice and control are linked to better health and wellbeing (Graham 2014). When surveyed, workers report favoring arrangements that would allow them to adjust the timing and speed of labor market exit according to their preferences (OECD 2017, Henkens et al. 2021, Munnell and Walters 2019). However, partial retirement options in OECD countries do not appear to increase total working hours, largely because they also afford the opportunity to retire earlier than planned (OECD 2017). There is also some evidence that partial retirement regulations can have a negative effect on hiring older workers or be used as an alternative pathway for retrenchment (Busch et al. 2021). Partial retirement may be incompatible with job and task bundling, especially for high-skill jobs, and may raise the cost of mature workers, which in turn

reduces incentives for hiring (Lorenz et al. 2020, Munnell and Walters 2019).

Pension reforms carry high political costs, pointing to the importance of getting the design right from the outset. In Europe, several countries have reversed earlier reforms by postponing, limiting, or outright reversing existing or planned increases in early or normal retirement ages (Fouejieu et al. 2021). More generally, the experience of both advanced and developing economies shows that design flaws in social protection systems can take many years to untangle and may carry very high fiscal *and* political costs. Countries seeking to expand social protection systems therefore should incorporate lessons learned to ensure sustainability from the outset and avoid painful reforms later.

Incentives to work increase as people receive information on future pension income. Evidence from the United States shows that the framing of public messages regarding pensions matters for when benefits are claimed. Low-cost interventions (informational brochures, invitation to a short web-tutorial) informing older workers about expected pension benefits increased labor force participation one year later by 4 percentage points relative to the control group (Liebman and Luttmer 2015). Pension reforms have routinely been accompanied by financial education information campaigns in the OECD (OECD 2008). No equivalent research is yet available for LMICs, but there is evidence that information campaigns geared towards changing jobs and career decisions, for example financial education or career guidance, can impact individual and family choices (OECD 2008).[21]

Labor regulations can also allow for greater flexibility in work arrangements to accommodate varying and changing needs among mature workers. For example, allowing for more part-time work, temporary work, or fixed-term contracts, can in fact serve mature workers looking to adapt their working schedules. Between 2007 and 2019, over 100 countries undertook significant reform of employment regulations, including on fixed-term contracts, severance payments, annual leave, and working-time arrangements, but there is no evidence regarding the impact on employment for mature workers (Kuddo 2018 and World Bank 2019).

Tax reform can reduce disincentives to work. This is especially the case for workers with a larger reserve labor supply, typically women, less-educated workers, and mature workers (Meghir and Phillips 2010). OECD countries (Australia, Denmark, the Netherlands, Sweden, and the United Kingdom, among others) have introduced tax credits, in some cases with the credit increasing with the age of the worker. Tax credit reform linked to pension reform increased participation among mature workers in Sweden, except for self-employed and higher-earning workers, among whom the "slack" may be smaller (Laun 2017).

Improving access to quality services

Subsidizing child- or other forms of care for family members can improve labor market participation and earnings outcomes. Affordable childcare or long-term care for sick and elderly persons can relieve mature workers from informal care burdens and help them manage personal and professional commitments. In Rio de Janeiro, Brazil, a lottery was used to allocate public center-based daycare to households. Access to daycare centers was associated with sustainable increases in household income, due to grandparents' increased labor income. Grandparents' earnings, likelihood of employment, hours worked, and social security contributions increased measurably (Attanasio et al. 2017). This positive association between care services and participation is consistent with research on the impact on women's labor market outcomes of different forms of childcare provision in Latin America, Russia, and the EU, where studies have found strong effects on activation, employment, and hours worked (Mateo Diaz and Rodriguez-Chamussy 2016, Del Boca and Locatelli 2006, World Bank 2017). A quasi-experimental study in Spain focused on the implementation of successive care-subsidy reforms, involving cash subsides as well as care services. It concluded that changes in care subsidies had a stronger effect on early retirement decisions than reforms tightening options for early retirement (Costa-Font and Vilaplana-Prieto 2022).[22]

Safer transportation helps vulnerable groups access jobs. In Lima, Peru, an improved urban transport system led to significant gains in employment and earnings for women (but not for men). This demonstrates that infrastructure investments that make it more convenient and safer to use public transport can generate important labor market

21 For example, see Jensen 2010, 2012, Alzúa et al. 2021, OECD 2021. Information on trade-specific earnings, for example, can have substantial effects on women's choices to enter comparatively high-earning trades traditionally reserved for men (Gassier et al. 2022).

22 Cash subsidies can have both positive and negative effects on caregivers' labor force participation, as income effects may reduce participation.

impacts for groups that are more vulnerable to personal safety threats during travel, that have care obligations that compel them to work closer to home, and that rely heavily on efficient transport modes (Martinez et al. 2019). Better transportation is similarly likely to improve mobility for mature workers who depend on public transportation but who may also be vulnerable when commuting.

Strengthening human capital

Subsidizing skills training, and addressing skills-information asymmetries, is a common strategy for increasing workers' employability, but requires careful design. With the right training methods, adults and mature workers can learn new skills to good effect (Knowland and Thomas 2014). Tailoring programs to serve the needs of older workers will be essential. First, the design of training interventions needs to consider training modalities (see below), motivation among individuals and employers for taking up training offers, and the need to build capacity in the training sector (Glick et al. 2015). Second, the deadweight and substitution losses associated with training can be high (McKenzie 2017a) and, on average, many training programs fail to have any impact. However, results vary tremendously, and impacts can grow over time, suggesting that design and targeting are key (Card et al. 2018).

Training that is not adapted to older workers' needs could reduce the value of training. Some studies have found that the training of older workers has lower impacts on key dimensions such as learning, career development, earnings, or job security, and that older employees can be less ambitious in their training participation (Zwick 2011). The generally low uptake of adult training programs is at least partial evidence that many current programs do not fulfill needs. A likely reason is that many training programs are not adapted to older workers' capabilities and learning styles: notably, they do not provide informal and self-paced learning and work-integrated approaches or make use of older workers' cognitive strengths, such as the capacity to direct and act on information received (Spotlight 13.2) – (Picchio 2021). In countries with high informality, training programs that do not factor in the opportunity cost of attending training for workers' earnings are likely to be less effective, as are programs that fail to ac-knowledge how high-stress life circumstances may affect workers' mental capabilities (Saraf et al. 2018).

Countries are using different instruments to increase individual access to, and incentives for, life-long learning, including voucher schemes and training subsidies. With individual learning schemes (including vouchers, individual learning accounts, and training savings accounts), individuals choose their own options for skills development (Spotlight 13.3). Voucher-based systems can help stimulate training, especially for workers in non-traditional or less stable forms of employment. Voucher systems have had mixed success, however, especially for hard-to-serve groups such as low-skilled workers. Experience shows that simple design, adequate and predictable funding, effective information and guidance, and a focus on supporting high-quality training matter significantly (OECD 2019c). Specific outreach efforts are needed to target low-skill groups, as well as employers, and encourage them to co-invest in skills development (OECD 2019c, Vodopivec et al. 2019). For example, an information campaign on a training program in Germany succeeded in stimulating uptake only for workers below age 45, suggesting that older workers were considered less interesting due to limited pay-off time (tenure) or lower ability (Van den Berg et al. 2018).

SPOTLIGHT 13.2 Gray matter – training for the aging brain

The way in which the brain learns – develops new skills – differs over the lifecycle. As discussed in Spotlight 13.1 above, the aging brain gets better at using prior experiences and knowledge to find solutions to new problems, and it can even do this much faster than a younger brain. Hence, adapted training methods and support can foster an effective learning process at older age.

Older employees get higher returns from informal and directly relevant training and from training contents that build on their ability to apply and use previously acquired knowledge and experiences. Learning programs should therefore exploit rules and regularities and allow for self-paced, job-related, and work-integrated training modes.

Source: Picchio 2021, Thomas et al. 2020, Knowland and Thomas 2014.

SPOTLIGHT 13.3 Individual learning accounts to foster adult learning

Individual learning accounts (ILAs) provide people with direct support through training entitlements in individual accounts and are recommended by the European Union (EU) Council as a policy to facilitate the "twin transition" to a more digitally capable and green Union. The training entitlements offered through ILAs are associated with the individual and as such fully transferrable across transitions between jobs, from job to learning, from employment to unemployment, and between activity and inactivity. Thus, they can be accumulated and used over a lifetime. To deliver higher skills accumulation, these accounts need to be embedded in a broader framework addressing other skills constraints, including the availability of high-quality and relevant training opportunities, information and guidance services, paid training leave, and skills recognition frameworks. To achieve adequate funding, cost-sharing arrangements involving funds from the public sector, private sector, and social partners can be considered.

Source: European Union Council 2022 and OECD 2019d.

Mature workers' motivation and aspirations can be strengthened with targeted training and organizational approaches. Experience from entrepreneurship and employment programs in LMICs shows that trainings focused on psychosocial, or "mindset," components have contributed to successful labor market (or business) outcomes, sometimes more so than technical training.[23] These trainings focus on, *inter alia*, future-oriented and proactive thinking and a "can-do" attitude. This type of training, when delivered adequately, could be helpful to mature workers who may need or want change in their work in order to stay engaged longer. Training programs including relatable role models have been successful, for example in Chile and Kenya. The exposure to a role model was, in fact, more important than the information or training the role model provided (Lafortune et al. 2018, Brooks et al. 2018). There is evidence that older people continue to identify role models in their working life just as younger people do; that these role models could be significantly younger than the workers themselves; and that being able to identify role models played a significant part in worker commitment and satisfaction (Gibson and Barron 2003). Giving mature workers the opportunity to participate in teams comprising people with varied backgrounds and skills could help provide such role models and thus raise motivation and aspirations; and would support higher overall productivity (Göbel and Zwick 2013). Generation, a non-profit organization focused on fostering productive labor market transitions, offers a wide range of support including mentoring and networking (Spotlight 13.4).

SPOTLIGHT 13.4 Generation – facilitating labor market transitions over the working life

The nonprofit organization Generation runs programs to close emerging skills gaps by upskilling and reskilling workers, including mid-career workers. Working alongside employers and trainees, Generation aims to foster career changes that benefit employees and employer. In Singapore, for example, Generation has teamed up with Microsoft to train 1000+ unemployed people, two in five of whom were mid-career workers – for entry-level jobs in the tech industry. Students receive technical as well as job-search skills training, work with mentors, and participate in employer networking events. The evidence suggests that Generation helps create sustainable job placements and helps individuals access higher-paying jobs, resulting in income growth for individuals.

Source: Generation.org.

23 See for example Anderson-MacDonald et al. 2016, Bloom et al. 2018, 2010, Campos et al. 2017, Glaub et al. 2014, McKenzie and Puerto 2017.

Given that mature older adults learn better on the job, encouraging mature apprenticeship programs could also be considered. The evidence on the impact of apprenticeships and internships suggests that classroom training combined with on-the-job training may have stronger impact on labor market outcomes than skills training or on-the-job training alone (J-PAL 2023). When coupled with high-quality trainers, apprenticeships can be effective in raising employment (Crépon and Premand 2018, Hardy et al. 2019). However, the majority of programs and evidence are focused on youth with limited relevance for mature workers.

Demand-side interventions: Incentives and remove barriers to hiring and investing in more workers

Policies directed to potential employers focus on increasing incentives to hire mature workers by addressing regulatory constraints that raise labor costs, and on initiatives to foster firm-provided training to increase skills and thereby productivity levels.

Closing the gap between labor costs and productivity

Regulatory reform, information, and incentives can help reduce gaps between mature workers' earnings and their productivity. Japan, the Republic of Korea, and Singapore offer examples of countries that have implemented policies to reduce seniority wage practices. Korea has actively promoted, disseminated, and subsidized performance-based compensation models. As part of a broader effort to foster the hiring of senior workers, Japan and Singapore have introduced financial grants to incentivize firms to incorporate worker performance into their wage and personnel system (OECD 2019b). Public sector reform can lead the way by softening seniority wage practices, fully or partially moving towards performance-based pay.

Similarly, governments can reform social contributions and employment protection legislation to lower costs while ensuring adequate social protection support. This can include reforming systems for severance pay and different entitlements that often increase automatically with tenure. Labor regulations in several countries have undergone reform in the past decades, as policymakers attempt to balance the need to protect workers with the need to allow for flexible solutions that do not unduly limit labor demand. The evidence on such reforms and employment effects is generally mixed, however. A broad conclusion is that when extreme forms are avoided, the impact on employment is modest (Betcherman 2015, World Bank 2022b). The evidence of payroll tax cuts on employment is likewise varied. Some cross-country studies point to substantial increases in employment (Latin America) and reductions in informality (Central and Eastern Europe and Latin America). Other country-level studies of payroll tax cuts, however, show both low to no employment effects (Argentina, Chile), and significant employment effects (Colombia, Türkiye) – (Pagés 2017). As a guideline, policy makers could strive for a "flexicurity" approach which combines broader reforms to severance pay and other benefits with permanent contracts that reduce labor costs while increasing effective protection of workers in case of employment shocks (OECD 2019b). For example, reforms need to be combined with policies that strengthen unemployment benefit systems, which remain underdeveloped in many LMICs (ILO 2021). Reduction in social contributions needs to be paired with increased financing of social protection through general taxation (Packard et al. 2019).

Wage subsidies are intended to help address both high labor costs and information asymmetries about worker competence but require strong targeting and timing to deliver benefits. Wage subsidies reduce the cost of labor for some time (compensating for the fact that a worker may be more unproductive in the beginning of employment) and help employers reduce hiring risks by providing them with the opportunity to evaluate skill levels more comprehensively than is possible in the hiring process. Evidence from North Macedonia on wage subsidies (not age-specific) suggests that, when well designed and targeted, such subsidies can help disadvantaged groups overcome information constraints or externalities (Armand et al. 2020). Yet they often suffer from low uptake and low sustainability over the long run (McKenzie 2017a). Experience from Finland and Belgium suggests that wage subsidies specifically targeted to older workers may delay early retirement but carry such deadweight losses that they are not cost effective. Subsidized work appears simply to displace unsubsidized work, with little net gain in employment of older workers (Vodopevic et al. 2019, Boockmann 2015).

Addressing ageism

Age anti-discrimination laws (ADL) exist in many developing countries, but weak enforcement may render them less effective. An overview from 2008 showed that laws that prohibit discrimination in the workplace due to age were in place in about 50 countries (Ghosheh 2008), many of them developing countries. High informality or weak enforcement reduces the impact of these regulations, however. The general evidence on labor law enforcement in developing countries is not conclusive, largely due to the lack of studies addressing this issue (Ronconi 2019).

Social campaigns to provide information and raise awareness have proved successful in influencing stakeholders toward employing older workers. In Germany, a relatively low-cost local marketing campaign used banners, interviews, job fairs, and information brochures to debunk myths and inform employers (and others) about the value of mature workers. The intervention helped increase retention of mature workers (Homrighausen and Lang 2019). More generally, raising awareness about implicit stereotypes can have significant payoffs: an intervention addressing implicit stereotypes about immigrants among Italian schoolteachers raised school grades for immigrant children (Alesina et al. 2018). Research undertaken by the World Bank shows that social media campaigns can be highly effective in influencing norms and can allow for very granular targeting.[24] Similarly, "edutainment" approaches that use entertainment media to convey educational narratives, aspirational role models, and "new" norms to a large population may work: evidence from TV series seeking to improve sexual health and attitudes toward gender-based violence (GBV) in Sub-Saharan Africa showed strong impacts on norms and practices (Banerjee et al. 2019a, 2019b).

Promoting firm investment in workers' human capital

Firms can help extend productive working lives by providing mature workers with access to continuous skills development, complementary technology, and working environments adapted to their needs, along with targeted support that reduces health risks in old age.

It is critical but difficult to increase firms' investment in updating and upgrading workers' skills, including among mature workers. Leveraging private sector support is important to increase available resources for training, to increase private sector ownership of the skills agenda, and to garner the specific knowledge and insights of firms regarding their current and future skill needs (UNESCO 2022). Governments in many LMICs have implemented different incentives, including private sector-financed approaches (e.g., training funds) and budget-funded financial incentives, but with mixed results.

Training funds have been a common approach to provide resources to invest in training, especially for small and medium enterprises (SMEs), but such funds require strong governance, transparency, and solid links to the private sector to work well. In about half of the world's developing countries, there is a national training skills or training fund in place, most of them financed through a payroll levy on employers.[25] These training funds have received criticism on several grounds, however. They tend to mainly benefit large firms and may represent large deadweight loss (subsidizing training that would have taken place without support) at the price of higher tax rates. Training funds have also sometimes been used to support the general budget, or for cross-subsidizing training in informal, non-contributing firms. Finally, training has often been delivered through public institutions that are less connected with the demand side. Many training funds are now being reformed to align contributions better with benefits, for example by including government/donors as contributors, or strengthening governance, transparency, and private sector voice in the use of funds (UNESCO 2022).

Financial incentives to foster training have so far had limited impact on older workers' employment in HICs. In Germany, a firm-level subsidy program targeting workers ages 45 and above in SMEs was found to have improved job stability and employment by prolonging working life; programs with long duration had a stronger effect on both jobs and earnings (Singer and Toomet 2013). For tax incentives, both substitution and deadweight losses appear to be significant, however. Direct subsidies, often structured as co-financing arrangements, may be more effective insofar as they facilitate the targeting of specific groups of firms and employees (Picchio 2021).

24 https://blogs.worldbank.org/voices/using-social-media-change-norms-and-behaviors-scale.

25 Estimates based on World Bank Employing Workers 2020.

Low-cost information campaigns (within companies, and to companies) may go some way towards raising awareness and increasing firms' own training initiatives or uptake of public skills programs, especially among SMEs. In many OECD countries, governments run campaigns and provide employers with toolkits and guidance material on how to best address skills and health issues (OECD 2019b).

Complementary investments in organizational change or infrastructure can also have significant productivity payoffs. Adapted technology, ergonomic office equipment, mixed-age teams, and other adjustments can help workers stay healthy and engaged. A much-cited example of the significant potential payoffs of such policies is the auto manufacturer BMW's Dingolfing plant in Germany, where a small investment in ergonomics and work organization (workstation rotation) resulted in a 7 percent productivity increase, exceeded quality targets, and reduced absenteeism (Spotlight 13.5) – (EBRD 2020).

Interventions focusing on workplace health should help increase worker retention and increase mature workers' productivity; however, there is little evidence as to what works to encourage these. The United Kingdom targets SMEs with a specific national occupational health service to this effect (OECD 2019b). Occupational health and safety programs have been shown to improve risk factors for injuries and chronic illnesses, many of which increase with age (Anger et al. 2015). This can include both access to health care and support for healthy lifestyles – diet, exercise, and social interaction, which also affects labor market participation as well as productivity (Prinz et al. 2018). However, there is no conclusive evidence of positive impacts of such interventions on productivity or labor force participation, largely due to lack of quality studies (Poscia et al. 2016). Some positive examples on which to build do exist, however. In the United States, an occupational health intervention involving access to physicians was associated with a significant reduction in both sickness absence and early retirement (Crawford et al. 2009). Interventions could also be adapted to the informal sector context. A study of informal sector workers in Thailand showed that safe working practices improved older workers' work ability, suggesting that targeted information/promotion programs could help increase their productivity (Thanapop and Thanapop 2021).

SPOTLIGHT 13.5 Firms with age-sensitive management practices

Centrica, a British multinational utility company, has long since removed age limits from its apprenticeship program. It additionally offers targeted "returnships"—featuring professional assignments, coaching, and mentoring—to professionals aged 50+ who have taken a career break but are interested in returning to work.

The German auto manufacturer BMW staffed a production line whose age composition mimicked its expected future workforce (that is, older) and then collaborated with workers to adapt job environment and work rotation to their needs. Changes included ergonomic adaptation, light strengthening exercises, and job rotation to reduce worker strain. The cost of investment in adaptive measures, at 20,000 euros, was negligible, but resulted in a productivity increase of 7 percent, bringing the line on par with production lines featuring younger workers.

In Achmea, a large Dutch financial services company, career advice is provided to an employee every five years after they have reached 45 years of age, and the company provides additional paid leave to mature workers for study.

Berner Ltd., a Finnish chemical manufacturer, has implemented a program involving four pillars: training of management; improvement of the work community and environment; maintenance and enhancement of individual work ability; and the creation of a labor reserve. As a result, retirement owing to incapacity has almost been eradicated, and the average retirement age has increased. Success factors include external support from occupational health care providers and individual career planning and performance reviews.

Source: EU OSHA 2016, Hannon 2016, Loch et al. 2010.

Fostering senior entrepreneurship

Government or NGO-based programs targeting senior entrepreneurship (start-up as well as existing entrepreneurs) are emerging across HICs, but there is little evidence on impacts. Evidence from the United States suggests that high-growth entrepreneurs, even in tech-intensive industries, are middle-aged rather than young and, in many contexts, entrepreneurship programs appear to work best for participants with more experience (Azoulay et al. 2020). Yet, despite the importance of senior entrepreneurship, there is little evidence on what interventions work to encourage senior-led business start-up and growth, especially not from LMICs, where most entrepreneurship programs target youth. There is, however, significant evidence on entrepreneurship programs in LMICs that have successfully provided financial support, business advice, training and market access – often in combination – to micro-entrepreneurs (Jayachandran 2020). Many entrepreneurs face a multitude of constraints (aspirations, skills, information, finance, networks) and are best served by comprehensive programs, although some potential high-growth firms may mostly be limited by credit constraints (McKenzie 2017b). Given seniors' specific needs, interventions could focus on removing constraints including (often) lower technical skills, reduced tolerance for financial risk, and shorter time horizon; interventions might also provide support to foster entrepreneurial mind-sets (Isele and Rogoff 2014). Programs in HICs have focused on digital skills, connect seniors with younger co-investors, provide targeted counseling and entrepreneurship training, and target micro-finance programs to this group, much as is done for women or other groups with special needs and constraints (Isele and Rogoff 2014). Role models may again prove useful for inspiration and knowledge transfer (Omrani amd Ludivine 2019).

Intermediation interventions: Strengthening the capacity of employment services to improve matching

Public and private intermediation services can be strengthened to improve the matching of older workers to jobs. Most European public employment services have no specific policies for older workers (European Network of Public Employment Services 2019). A first step is to change the age criteria for program eligibility, often capped at retirement age, so that older workers are not automatically excluded from different forms of active labor market support. A second step would be to fully capacitate the employment service workforce in assisting older workers. This will require information to rectify ageist views among staff, identifying specific constraints among mature workers (mobility, digital literacy, training needs and modalities, ageist norms, and others), and stronger capacity within employment services to reach out to employers for the benefit of mature workers. Strengthened employment services could provide tailored information on job opportunities and reskilling opportunities for older workers, as well as training in job search skills, including in digital skills that are often lacking but increasingly essential for the job search.

Comprehensive approaches involving employers are needed to improve job matching. In Germany, "regional employment pacts" under the "Initiative 50plus" were created with employment services and the private sector. These successfully included targeted efforts to reactivate and reintegrate mature workers with more and better jobs. The pacts have reached out to firms and other stakeholders and have included targeted profiling, assessments, specific training measures, internships, and information campaigns. These programs have primarily benefitted younger seniors (average age 54), however (OECD 2019b).

Employment services could also help workers move out of arduous occupations to support longer working lives, although the evidence suggests this is a challenging task (OECD 2019b). Belgium, for example, provides a subsidy to workers who transition into a less arduous occupation with the same employer and lose income as a result (OECD 2018). Retraining and job search assistance can also be specifically targeted to groups particularly likely to exit the workforce early due to working conditions (OECD 2019c).

CONCLUSIONS: SOME META-LESSONS FOR PRODUCTIVE LONGEVITY

The world's population is aging rapidly in both poor and rich countries, calling for broad policy reform to maintain welfare levels across generations. This chapter has focused on the set of policies that may help increase "productive longevity" by maintaining mature workers in the active labor force and increasing their productivity. These objectives can be considered "low-hanging fruit": it is likely considerably easier to assist and convince active workers to stay in the labor market, with incremental efforts to strengthen human capital and tweak incentives, than to activate and train people out of long-term unemployment or inactivity towards the end of the potential working life. As our review shows, the research agenda is only beginning to develop, especially for low- and middle- income countries, and the evidence is still thin in many areas. With this important caveat in mind, a few concluding observations follow.

All countries, rich and poor, will need to put productive longevity on the policy agenda. Many MICs are already dealing with aging, even shrinking, populations; both LICs and MICs will face rapidly growing numbers of elderly in the future, and the shift from young to older populations can happen quickly. A wide range of policy instruments are needed to protect welfare levels in an aging world. Prolonging working lives (for a particular set of workers) and increasing the productivity of mature workers (across the board) is part of this agenda.

The optimal policy mix will differ depending on the country context. Mature workers, especially in poorer countries, are a heterogeneous group, with many workers, often the majority, working informally and in low-productivity occupations. Given high informality and weak enforcement, regulatory reform to social insurance, labor regulations, and taxation will only affect a smaller segment of workers, as will initiatives directed only at formal firms. In this dual labor market, however, it is this (relatively small) group of formal sector workers that can reasonably be expected to work longer. For the remainder of the mature workforce, policy needs to focus on how to avert old-age poverty by providing social protection and raising the productivity of their work.

Poorer countries can learn from richer countries' past mistakes and design social protection and regulatory frameworks adequately for an aging population. Many LMICs are now developing their social insurance systems and putting in place taxation and employment regulatory frameworks. Even with low coverage rates, poorly designed systems can be extremely costly. By acting preemptively, countries can avoid repeating mistakes that have taken HICs decades to unravel with reforms that are proving difficult and politically costly.

The impact and cost effectiveness of productive longevity policies need to be weighed against the payoff to investing in raising human capital across the entire population. Poorer countries face different and perhaps starker intergenerational policy tradeoffs than do richer countries. Many lower-income countries' older populations are characterized by low levels of human capital and large gaps relative to younger generations. Significantly raising productivity levels of the mature workforce through skills investments may be very costly, especially in countries with limited resources for investment. Some countries thus may focus on investing heavily in the human capital of children and youth (early childhood development, schooling) as well as younger adults (life-long learning). For the older population, policy will center on strengthening human capital with health interventions and strategic, demand-led skills development, supporting the businesses operated by mature workers, and providing social safety nets.

Even with these constraints, countries can work to identify "win-win" policies that benefit all generations. For example, providing childcare and long-term care for the elderly, thus alleviating the care burden, can stimulate labor market participation and the move to more productive work in both older and younger workers, in particular women. Facilitating access to work, for example with safer transportation systems, will have benefits for vulnerable groups in general.

Productive longevity does not affect all groups similarly, and more nuanced analysis is also needed. This chapter is a first attempt at raising policy areas and mapping out the associated evidence at an aggregate level. Even so, the need for a differentiated approach shines through, perhaps especially from a gender perspective. Women live longer than men but generally have lower pensions. They are less likely to be in paid work, have lower average salaries, and face more obligations to provide informal care. There is even some evidence that women are worse affected by ageism. At the same time, there is some evidence from the United States that,

although age-friendly jobs in the country have increased, lower-skilled male workers have been left out of employment gains (Acemoglu et al. 2022). Looking in detail at how gender, skills, location, and other factors affect productive longevity will be essential to develop adequate policies.

More evidence is needed as to what works for productive longevity. As this review shows, most evidence for what works in terms of prolonging working lives is based on HICs, which have faced aging pressures for a longer time. Even in these countries, the knowledge base is still very much under development. Where available, the evidence is often mixed, pointing to the challenges associated with this policy agenda. Much less is known about what works for a developing-country context characterized by, *inter alia*, higher informality and less-developed social protection systems, higher shares of self-employment, lower skill and productivity levels, smaller firms, and different norms around co-habitation and care responsibilities. To identify the best responses to the aging challenge, a comprehensive research agenda will need to be developed, and soon.

REFERENCES

1. Acemoglu, Daron, and Pascual Restrepo. 2022. "Demographics and Automation." *The Review of Economic Studies*, 89(1):1–44.
2. Acemoglu, Daron, Nicolaj Søndergaard Mühlbach, and Andrew Scott. 2022. "The Rise of Age Friendly Jobs." NBER Working paper Series, No. 20463. Boston: National Bureau of Economic Research.
3. Ahlqvist, Victor, and Erling Borén. 2017. "Leaving Already? The Swedish Unemployment Insurance as a Pathway to Retirement." Masters Dissertation, Lund University.
4. Alesina, Alberto, Michela Carlana, Eliana La Ferrara, and Paolo Pinotti. 2018. "Revealing Stereotypes: Evidence from Immigrants in Schools." NBER Working Paper Series, No. 25333. Boston: National Bureau of Economic Research.
5. Allel, Kasim, Ana León, Ursula Staudinger, and Esteban Calvo. 2019. "Healthy Retirement Begins at School: Educational Differences in the Health Outcomes of Early Transitions into Retirement. *Ageing and Society*, 41(1): 137-157.
6. Almeida, Rita, Jere Behrman, and David Robalino (eds). 2012. "The Right Skills for the Job? Rethinking Training Policies for Workers." Human Development Perspectives. Washington, D.C.: World Bank.
7. Alzúa, Maria, Soyolmaa Batbekh, Altantsetseg Batchuluun, et al. 2021. "Demand-Driven Youth Training Programs: Experimental Evidence from Mongolia." *World Bank Economic Review*, 32(3): 720-744.
8. Anderson-MacDonald, Stephen, Rajesh Chandy, and Bilal Zia. 2016. "Pathways to Profits Identifying Separate Channels of Small Firm Growth through Business Training." World Bank Policy Research Working Paper Series, No. 7774. Washington, D.C.: World Bank.
9. Anger, W. Kent, Diane Elliot, Todd Bodner, Ryan Olson, et. al. 2015. "Effectiveness of Total Worker Health Interventions." *Journal of Occupational Health Psychology*, 20(2):226–247.
10. Armand, Alex, Pedro Carneiro, Federico Tagliati, and Yiming Xia. 2020. "Can Subsidized Employment Tackle Long-Term Unemployment? Experimental Evidence from North Macedonia." IZA Discussion Paper Series, No.13478. Bonn, Germany: Institute of Labor Economics.
11. Ardito, Chiara. 2021. "The Unequal Impact of Raising the Retirement Age: Employment Response and Program Substitution." *IZA Journal of Labor Economics*, 10(3).
12. Atkinson, Carol, and Peter Sandiford. 2016. "An Exploration of Older Worker Flexible Working Arrangements in Smaller Firms: Older Worker FWA." *Human Resource Management Journal*, 20(1): 12-28.
13. Attanasio, Ozario, Richardo Paes de Barros, Pedro Carneiro, David Evans, et al. 2017. "Impact of Free Availability of Public Childcare on Labour Supply and Child Development in Brazil." 3ie Impact Evaluation Report 58. New Delhi: 3ie.
14. Auer, Peter, and Mariàngels Fortenu. 2000. "Ageing of the Labour Force in OECD Countries: Economic and Social Consequences." Employment Paper 2000/2. Geneva: International Labour Organization.
15. Azoulay, Pierre, Benjamin Jones, J. Daniel Kim, and Javier Miranda. 2020. "Age and High-Growth Entrepreneurship." *American Economic Review: Insights*, 2(1):65-82.
16. Backes-Gellner, Uschi, Martin R. Schneider, and Stephan Veen. 2011. "Effect of Workforce Age on Quantitative and Qualitative Organizational Performance: Conceptual Framework and Case Study Evidence." *Organization Studies*, 32(8):1103-1121.
17. Backhaus, Andreas, and Mikkel Barslund. 2021. "The Effect of Grandchildren on Grandparental Labor Supply: Evidence from Europe." *European Economic Review*, 137(C).
18. Baird, Sarah, David McKenzie, and Berk Ozler. 2018. "The Effects of Cash Transfers on Adult Labor Market Outcomes." World Bank Policy Research Working Paper Series, No. 8404. Washington, D.C.: World Bank.
19. Banerjee, Abhijit, Eliana La Ferrara, and V. Orozco Olvera. 2019a. "The Entertaining Way to Behavioral Change: Fighting HIV with MTV." World Bank Policy Research Working Paper Series, No. 8998. Washington, D.C.: World Bank.
20. _____. 2019b. "Entertainment, Education, and Attitudes Toward Domestic Violence." *AEA Papers and Proceedings*, 109:133–37.
21. Barrett, Alan, Irene Mosca, and Brendan J. Whelan. 2015. "How Well-informed are Pension Scheme Members on their Future Pension Benefits? Evidence from Ireland." *Journal of Aging and Social Policy*, 27(4): 295-313.
22. Barrientos, Armando. 2011. "Participation and Earnings of Older People in Argentina: Nice Work if You Can Get It?" *The Journal of*

Development Studies, 47(7):1061-1079.
23. Betcherman, Gordon. 2015. "Labor Market Regulations : What Do We Know About Their Impacts in Developing Countries?" *The World Bank Research Observer*, 30(1): 124-153.
24. Bloom, Nicholas, Aprajit Mahajan, David McKenzie and D. John Roberts. 2010. "Why Do Firms in Developing Countries Have Low Productivity?" *American Economic Review: Papers & Proceedings*, 100(2): 619–623.
25. _____. 2018. "Do Management Interventions Last? Evidence from India." World Bank Policy Research Working Paper, No. 8339. Washington, D.C.: World Bank.
26. Böheim, René, and Thomas Nice. 2019. "The Effect of Early Retirement Schemes on Youth Employment." *IZA World of Labor* 2019, 70(2).
27. Boissonneault, Michael, Jaap O. Mulders, Konrad Turek, and Yves Carriere. 2020. "A Systematic Review of Causes of Recent Increases in Ages of Labor Market Exit in OECD Countries." *PLoS ONE* 15(4): e0231897.
28. Boockmann, Bernhard. 2015. "The Effects of Wage Subsidies for Older Workers." IZA World of Labor 201, 189.
29. Bosch, Mariano and Jarret Guajardo. 2012. "Labor Market Impacts of Non-Contributory Pensions: The Case of Argentina's Moratorium." IDB Working Paper Series, No. 366. Washington, D.C: Interamerican Development Bank.
30. Brooks, Wyatt, Kevin Donovan, and Terence R. Johnson. 2018. "Mentors or Teachers? Microenterprise Training in Kenya." *American Economic Journal: Applied Economics*, 10(4): 196-221.
31. Busch, Fabian, Robert Fenge, and Carsten Ochsen. 2021. "Do Firms Hire More Older Workers? Evidence from Germany." CESifo Working Paper Series, No. 9219. Munich, Germany: Munich Society for the Promotion of Economic Research – CESifo.
32. Bussolo, Maurizio, Johannes Koettl, and Emily Sinnott. 2015. "Golden Aging: Prospects for Healthy, Active, and Prosperous Aging in Europe and Central Asia."Washington, D.C.: World Bank.
33. Butrica, Barbara, Richard W. Johnson, Karen E. Smith, and Eugene Steuerle. 2006. "The Implicit Tax on Work at Older Ages." Washington, D.C.: The Urban Institute.
34. Card, David, Jochen Kluve, and Andrea Weber. 2017. "What Works? A Meta Analysis of Recent Active Labor Market Program Evaluations." *Journal of the European Economic Association*, 16 (3): 894-931.
35. Campos, Francisco, Michael Frese, Markus Goldstein, Leonardo Iacovone, et al. 2017. "Personality vs. Practices in the Making of an Entrepreneur: Experimental Evidence from Togo." Draft paper for the 2017 Center for the Study of African Economies (CSAE). Retrieved at: https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=CSAE2017&paper_id=493.
36. Carlsson, Magnus, and Stefan Eriksson. 2019. "Age Discrimination in Hiring Decisions: Evidence from a Field Experiment in the Labor Market." *Labour Economics*, 59: 173-183.
37. Chernina, Yevgenia, and Vladimir Gimpelson. 2022. "Do Wages Grow with Experience? Deciphering the Russian Puzzle." IZA Discussion Paper Series, No. 15068. Bonn, Germany: Institute of Labor Economics.
38. Costa-Font, Joan, and Cristina Vilaplana-Prieto. 2022. "Caregiving Subsidies and Spousal Early Retirement Intentions." IZA Discussion Paper Series, No. 15339. Bonn, Germany: Institute of Labor Economics.
39. Crawford, Joanne, Richard Graveling, Hilary Cowie, and Ken Dixon. 2010. "The Health Safety and Health Promotion Needs of Older Workers. *Occupational Medicine*, 60(3):184-92.
40. Crépon, Bruno, and Patrick Premand. 2018. "Creating New Positions? Direct and Indirect Effects of a Subsidized Apprenticeship Program." Policy Research Working Paper Series, no. 8561. Washington, D.C.: World Bank.
41. D'Amico Ronald, K. Dunham, Annelies Goger, Charles Lea, et al. 2009. "Findings from a Study of One-stop Self-Services: A Case Study Approach." ETA Occasional Paper, 2011-19. Washington, D.C.: U.S. Department of Labor, Employment and Training Administration.
42. Del Boca, Daniela, and Marinela Locatelli. 2006. "The Determinants of Motherhood and Work Status: A Survey." IZA Discussion Paper Series, No. 2414, Bonn, Germany: Institute of Labor Economics.
43. Deloitte. 2018. "The Rise of the Social Enterprise: 2018 Deloitte Global Human Capital Trends." Deloitte Insights.
44. Desjardins, Richard, and Anne Warnke. 2012. "Ageing and Skills: A Review and Analysis of Skill Gain and Skill Loss Over the Lifespan and Over Time." OECD Education Working Paper Series, No. 72. Paris: OECD Publishing.
45. Doerwald, Friederike., Sussane Scheibe, Hannes Zacher and Nico Van Yperen. 2016. "Emotional Competencies Across Adulthood: State of Knowledge and Implications for the Work Context." *Work, Aging and Retirement*, 2(2).
46. Dohmen, Thomas. 2003. "Performance, Seniority and Wages: Formal Salary Systems and Individual Earnings Profiles." IZA Discussion Paper Series, No. 935. Bonn, Germany: Institute of Labor Economics.
47. Donovan, Kevin, Will Jianyu Lu, and Todd Schoellman. 2020. "Labor Market Dynamics and Development."Yale Economic Growth Center Discussion Paper Series, No. 1079. Yale University.
48. European Bank for Reconstruction and Development (EBRD). 2020. "Economic Inclusion for Older Workers: Challenges and Responses." London: European Bank for Reconstruction and Development.
49. Economic Commission for Latin America and the Caribbean/International Labor Organization (ECLAC/ILO). 2018. "Employment Situation in Latin America and the Caribbean: Labour Market Participation of Older Persons: Needs and Options." Geneva: International Labour Organization.
50. Elinder, Mikael, Johannes Hagen, Mattias Nordin, and Jenny Save-Söderbergh. 2020. "Who Lacks Pension Knowledge, Why and Does it Matter? Evidence from Swedish Retirement Savers." Institute for Evaluation of Labour Market and Education Policy, Working Paper Series, No. 2020:24. Uppsala, Sweden: Institute for Evaluation of Labour Market and Education Policy.
51. Elgin, Ceyhun, M. Ayhan Kose, Franziska Ohnsorge, and Shu Yu. 2021. "Understanding Informality." C.E.P.R. Discussion Paper Series, No. 16497. London: Centre for Economic Policy Research.
52. European Agency for Safety and Health at Work (EU-OSHA). 2016. "Healthy Workplaces for All Ages: Promoting a Sustainable Working Life." Luxembourg: European Agency for Safety and Health at Work.
53. European Commission. 2012. "Special Eurobarometer 378: Active Aging." January 2012. https://europa.eu/eurobarometer/surveys/detail/1002.
54. _____. 2015. "Discrimination in the EU in 2015." Brussels: Directorate-General for Justice and Consumers. http://dx.doi.org/10.2838/325154.
55. European Network of Public Employment Services. 2019. "PES Strategies in Support of an Ageing Workforce: Study Report." Luxembourg: EU Publishing Office.
56. European Union Council. 2022. "Council Recommendation on Individual Learning Accounts." *Official Journal of the European*

Union. 2022/C 243/03. June 16, 2022. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022H0627(03)&qid=1664444877706&from=EN.
57. Fairlie, Robert, Sameeksha Desai, and AJ Herrmann. 2019. "2018 National Report on Early-Stage Entrepreneurship." Kauffman Indicators of Entrepreneurship. Kansas City: Ewing Marion Kauffman Foundation.
58. Ferranna, Maddalena, JP Sevilla, Leo Zucker and David Bloom. 2022. "Patterns of Time Use among Older People." NBER Working Paper Series, No. 30030. Boston, MA: National Bureau of Economic Research.
59. Fouejieu, Armand, Alvar Kangur, Samuel Romero Martinez, and Mauricio Soto. 2021. "Pension Reforms in Europe: How Far Have We Come and Gone?" IMF Fiscal Affairs Department DP/2021/016. Washington, D.C.: International Monetary Fund.
60. French, Eric, and John B. Jones. 2012. "Public Pensions and Labor Supply over the Life Cycle." *International Tax and Public Finance*,19(2): 268–287.
61. Gassier, Marine; Lacina Trore, and Léa Rouanet. 2022. "Addressing Gender-Based Segregation through Information Evidence from a Randomized Experiment in the Republic of Congo." World Bank Policy Research Working Paper Series, No. 9934. Washington, D.C.: World Bank.
62. Generation. 2021. "Meeting the World's Mid-career Moment." https://www.generation.org/wp-content/uploads/2021/07/Meeting-the-Worlds-Midcareer-Moment-July-2021.pdf.
63. Geppert, Christian, Yvan Guillemette, Hermes Morgavi, and David Turner. 2019. "Labour Supply of Older People in Advanced Economies: The Impact of Changes to Statutory Retirement Ages." OECD Economics Department Working Paper Series, No. 1554. Paris: OECD Publishing.
64. Ghosheh, Naj. 2008. "Age Discrimination and Older Workers: Theory and Legislation in Comparative Context." Conditions of Work and Employment Series, No. 20. Geneva, Switzerland: International Labour Organization.
65. Gibson, Donald E., and Lisa A. Barron. 2003. "Exploring the Impact of Role Models on Older Employees." *Career Development International*, 8(4): 198-209.
66. Giesecke, Matthias. and Philipp Jäger. 2021. "Pension Incentives and Labor Supply: Evidence from the Introduction of Universal Old-Age Assistance in the UK." *Journal of Public Economics*, 203(C).
67. Giles, John, Dewen Wang, and Wei Cai. 2012. "The Labor Supply and Retirement Behavior of China's Older Workers and Elderly in Comparative Perspective." In *Aging in Asia: Findings from New and Emerging Data Initiatives,* edited by James P. Smith, and Malay Majmundar. Washinton D.C.: National Academies Press.
68. Glaub, Matthias E., Michael Frese, Sebastian Fischer, and Maria Hoppe. 2014. "Increasing Personal Initiative in Small Business Managers or Owners Leads to Entrepreneurial Success: A Theory-Based Controlled Randomized Field Intervention for Evidence-Based Management." *Academy of Management Learning & Education* 13(3): 354-379.
69. Glick, Peter, Crystal Huang, and Nelly Mejia. 2015. "The Private Sector and Youth Skills and Employment Programs in Low and Middle-Income Countries." Washington, D.C.: World Bank.
70. Gragnolati, Michele, Ole Hagen Jorgensen, Romera Rocha, and Anna Fruttero. 2011. "Growing Old in an Older Brazil: Implications of Population Aging on Growth, Poverty, Public Finance, and Service Delivery." Directions in Development. Washington, D.C.: World Bank.
71. Graham, Carol. 2014. "Late-life Work and Well-being." IZA World of Labor 2014: 107. doi: 10.15185/izawol.107.
72. Gruber, Jonathan, Kevin Milligan, and David Wise. 2009. "Social Security Programs and Retirement Around the World: The Relationship to Youth Employment." NBER Working Paper Series, No. 14647. Boston, MA: National Bureau of Economic Research.
73. Guha, Pradyut, Bodrul Islam, and Md Aktar Hussain. 2020. "COVID-19 Lockdown and Penalty of Joblessness on Income and Remittances: A Study of Inter-State Migrant Labourers from Assam, India." *Journal of Public Affairs*, 21 (4): e2470. https://doi.org/10.1002/pa.2470.
74. Gutierrez, Italo and Pierre-Carl Michaud. 2019. "Job Insecurity and Older Workers' Mental Health in the United States." *Health and Labor Markets*, 47(July 11): 71-98.
75. Göbel, Christian and Thomas Zwick. 2013. "Are Personnel Measures Effective in Increasing Productivity of Old Workers?" *Labour Economics*, 22(June): 80-93.
76. Hannon, Kerry. 2016. "5 Workplaces That Embrace Older Workers." Forbes. November 18, 2016. https://www.forbes.com/sites/nextavenue/2016/11/18/5-workplaces-that-embrace-older-workers/?sh=28306dc35914.
77. Hardy, Morgan, Isaac Mbiti, Jamia McCasland and Isabelle Salcher. 2019. "The Apprenticeship-to-Work Transition: Experimental Evidence from Ghana." World Bank Policy Research Working Paper Series, No 8851. Washington, D.C.: World Bank.
78. Henkens, Kène, Hendrik van Dalen, and Hanna van Solinge. 2021. The Rhetoric and Reality of Phased Retirement Policies. *Public Policy & Aging Report,* 31(3): 78-82.
79. Homrighausen, Pia, and Julia Lang. 2019. "Do Informational Nudges Alter Firms' Hiring Behavior of Older Workers?" [Conference Paper] *Beiträge zur Jahrestagung des Vereins für Socialpolitik 2019: 30 Jahre Mauerfall - Demokratie und Marktwirtschaft* - Session: Labor Economics VI, No. D08-V3, ZBW. Kiel, Hamburg: Leibniz-Informationszentrum Wirtschaft.
80. International Labour Organization (ILO). 2017. "World employment social outlook: Trends for women." Geneva, Switzerland: International Labour Organization.
81. _____. 2021. "World Social Protection Report 2020–22: Social protection at the crossroads in pursuit of a better future." Geneva, Switzerland: International Labour Organization.
82. Isele, Elizabeth, and Edward G. Rogoff. 2014. "Senior Entrepreneurship: The New Normal." Public Policy & Aging Report, 24 (4): 141–147. https://doi.org/10.1093/ppar/pru043
83. International Telecommunication Union (ITU). 2021. "Ageing in a Digital World – From Vulnerable to Valuable." Geneva, Switzerland: ITU. http://handle.itu.int/11.1002/pub/818a937f-en.
84. Jayachandran, Seema. 2020. "Microentrepreneurship in Developing Countries." NBER Working Paper Series, No. 26661. Boston, MA: National Bureau of Economic Research.
85. Jedwab, Remi, Paul Romer, Asif Islam, and Roberto Samaniego. 2021. "Human Capital Accumulation at Work: Estimates for the World and Implications for Development."World Bank Policy Research Working Paper, No. 9786. Washington, D.C.: World Bank.
86. Jensen, Robert. 2010. "The (Perceived) Returns to Education and the Demand for Schooling." *Quarterly Journal of Economics*, 125(2): 515–48.
87. Jensen, Robert. 2012. "Do Labor Market Opportunities Affect Young Women's Work and Family Decisions? Experimental Evidence from India." *Quarterly Journal of Economics*, 127 (2): 753–792.
88. Jin, Bora and Lisa Baumgartner. 2019. "Ageism in the Workplace: A Review of the Literature." Adult Education Research Conference. https://newprairiepress.org/aerc/2019/papers/14.

89. Johnson, Sheena J., Sabine Machowski, Lynn Holdsworth, Marcel Kern, and Dieter Zapf. 2017. "Age, Emotion Regulation Strategies, Burnout, and Engagement in the Service Sector: Advantages of Older Workers." *Revista de Psicología Del Trabajo Y de Las Organizaciones* 33 (3): 205–16. https://doi.org/10.1016/j.rpto.2017.09.001.
90. J-PAL Policy Insight. 2023. "Vocational and Skill Straining Programs to Improve Labor Market Outcomes." Cambridge: Abdul Latif Jameel Poverty Action Lab.
91. Kalwij, Adriaan, Arie Kapteyn and Klaas Vos. 2010. "Retirement of Older Workers and Employment of the Young." *De Economist*, 158: 341-359.
92. Knowland, Victoria, and Michael Thomas. 2014. "Educating the Adult Brain: How the Neuroscience of Learning Can Inform Educational Policy." *International Review of Education*, 60(1): 99-122.
93. Kuddo, Arvo. 2018. "Labor Regulations throughout the World: An Overview." Jobs Working Paper, No. 16. Washington, D.C.: World Bank.
94. Kyyrä, Tomi and Virve Ollikainen. 2008. "To search or not to search? The effects of UI benefit extension for the older unemployed." *Journal of Public Economics*, 92(10-11): 2048-2070.
95. Lafortune, Jeanne, Julio Riutort, and José Tessada. 2018. "Role Models or Individual Consulting: The Impact of Personalizing Microentrepreneurship Training." *American Economic Journal: Applied Economics* 10(4): 222–245.
96. Lam, David and Ahmed Elsayed. 2021. "The Interrelationship of Growth, Formality, Informality, and Regulation." In *Labour Markets in Low-Income Countries: Challenges and Opportunities*. Oxford University Press.
97. Laun, Lisa. 2017. "The effect of Age-Targeted Tax Credits on Labor Force Participation of Older Workers." *Journal of Public Economics*, 152: 102-118.
98. Levin, Victoria. 2015. "Promoting Active Aging in Russia: Working Longer and More Productively." World Bank: Washington, D.C.
99. Liebman, Jeffrey. and Erzo Luttmer. 2015. Would People Behave Differently If They Better Understood Social Security? Evidence from a Field Experiment. *American Economic Journal: Economic Policy*, 7 (1): 275-99.
100. Lock, Christoph, Fabian Sting, Nikolaus Bauer, and Helmut Mauermann. 2010. "The Globe: How BMW is defusing the demographic time bomb." Harvard Business Review: Human Resource Management. March 2010.
101. Lorenz, Svenja, M. Pfister, Thomas Zwick. 2020. "Beware of the employer: Financial Incentives for Employees May Fail to Prolong Old Age Employment." ZEW Discussion Papers, No. 20-007, Mannheim: Leibniz-Zentrum für Europäische Wirtschaftsforschung.
102. Martinez, Daniel, Oscar Mitnik, Edgar Salgado, Lynn Scholl, Patricia Yanez-Pagans. 2019. "Connecting to Economic Opportunity? The Role of Public Transport in Promoting Women's Employment in Lima." *Journal of Economics, Race, and Policy*, First Online: 26 November 2019.
103. Mateo Díaz, Mercedes, and Lourdes Rodriguez-Chamussy. 2016. "Cashing in on Education: Women, Childcare, and Prosperity in Latin America and the Caribbean." Latin American Development Forum. Washington, D.C.: World Bank and Inter-American Development Bank.
104. Mayhew, Ken and Bob Rijkers. 2004. "How to Improve the Human Capital of Older Workers, or the Sad Tale of the Magic Bullet." Paper prepared for the joint EC-OECD Seminar on Human Capital and Labour Market Performance, held in Brussels on Dec 8, 2004. https://www.oecd.org/els/emp/34932028.pdf.
105. McKenzie, David. J. 2017a. "How Effective are Active Labor Market Policies in Developing Countries? A Critical Review of Recent Evidence." World Bank Policy Research Working Paper Series, No. 8011. Impact Evaluation Series. Washington, D.C.: World Bank.
106. _____. 2017b. "Identifying and Spurring High-Growth Entrepreneurship: Experimental Evidence from a Business Plan Competition." *American Economic Review*, 107(8): 2278–2307.
107. McKenzie, David, and Susana Puerto. 2017. "Growing Markets through Business Training for Female Entrepreneurs: A Market-Level Randomized Experiment in Kenya." IZA Discussion Paper Series, no. 10615, March 2017. Bonn, Germany: Institute for Labor Economics.
108. McKinsey Global Institute. 2021. "The future of work after COVID-19." McKinsey & Company. https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19.
109. Meghir, Costas, and David Phillips. 2010. "Labour supply and taxes." In *Dimensions of Tax Design*. Edited by Adam Stuart, Timothy Besley, Richard Blundell et al. New York: Oxford University Press, Inc.
110. Munnell, Alicia and April Wu. 2013. "Will Delayed Retirement by the Baby Boomers Lead to Higher Unemployment Among Younger Workers?" CRR working paper 2012-22. Boston: Center for Retirement Research at Boston College.
111. Munnell, Alicia H. and Abigail N. Walters. 2019. "Proposals to Keep Older People in the Labor Force." Economic Studies at Brookings, January 2019. Washington, D.C.: Brookings Institute.
112. National Center on Senior Transportation (NCST). 2011. "Seniority Community Service Employment Program: A Resource for SCSEP Providers." Washington, D.C.: National Center on Senior Transportation.
113. Neumark, David, Ian Burn and Patrick Button. 2019. "Is It Harder for Older Workers to Find Jobs? New and Improved Evidence from a Field Experiment." *Journal of Political Economy*, 127 (2).
114. Ng, Thomas W., and Daniel C. Feldman. 2008. "The Relationship of Age to Ten Dimensions of Job Performance." *Journal of Applied Psychology*, 93(2):392-423.
115. Organization for Economic Cooperation and Development (OECD). 2008. "Improving Financial Education and Awareness of Insurance and Private Pensions." Paris: OECD Publishing.
116. _____. 2013. "OECD Employment Outlook 2013." Paris: OECD Publishing.
117. _____. 2017: "Pensions at a glance." Paris: OECD Publishing.
118. _____. 2018. "Working Better with Age." Belgium Country Note. Paris: OECD Publishing.
119. _____. 2019a. "Pensions at a glance. Country profiles: China." Paris: OECD Publishing.
120. _____. 2019b. "Working Better with Age." Paris: OECD Publishing.
121. _____ 2019c. "Adapting to Demographic Change." Paper prepared for the first meeting of the G20 Employment Working Group under the Japanese G20 Presidency, 25-27 February 2019, Tokyo. Retrieved at: https://www.oecd.org/g20/summits/osaka/OECD-Ageing-and-Demographic-change-G20-JPN.pdf.
122. _____ 2019d. "Individual Learning Accounts: Design is key for success." Policy Brief on the Future of Work. Paris: OECD Publishing.
123. _____. 2021. "OECD Employment Outlook 2021: Navigating the COVID-19 Crisis and Recovery." Paris: OECD Publishing.
124. Omrani, Nessrine and Ludivine Martin. 2019. "Understanding Senior Entrepreneur Behavior." *Journal of Enterprising Culture*, 27:259-282.
125. Packard, Truman, Ugo Gentilini, Margaret Grosh, Philip O'Keefe, Robert Palacios, David Robalino, and Indhira Santos. 2019. "Protecting All: Risk Sharing for a Diverse and Diversifying World of

Work." Washington, D.C.: World Bank.
126. Pagés, Carmen. "Do payroll tax cuts boost formal jobs in developing countries?" IZA World of Labor 2017, 345.
127. Paweenawat, Sasiwimon W. and Lusi Liao. 2021. "Labor Supply of Older Workers in Thailand: The Role of Co-residence, Health, and Pensions." ADBI Working Paper 1224. Tokyo: Asian Development Bank Institute.
128. Picchio, Matteo. 2021. "Is training effective for older workers?" IZA World of Labor 2021, 121(2).
129. Pit, Sabrina, Malcolm Fisk, Winona Freihaut, Fashola Akintunde, Bamidele Aloko, Britta Berge, Anne Burmeister, et al. 2021. "COVID-19 and the Ageing Workforce: Global Perspectives on Needs and Solutions across 15 Countries." *International Journal for Equity in Health* 20 (1). https://doi.org/10.1186/s12939-021-01552-w.
130. Pizzinelli, Carlo, and Ippie Shibata. 2022. "Has COVID-19 Induced Labor Market Mismatch? Evidence from the US and the UK." IMF Working Paper Series, No. 2022/005. Washington, D.C.: International Monetary Fund.
131. Poscia, Andrea, Umberto Moscato, Daniele Ignazio La Milia, Sonja Milovanovic, Jovana Stojanovic, Alice Borghini, Agnese Collamati, Walter Ricciardi, and Nicola Magnavita. 2016. "Workplace Health Promotion for Older Workers: A Systematic Literature Review." *BMC Health Services Research* 16 (S5): 329. https://doi.org/10.1186/s12913-016-1518-z.
132. Prinz, Daniel, Michael Chernew, David Cutler, and Austin Frakt. 2018. "Health and Economic Activity Over the Lifecycle: Literature Review." NBER Working Paper Series, No. 24865. Boston, MA: National Bureau of Economic Research.
133. Pricewaterhouse Coopers International Limited (PwC). 2018. "Golden Aging Index." Available online: https://www.pwc.com/hu/hu/csr/assets/golden-age-index-2018.pdf.
134. Riphahn, Regina T., and Rebecca Schrader. 2021. "Reforms of an Early Retirement Pathway in Germany and Their Labor Market Effects." IZA Discussion Paper Series, No. 14908. Bonn, Germany: Institute of Labor Economics.
135. Rocha, Romero. 2017. "Aging, Productivity and Wages: Is an Aging Workforce a Burden to Firms?" *Revista Espacios*, 38 (39).
136. Ronconi, Lucas. 2019. "Enforcement of Labor Regulations in Developing Countries." IZA World of Labor 2019: 457. doi: 10.15185/izawol.457.
137. Rutkowski, Michal. 2018. "Reimagining Social Protection." Finance and Development: December 2018. Washington, D.C.: International Monetary Fund.
138. Schmieder, Julia. 2021. "Fertility as a Driver of Maternal Employment." *Labour Economics*, 72 (October): 102048. https://doi.org/10.1016/j.labeco.2021.102048.
139. Singer, Christine, and Ott-Siim Toomet. 2013. "On Government-Subsidized Training Programs for Older Workers." IAB Discussion Paper, No. 21/2013, Nürnberg: Institut für Arbeits smarkt- und Berufsforschung.
140. Saraf, Priyam. 2019. "A Study of Fragility, Entrepreneurship and Mental Health: Investing in Better Cognitive and Behavioral Skills for Small Medium Enterprise Entrepreneurs to Thrive in Conflict-Affected Areas of Pakistan." Washington, D.C.: World Bank.
141. Söderbacka, Tina, Linda Nyholm, and Lisbeth Fagerström. 2020. "Workplace Interventions that Support Older Employees' Health and Work Ability - A Scoping Review." *BMC Health Services Research,* 20 (472).
142. Staubli, Stefan and Josef Zweimüller. 2013. "Does raising the early retirement age increase employment of older workers?" *Journal of Public Economics*, 108(C): 17-32.
143. Staudinger, Ursula M., Ruth Finkelstein, Esteban Calvo, and Kavita Sivaramakrishnan. 2016. "A Global View on the Effects of Work on Health in Later Life." *Gerontologist*, 56(S2): 281–292
144. Thanapop, Sasithorn and Chamnong Thanapop. 2021. "Work Ability of Thai Older Workers in Southern Thailand: a Comparison of Formal and Informal Sectors." *BMC Public Health* 21: 1218.
145. Thomas, Michael S.C., Victoria C.P. Knowland, and Cathy Rogers. 2020. "The Science of Adult Literacy." Social Protection and Jobs Discussion Paper Series, No. 2001. Washington, D.C.: World Bank
146. United Nations Educational, Scientific, and Cultural Organization (UNESCO). 2022. "Global Review of Training Funds: Spotlight on levy-schemes in 75 countries." Paris: United Nations Educational, Scientific and Cultural Organization.
147. United Nations Population Fund (UNFPA). 2012. "Ageing in the Twenty-First Century: A Celebration and A Challenge." New York, NY: United Nations Population Fund.
148. United Nations (UN). 2007. "World Economic and Social Survey 2007: Development in an Ageing World. Department of Social Affairs." New York, NY: United Nations.
149. _____. 2019. "World Population Aging 2019: Highlights." New York, NY: United Nations.
150. Van den Berg, Gerard J., Christine Dauth, Pia Homrighausen, and Gesine Stephan. 2018. "Informing employees in small and medium sized firms about training: results of a randomized field experiment." IZA Discussion Paper Series, no. 11963. Bonn, Germany: Institute of Labor Economics.
151. van der Horst, Mariska. 2019. "Internalised Ageism and Self-Exclusion: Does Feeling Old and Health Pessimism Make Individuals Want to Retire Early?" *Social Inclusion,* 7 (3): 27–43.
152. Veríssimo, João, Paul Verhaeghen, Noreen Goldman, Maxine Weinstein, and Michael T. Ullman. 2022. "Evidence That Ageing Yields Improvements as Well as Declines across Attention and Executive Functions." *Nature Human Behaviour*, 6: 97–110. https://doi.org/10.1038/s41562-021-01169-7.
153. Vickerstaff , Sarah and Mariska Van der Horst. 2021. "The Impact of Age Stereotypes and Age Norms on Employees' Retirement Choices: A Neglected Aspect of Research on Extended Working Lives." *Frontiers in Sociology*, 6:686645. doi: 10.3389/fsoc.2021.686645.
154. Vodopivec, Milan, Dan Finn, Suzana Laporšek, Matija Vodopivec, and Nejc Cvörnjek. "Increasing employment of older workers: Addressing labour market obstacles." *Journal of Population Ageing*, 12: 273–298.
155. World Health Organization (WHO) 2021. "Global Report on Ageism." Geneva: World Health Organization.
156. World Bank. 2016. "Live Long and Prosper: Aging in East Asia and Pacific." Washington, D.C.: World Bank.
157. _____. 2017. Why Should We Care About Care? The Role of Childcare and Eldercare in Armenia. Washington, D.C.: World Bank.
158. _____. 2019. "World Development Report 2019: The Changing Nature of Work." Washington, D.C.: World Bank.
159. _____. 2020. "A Silver Lining: Productive and Inclusive Aging for Malaysia." Washington, D.C.: World Bank.
160. _____. 2021a. "Vietnam - Adapting to an Aging Society." Washington, D.C.: World Bank.
161. _____. 2021b. "Aging and the Labor Market in Thailand: Labor Markets and Social Policy in a Rapidly Transforming and Aging Thailand." Washington, D.C.: World Bank.
162. _____. 2022a. "Georgia Human Capital Review." Washington, D.C.: World Bank.
163. _____. 2022b. "Charting a Course Towards Universal Social Protection: Resilience, Equity, and Opportunity for All." Wash-

ington, D.C.: World Bank.
164. Zwick, Thomas. 2009. "Why Pay Seniority Wages?" ZEW - Centre for European Economic Research Discussion Paper No. 09-005. http://dx.doi.org/10.2139/ssrn.1394351.
165. _____. 2011. "Why Training Older Employees is Less Effective." ZEW - Centre for European Economic Research Discussion Paper No. 11-046. http://dx.doi.org/10.2139/ssrn.1886428.

Annex 13

TABLE 13A.1 Labor market data for older adults

	Brazil	Chile	Colombia	Costa Rica	Mexico	Russia	South Africa	EU27	OECD
Demographic situation									
Old-age dependency ratio	14%	18%	13%	13%	11%	23%	9%	31%	64%
Effective labour force exit age (years) Men	65	68	70	70	70	63	62	64	66
Women	62	63	63	64	66	61	57	63	64
Gender gap in exit (years)	3	5	7	6	4	2	5	1	2
Employment									
Employment rate, 50-74 (% of the age group)	36	49	51	45	50	38	31	48	51
of which 50-54	62	66	66	66	66	85	57	81	79
55-64	44	56	54	50	52	51	37	60	61
65-69	22	30	35	22	35	7	10	15	23
70-74	10	18	23	15	25	..	..	7	11
Gender gap in employment, 55-64 (% point gap)	26	32	34	36	36	18	13	12	13
Job characteristics									
Incidence of part-time work, 55-64 (% of total employment)	-	19	17	35	28	13	17	15	19
of which involuntary 55-64 (% of part-time work)	-	45	36	-	-	27	-	23	20
Incidence of temporary work, 55-64 (% of employees)	-	19	18	6	-	6	-	5	8
Incidence of self-employment, 55-64 (% of total employment)	46	29	63	44	47	8	24	18	22
Full-time earnings, 55-64 relative to 25-54 (ratio)	-	0.96	1.19	1.26	1.0	-	-	-	1.06
Dynamics									
Retention rate for workers currently aged 60-64 (% of employees t-5)	28	43	-	37	46	-	-	53	52
Hiring rate 55-64 (% of employees)	34	16	24	14	13	-	-	6	8
Joblessness									
Unemployment rate, 55-64 (% of the labour force)	7.9	6.9	10.5	12.0	2.6	3.6	11.2	5.2	5.2
Incidence of long-term unemployment, 55-64 (% of total unemployment)	-	-	7.9	7.1	2.6	26.0	68.6	47.9	38.7
Employability									
Share of 55-64 with tertiary education (% of the age group)	15	16	16	21	15	50	15	26	29
Absolute (% of all employed in the age group)	-	33	-	-	17	-	-	40	41
Relative to employed persons aged 25-54 (ratio)	-	0.67	-	-	0.50	-	-	0.81	0.79

Source: OECD older worker scoreboard, https://www.oecd.org/employment/ageingandemploymentpolicies.htm

14

Adequacy Pensions and Access to Healthcare

Maintaining human capital during old age

Gustavo Demarco [a], Johannes Koettl [b] Miglena Abels [c], and Andrea Petrelli [b]

[a] Pensions Global Solution Group, World Bank
[b] Social Protection and Labor, Middle East and North Africa, World Bank
[c] Social Protection and Labor, Global, World Bank

INTRODUCTION

Maintaining human capital during old age requires both an adequate pension (cash component) as well as access to affordable quality healthcare (healthcare component). Lack of universal/affordable healthcare and long-term care services for the elderly means governments may need to provide sufficiently higher old age financial assistance to poor elderly to compensate for high out-of-pocket health expenses. While countries with universal[1] quality healthcare may be able to ensure a minimum standard of living for the elderly at a lower benefit level, in countries where the elderly face high out of pocket health expenses – pensions may need to be higher to achieve that same minimum living standard.[2]

Governments should aim to provide a "minimum level of protection" for the disabled and elderly poor that fall outside the reach of contributory social insurance. Given the prevalence of informal jobs in developing countries, *Bismarkian* formal sector social insurance programs (pensions, health insurance, and unemployment benefits) have failed to provide sufficient coverage and protection. As a result, many countries, including low-income countries, have introduced non-contributory mechanisms to cover the informal sector and the self-employed. Some countries have chosen to cover all elderly, regardless of their income level at a substantially higher cost, while others have opted for means-tested pensions. Constrained fiscal space, multiple competing development objectives, and a growing number of older people due to demographic ageing generally means that developing countries could either afford to provide a lower benefit to a larger share of the elderly population, or a higher benefit to a more limited share of the elderly population.

Determining what level of pensions is "adequate", what constitutes a "minimum level of protection" and who should be eligible are the biggest design challenges today, for several well-documented reasons (high costs, incentives to formalize, etc.). A recent study for the South Asia Region (SAR) region (Demarco et al. 2022) presents the challenges to expand social pensions in a region where most population in the informal sector is poor and needs to rely on non-contributory programs to provide financial support to the elderly. A similar framework was used in studies for the Latin America and the Caribbean (LAC) region discussing the trade-off between the expansion of non-contributory pensions and the fiscal costs, even with benefits defined at poverty line level (Rofman, Apella, and Vezza 2015). This chapter adopts the conclusion from these studies, that expanding non-contributory pensions to provide all informal workers with retirement and coverage of other long-term social insurance risks would require enormous fiscal efforts and is not recommended. Although noncontributory pensions play a necessary role in providing income security in old age for the poorer informal workers, fiscal constraints will limit both the size of this kind of pensions and the income and age to be eligible to receive the old age benefit. The study also highlights that even if noncontributory pensions are devised to be affordable now, a major challenge is ensuring that the program remains affordable over time, given the population aging and the potential for discretionary increases in the benefit amounts.

In designing non-contributory pensions, policy makers should consider questions such as the following: (i) what percentage of the elderly are poor?; (ii) are elderly poorer (or more vulnerable) than other age groups?; (iii) what are the living arrangements of the elderly – do they live with other family members or alone?; (iv) what is their per capita consumption relative to the per capita consumption of non-elderly populations; (v) do they spend more on healthcare than other age groups?; (vi) do they spend more on healthcare out of pocket (and if not, could it be because there are other barriers in the way to seeking and obtaining healthcare altogether); (vii) what benefit level could be considered "adequate"; (viii) what would be the available fiscal space to expand benefits – both now and into the future – vis-à-vis competing development needs.

1 It is worthwhile to note that universal contributory health insurance programs, even when they exist, do not always provide sufficient elderly coverage, for instance, health insurance does not always cover long-term care.

2 While the chapter aims to underscore the need for both adequate pension as well as quality healthcare in order to support human capital in old age, it does not explicitly advocate for any single one approach to achieving this goal; it merely posits that in cases where the elderly lack healthcare, non-contributory old age pensions may need to be correspondingly adjusted to ensure the same level of wellbeing as in cases where sufficient/quality/high coverage healthcare is available to the elderly population. The chapter does not argue against broader initiatives that would provide increased affordable quality healthcare to the elderly through funds and risk pooling mechanisms.

Including the costs of access to quality health care in the definition of "adequate" pensions, does not necessarily imply that increased pensions are preferrable to addressing the deficiencies of the health system; it may just reflect the additional financial needs pensioners will face if access to universal health of good quality is not granted. Improving this access is, no doubt, a more efficient and permanent solution, but it may take longer to implement.

This chapter is organized as follows: (i) a review of current global patterns of non-contributory pension provision (design, coverage, eligibility criteria, benefit levels, costs) complimented by a discussion around adequacy, equity, and fiscal sustainability (ii) a review of healthcare provisions for the elderly without access to social insurance, (iii) recommendations.

FINANCIAL PROTECTION

The difficulties to expand contributory Social Insurance in developing countries has driven a growing number of governments to conclude that non-contributory programs are necessary to ensure minimum income protection at older ages. Several countries have moved in that direction in the past decade, notably in response to the impact of the COVID-19 crisis on vulnerable groups such as elderly and persons with disabilities. In the last two decades, around 30 countries have introduced some form of a non-contributory benefit targeted to the elderly. Analytical work and policy dialogue supported by development agencies has been consistent with this approach and provided analytical framework to support the policy shift and respond to the fiscal challenge of expanding tax-based pensions (Palacios and Robalino 2019). This chapter sets out to present a general framework to understand the rationale and objectives of the different models.

The design and scope of non-contributory programs targeted to the elderly varies considerably across the developing world, both in terms of eligibility criteria and the level of the benefits (Table 14.1). Some countries have chosen to provide a universal pension to all individuals above a certain age, while others limit access to those below a certain income level. For example, Egypt's Karama program, provides cash transfers to poorer elderly and persons with disabilities in a targeted manner, while Mexico[3] launched a universal program for all above age 65, regardless of their income. Argentina has adopted more complex modalities combining untargeted and targeted benefits on a contributory and non-contributory basis.

TABLE 14.1 Design and scope of non-contributory programs targeted to the elderly

Program Name	Targeting	Age
Albania: *Social Pensions*	pension tested	70
Argentina: *Universal Pension for the Elderly*	pension tested	70
Armenia: *State Social Pension*	pension tested	65
Bangladesh: *Old Age allowance*	means tested	65m/62f
Belarus: *Social pensions (disability and old age)*	pension tested	60m/55f
Bolivia: *Dignity Pension*	universal	60
Botswana: *Old-Age Pension*	universal	65
Brazil: *Beneficio de Prestacao Continuada (BPC / Continuous Cash Benefit)*	means tested	65
Bulgaria: *Old age pension - not related to labor activities*	means tested	70
Cabo Verde: *National Center for Social Pensions*	means tested	60
Canada: *Old Age Security Pension*	universal, residency	65
Chile: *Basic Solidarity Old Age Pension (PBS)*	pension tested	65
Colombia: *Social protection program for the elderly*	means tested	59m/54f

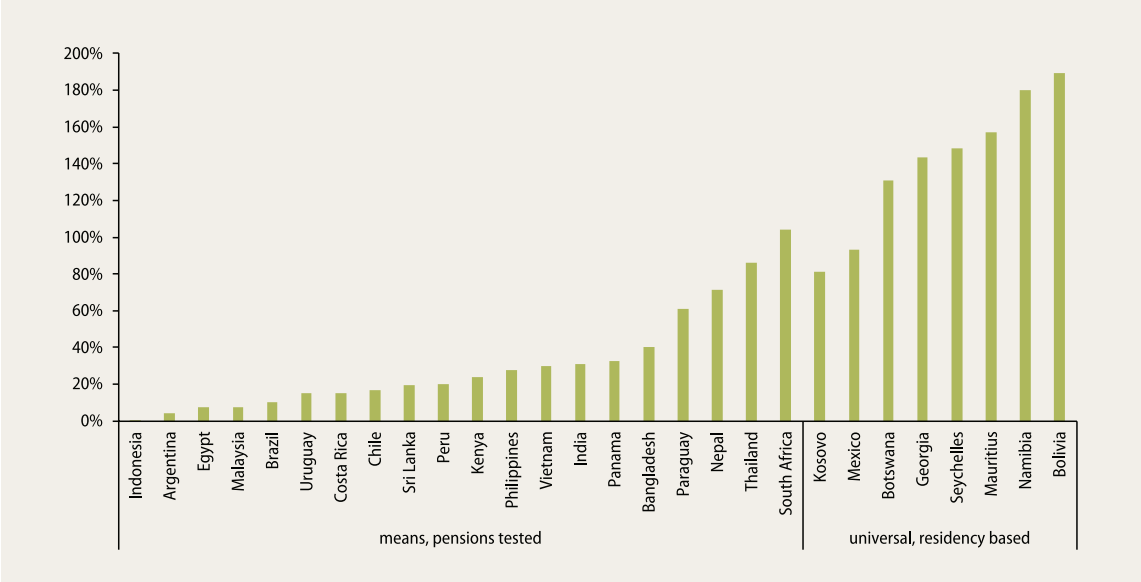
3 México universal pension: *Programa Pensión para el Bienestar de las Personas Adultas Mayores*

Program Name	Targeting	Age
Costa Rica: *Régimen no contributivo de pensiones por monto básico*	means tested	65
Ecuador: *Pension para Adultos Mayores*	means tested	65
Egypt: *Karama elderly assistance*	means tested	65
Eswatini: *Old Age Grant*	universal	60
Fiji: *Social Pension Scheme*	pension tested	68
Georgia: *Universal old age pension*	universal	65m/60f
Greece: *Social solidarity allowance for uninsured elders*	means tested	67
India: *Indira Gandhi National Old Age Pension Scheme*	means tested	60
Indonesia: *Elderly Social Assistance Programme*	means tested	70/60*
Kazakhstan: *Basic state pension*	pension tested	63m/58f
Kenya: *Older Persons Cash Transfer OPCT*	means tested	65
Kiribati: *Elderly Fund Pension*	universal	65
Kosovo: *Basic Pension (social pension, non-contributory)*	universal	65
Lesotho: *Old age pension*	pension tested	70
Malaysia: *Financial Assistance for Older Person*	means tested	60
Maldives: *Old Age Basic Pensions Scheme*	pension tested	65
Mauritius: *BRP - zero pillar*	universal-residency test	60
Mexico: *Programa Pensión para el Bienestar de las Personas Adultas Mayores*	universal	65
Mongolia: *Social Welfare Pension*	means tested	60m/55f
Namibia: *Old Age Pension*	universal	60
Nepal: *Senior Citizens Allowance*	pension tested	68
New Zealand: *Supperannuation*	universal, residency	65
Panama: *120 to the 65*	pension tested	65
Papua New Guinea: *New Ireland Social Pension*	universal regional	60
Paraguay: *Pensión Alimentaria para Adultos Mayores*	means tested	65
Peru: *Pension 65*	means tested	65
Philippines: *Social Pension for the elderly*	means tested	60
Samoa: *Senior Citizens Benefit*	universal	65
Seychelles: *Retirement Pension*	universal	63
South Africa: *Old-age grant*	means tested	60
Sri Lanka: *New Elders Assisstance Program*	means tested	70
Tajikistan: *Social pensions*	pension tested	65m/60f
Tanzania: *Zanzibar's Universal Social Pension*	universal	70
Thailand: *Old Age Allowance*	pension tested	60
Timor-Leste: *Elderly support allowance*	universal	60
Tonga: *Social Welfare Scheme for the Elderly*	means tested	70
Uruguay: *Non-contributory pensions for old age and disability*	means tested	70
Viet Nam: *Monthly subsidy for elderly*	means tested	60

Source: World Bank Atlas of Social Protection Indicators of Resilience and Equity (ASPIRE).
*Indonesia: Elderly Social Assistance Programme 70/60 if chronically ill

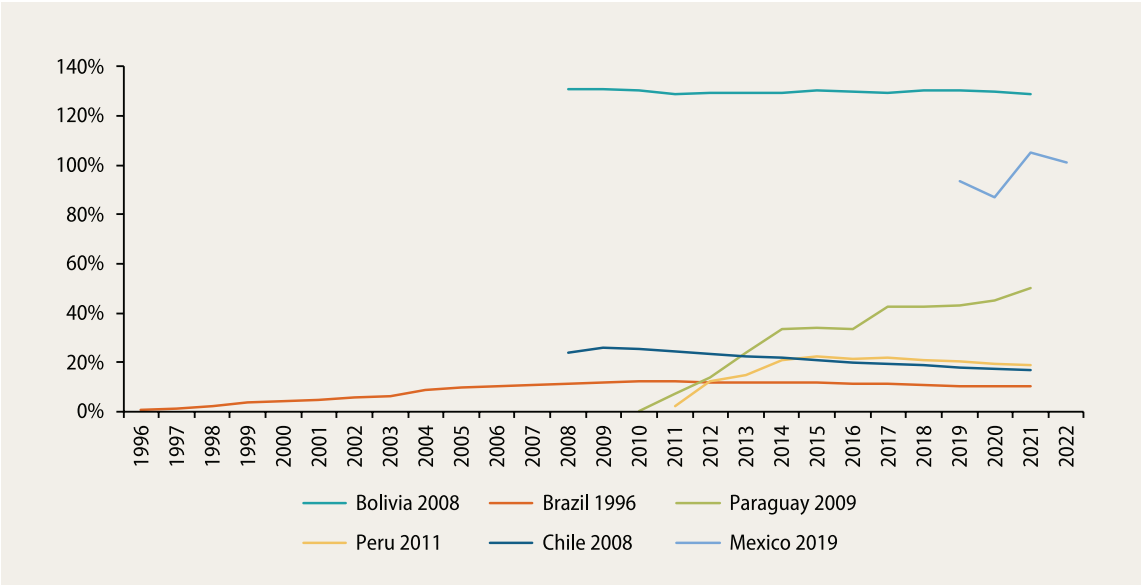
Lower ages of eligibility and/or a lower income threshold for means-testing unsurprisingly results in a higher count of beneficiaries. Figure 14.1 below shows non-contributory pensioners as a share of the population above age 65. Coverage is highest in Bolivia, Namibia, and Mauritius where the age of eligibility is 60 and the benefit is universal, meaning there isn't a means test and everyone above the age of 60 is eligible (percentages in the graph exceed 100 percent because the denominator is population ages 65+ whereas the retirement age is 60). Conversely, coverage in Uruguay, where the age for eligibility is 70 and benefits are means tested, stands at 15 percent of the population above age 65. Figure 14.2 presents the data on beneficiaries of social programs in LAC countries over time.

FIGURE 14.1 Coverage of non-contributory pensions, % population 65+



Source: World Bank ASPIRE dataset

FIGURE 14.2 Old age social pension beneficiaries, % population 65+



Source: World Bank ASPIRE dataset

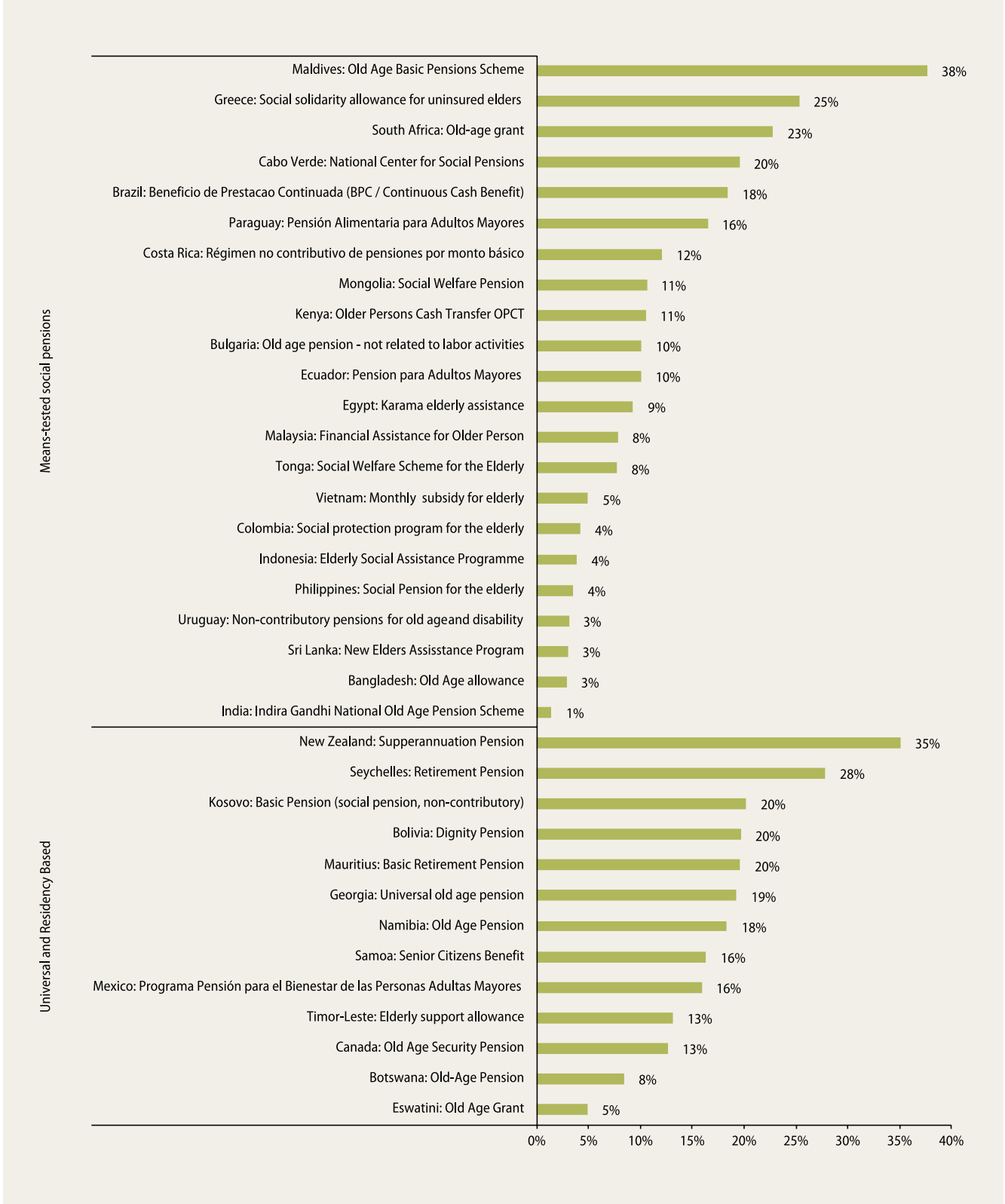
All these models have two main objectives in common – to ensure a minimum level of income support to the largest possible number of (poor or vulnerable) elderly. What that "minimum level" of income support needed is, and who is "poor", can vary from country to country. Some countries have assigned greater importance on expanding coverage at the expense of a lower level of pensions, while others have set more strict eligibility conditions (including higher eligibility ages or income threshold levels for means testing) – opting to provide higher benefits to fewer beneficiaries. Governments are faced with the need to balance the potential disincentives to formalization and higher costs that a high level of non-contributory pensions spell with the potential regressivity and limited impact on poverty of a low level of benefits (Figure 14.3).

While the overall objective of non-contributory pensions is to ensure a minimum standard of living in old age, some countries provide benefits that exceed the poverty line, while others only provide a fraction of the poverty line. Across the Organization for Economic Cooperation and Development (OECD) countries, means-tested non-contributory pensions average around 19 percent of gross average earnings. It is interesting to note however that some countries, including Australia, New Zealand, and the US have pension amounts for elderly eligible couples that are less than twice the benefit amount a single elderly person receives. In Australia, an eligible couple receives 1.5 times the benefit an elderly person living alone receives. In the developing countries where data is available, universal, and residency-based pensions average 18 percent of GDP per capita, whereas means-tested pensions average around 10 percent of GDP per capita. The current poverty line is approximately at 20 percent of GDP per capita in lower-income countries, and a little lower in middle- and higher-income countries. However, in only 8 of the countries where data is available (n=34), non-contributory old age pensions equal or exceed 20 percent of GDP per capita (Figure 14.4). Benefits below the poverty line alongside high out of pocket healthcare expenditures suggest that poor and vulnerable elderly in lower income countries may be inadequately positioned to maintain a decent[4] and healthy life at older ages. Out-of-pocket expenditure accounts for 48 and 43 percent of total health expenditure in lower middle income and low-income countries respectively, whereas it accounts for 32 percent in upper middle-income countries and only 14 percent in high income countries.

However, increasing the benefit level without carefully defining the pool of potential beneficiaries may lead to programs quickly becoming fiscally unaffordable. A recent study for the SAR region (Demarco et al. 2022) presents the challenges to expand social pensions in a region where most population in the informal sector is poor and needs to rely on non-contributory programs to provide financial support to the elderly. The study concludes that expanding noncontributory pensions to provide all informal workers with retirement and coverage of other long-term social insurance risks would require enormous fiscal efforts and is not recommended. Although noncontributory pensions play a necessary role in providing income security in old age for the poorer informal, fiscal constraints will limit both the size of this kind of pensions and the income and age to be eligible to receive the old age benefit. The study also highlights that even if noncontributory pensions are devised to be affordable now, a major challenge is ensuring that the program remains affordable over time, given the population aging and the potential for discretionary increases in the benefit amounts. Figure 14.5 shows the current and projected share of 60+ individuals in total population in South Asia region – most countries are projected to see their elderly populations double or more as a share of total population. The figure shows expenditure on non-contributory pensions – expenditure is highest in countries with universal coverage and high benefits as a share of GDP per capita. Fastest ageing countries with universal pensions will likely need to budget a growing, potentially unsustainable, fiscal allocation to their income support for the elderly.

4 The ILO Convention No. 102 recommends that non-contributory pensions, including means-tested old-age pensions, should guarantee that the provision offered is at least sufficient to maintain the family of the beneficiary in health and decency (Convention No. 102, Art. 67(c)).

FIGURE 14.3 Benefit amount, % GDP per capita



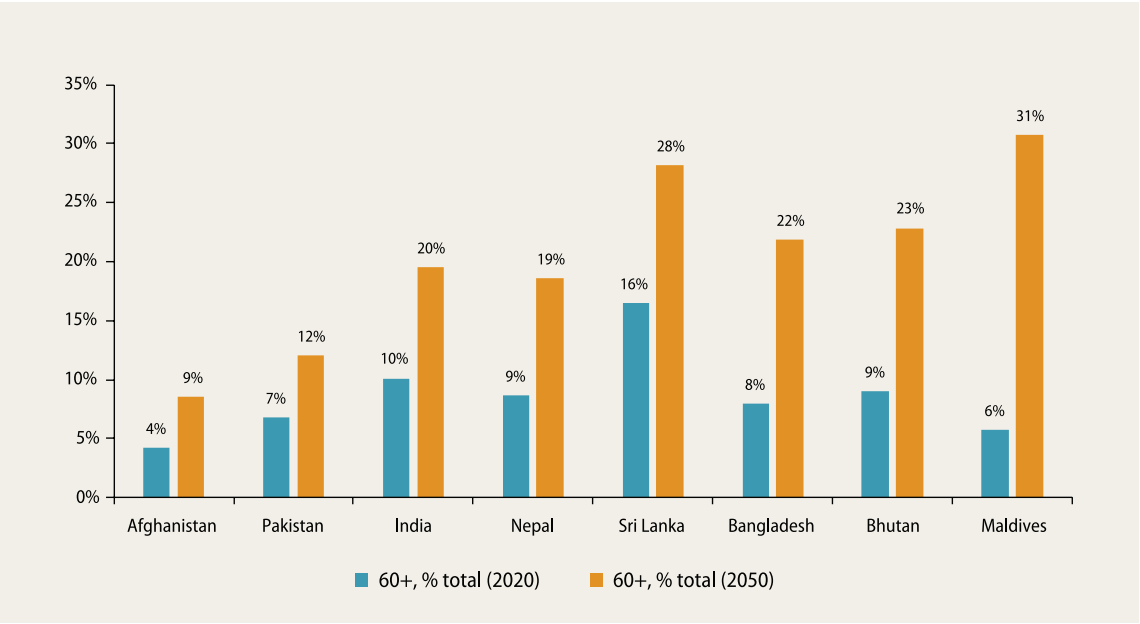
Source: Original calculations for this publication based on World Development Indicators and World Bank ASPIRE dataset

FIGURE 14.4 **Expenditure on non-contributory pensions, % GDP (latest year)**



Source: World Bank ASPIRE dataset

FIGURE 14.5 **Projected share of 60+ in total population in SAR**



Source: Original calculations for this publication based on data from World Bank ASPIRE

ACCESS TO HEALTH AND LONG-TERM CARE SERVICES

While rapid progress in medical science and treatments explain the important extension in life expectancy and aging worldwide, health and long-term care costs can quickly become overwhelming. These costs are higher in the last years of life, so older people face a much higher risk of encountering such catastrophic costs that would not only eat up their pension and other social benefits, but also their savings and other assets. So, to fulfill the financial protection mandate, countries not only need to provide pensions but also access to affordable health and long-term care.

In many countries, pension systems link to health care, and in a few countries even long-term care. Again, this seems to work well in the *Bismarckian* systems when the economy is highly formalized and coverage—both in terms of beneficiaries and contributors—is broad. In these countries, typically social insurance type pension systems are linked with social health insurance so that beneficiaries of pensions are also covered by—and contributing to—health insurance. There are some exceptions, notably the US, which has a separate health program for the elderly (Medicare) and the UK, which has a universal national health system.

There is large consensus on the motivation and need to provide healthcare for the elderly, but the concept of adequacy pensions usually misses the *implications of out-of-pocket healthcare expenditures*, which is in turn dependent on *the health care financing model* and *the quality of health service delivery*.

The table below, using the categories proposed by Scheil-Adlung (2013), includes some additional dimensions which may help us identify additional factors to incorporate in the concept of adequacy pensions.

TABLE 14.2 Additional dimensions to identify factors to incorporate in the concept of adequacy pensions

		Social Health Insurance			
	National Health Services	Traditional (Bismarckian)	National Health Insurance	Community-based Health Insurance	Private Health Insurance
Coverage	All	Formal sector	All	Selective (community members)	Selective (voluntary members)
Financing	Public budget	Contributions (group or national risk pooling)	Public budget and contributions	Local governments and NGOs	Individual contributions (low or no risk-pooling)
Sufficiency	Yes, if all health services are provided efficiently	Yes	Yes, if all health services are provided efficiently	Yes, if all health services are provided efficiently	Yes
	No, if some services are excluded or the quality is poor		No, if some services are excluded or the quality is poor	No, if some services are excluded or the quality is poor	
Out of pocket costs	Low	Low	Low	Low	High

Source: Adapted from Scheil-Adlung (2013)

The table shows five basic models to provide health coverage for the elderly, with different financial implications: (i) National Health Services (also known as "Public Health"); (ii) Health Insurance (under three possible variants: contributory, national or community based), and (iii) private health insurance.

The green shadow means that the probability of the members to incur in costs is null or low, while red means they must incur in costs, or they may need to do so. This may happen because the costs are on the members (by design), because the original sources of funding may result insufficient, or because the population covered may need to seek alternatives at their expense when quality of services is low.

National Health Services provided in many countries are the main mechanism of health coverage for the poorer (elderly and non-elderly). Countries with strong public health systems will provide health care at null or low cost. This would be the only case in which **adequacy pensions** can be defined at a level equivalent to the poverty line (p):

$$AP = p \qquad [1]$$

However, if public health does not cover some treatments, or the services are of poor quality, some

health services, treatments, and medicines may need to be paid out of pocket, and the level of adequate pension would change to:

$$AP = p + \alpha\, nc + \beta\, q \qquad [2]$$

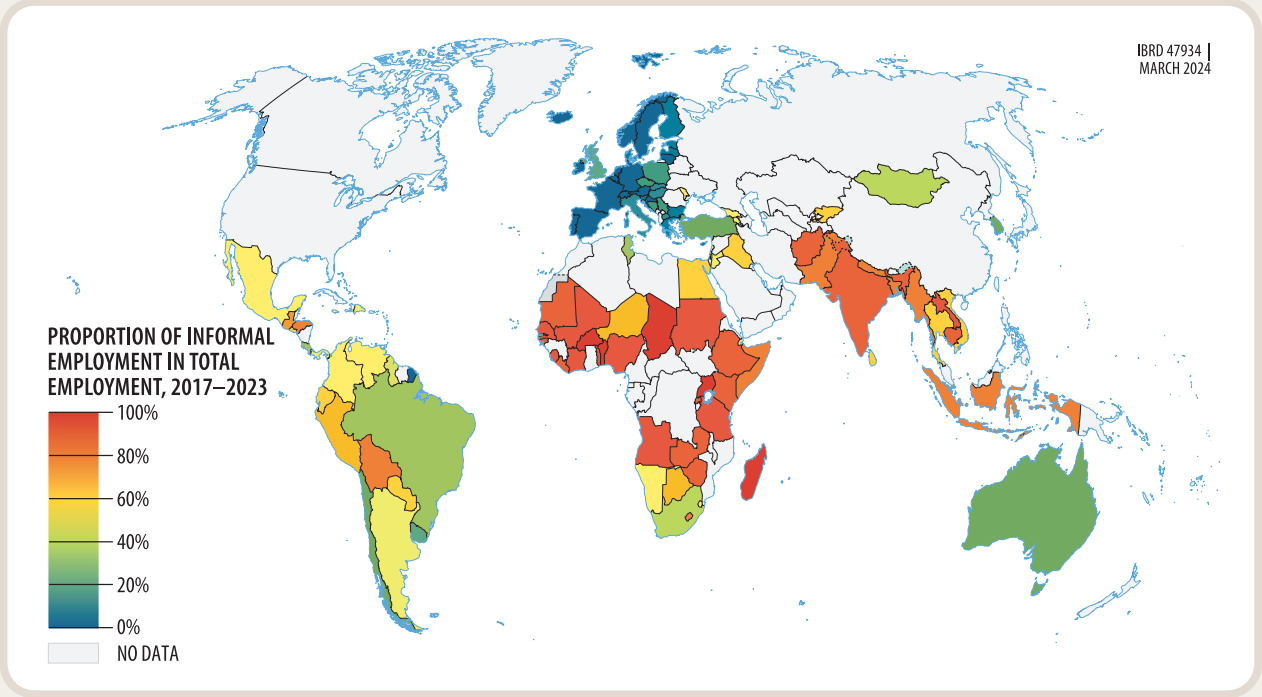
Where α and β are coefficients to increase the level of adequacy pension in the cases of non-covered services (nc) or to compensate for quality deficits (q, with $\beta \leq 0$). Both parameters are dependent on the probability of occurring and the costs incurred.

The source of financing appears in yellow in the table, to reflect the risk of a potential limitation of financing sources in the future (unsustainable social expenditure), resulting in the need for further adjustments in the level of pensions to be considered "adequate".

Similar situations can be observed in the cases of National Health Insurance and Community Based Insurance, except that these programs were developed in some countries to complement the Public Health programs and overcome some of their limitations and challenges. In several countries, NHI and CBHI coexist with NHS, but they usually provide additional services and more expedited treatment, especially for targeted groups such as children, elderly, and persons with disabilities. One of such examples is Egypt, where a National Health Insurance program was launched to provided poorer groups with better access to the services provided by the pre-existing Public Health hospitals and facilities.

The case of traditional Health Insurance is different because the health services provided are usually wider and, in general, of higher quality than in the case of public hospitals. However, these services are usually available to workers in the formal sector, which in developing countries represent a small percentage of the total labor force and usually excludes the growing group of self-employed, migrant workers, and other forms of work which are becoming prominent in the world, such as platform workers.

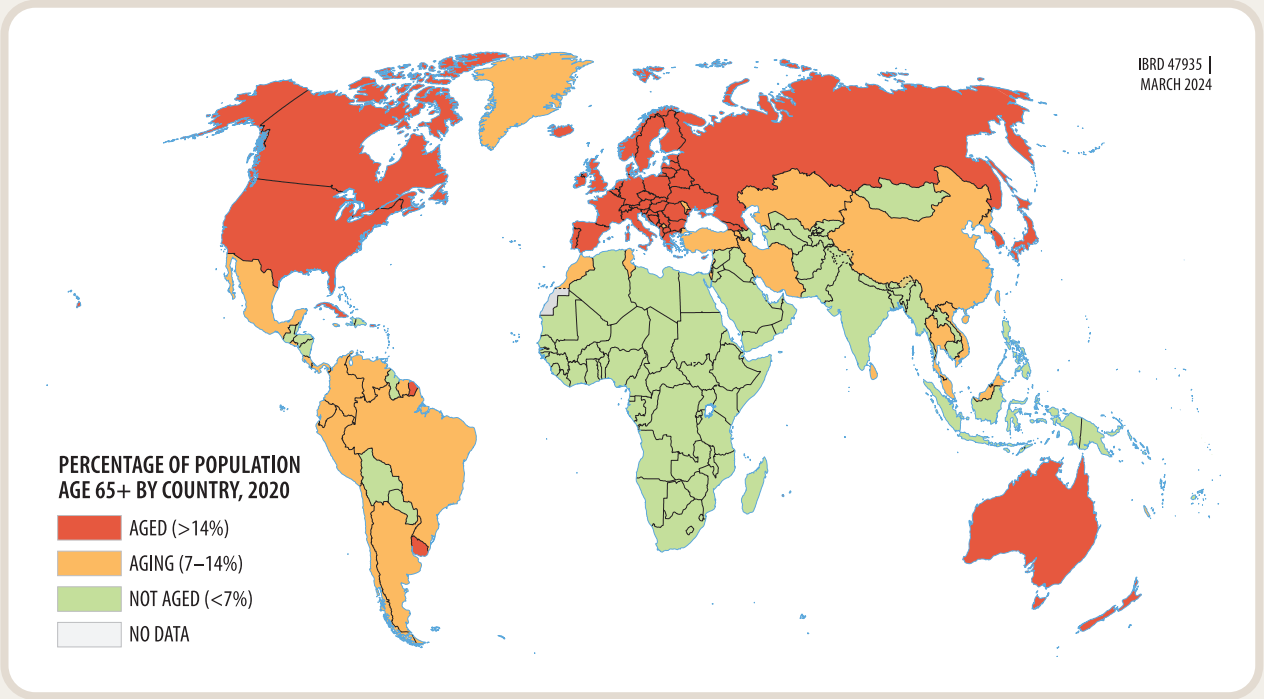
MAP 14.1 High shares of informality in developing countries



Source: ILOSTAT

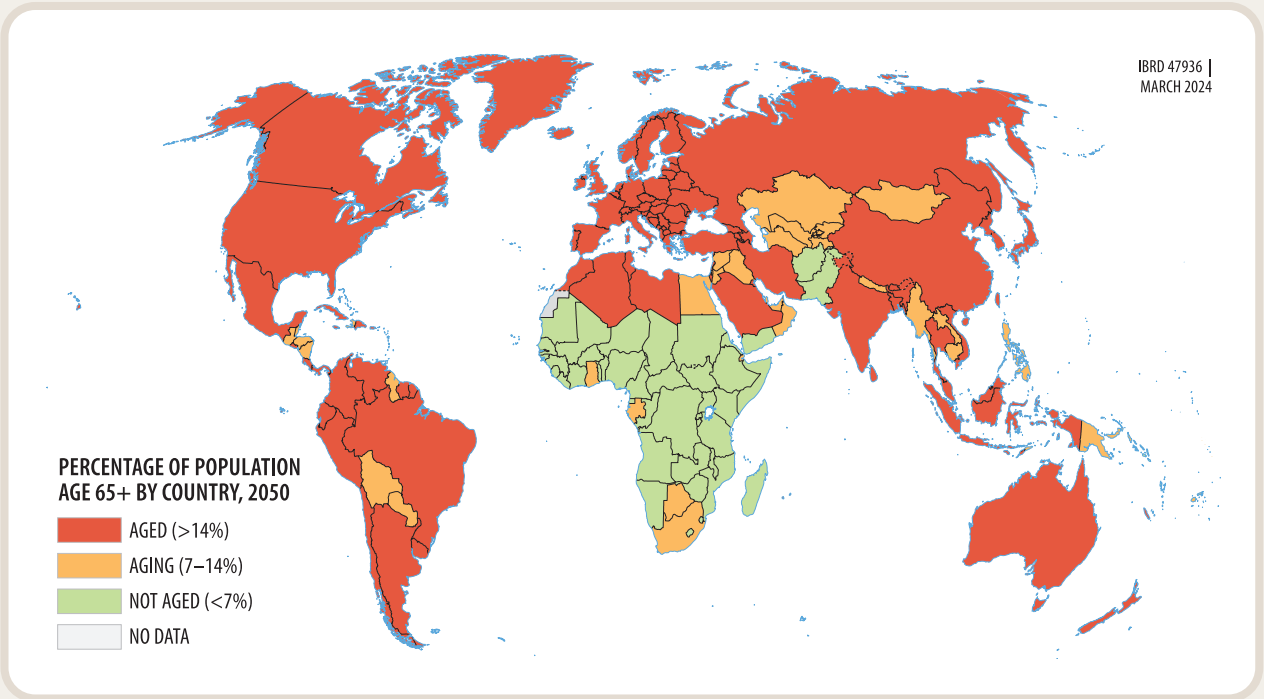
However, formal sector workers' health insurance is at risk of becoming unsustainable due to the increasing costs of health and pensions associated with demographic change. As shown in the following figures (Maps 14.1 - 14.3) and highlighted in multiple publications, aging population is happening at a high speed, even in young countries, many of which will have large number of the elderly in the coming decades.

MAP 14.2 Global Aging in 2020



Source: Adapted from Harasty and Ostemeier (2020)

MAP 14.3 Global Aging in 2050



Source: Adapted from Harasty and Ostemeier (2020)

The case of the voluntary private health insurance is beyond the scope of this chapter. It is limited to a small number of higher income groups of the population, so they have no implications on the analysis of "adequacy pensions".

In summary, minimum, or social pensions should be defined as "adequate" if they are able to provide income protection to prevent poverty and some minimum level of income to provide for health expenses at older ages, as shown in equation (2). Ideally, access to good quality health services would be a better solution, but we will assume that this would require more structural reforms of the health system, which could not be achieved in the shorter term.

The main problem with that formula is that most of the variables (notably nc, q and the parameters α and β) are difficult to observe or measure.

The Elder Economic Security Standard Index (Elder Index), developed by the Gerontology Institute at the University of Massachusetts, Boston (Elder Index 2022), provides a measure of the income that older adults in the United States need to meet their basic needs and age in place with dignity. This includes not only housing and food but also the cost of healthcare. The Elder Index is one example of a methodology that facilitates tailoring the adequacy measure to the elderly while still providing a relatively simple way to evaluate retirement security. Even so, the extension of such methodologies faces important data challenges, particularly in developing countries.

In the absence of detailed data required for an accurate measurement of "adequate pensions", we propose the use of a proxy variable. Out-of-pocket health expenditures (OOP) have frequently been suggested to increase the needs of poor, above the poverty level. There is abundant information on *OOP,* although the data not always discriminates the expenditures by income level and age. If that information was available, then the proper definition of adequacy pensions could simply be reduced to:

$$AP = p + OOP \qquad [3]$$

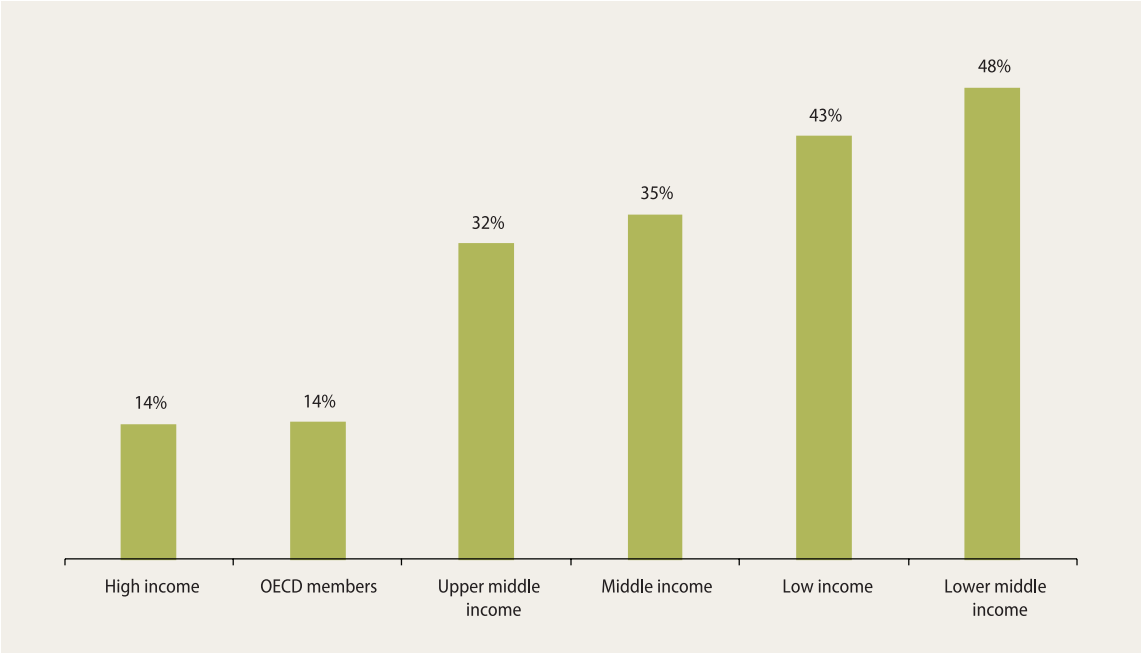
The caveat of this approach is that "*OOP*" may underestimate the needs of health coverage, especially for poorer population, who may not be able to incur so much *OOP* as their health needs would require, precisely because of their limited income, and they may just not attend medical consultations or stop treatments. A possible solution would be to use the OOP variable corresponding to a higher income group (for example, the lowest income quintile instead of the lowest decile households). It may be useful to incorporate this indicator (or estimate its level) in the definition of adequacy pensions.

Impoverishment[5] due to out-of-pocket spending occurs even in countries where the entire population is officially covered by a health insurance scheme or by national or subnational health services (Wagstaff et al. 2018). Out-of-pocket spending on health can add to the poverty head count and the depth of poverty by diverting household spending from non-health budget items. Data from WHO and World Bank shows that the size of out-of-pocket expenditures is highest among low and lower middle-income countries, followed by middle and upper middle-income countries and is lowest among high income countries (Figure 14.6). OOP spending on health care tends to be higher across countries where the share of total public health spending channeled through social security funds is lower. While high OOP spending can add to poverty, low OOP spending doesn't necessarily mean a good thing, especially if public health spending is lower and the country is low-income. Countries with low levels of public spending on healthcare that also report lower OOP costs suggests that the lower OOP expenditure levels may, to a degree, be resulting from people forgoing healthcare altogether at higher rates – lower OOP costs among low-income countries with lower levels of health spending channeled through social security funds may signal inadequate financial resources resulting in healthcare done without.

Analysis of household survey data also shows that having any OOP health costs is widespread among low and lower-middle income countries with around 8 out of 10 households reporting OOP health costs across all income quintiles. A deeper look at the household composition by age shows that a higher percentage of households with elderly vs households without elderly report having OOP health expenditures. Further analysis using the income distribution shows that the largest percentage of households reporting OOP costs fall in the richest quintile (Q5), while the lowest percentage of households reporting OOP costs are in the lowest income quintile (Q1): only 75 percent of households with elderly in the Q1 report having OOP costs while 87 percent of households with elderly in

5 Impoverishing out-of-pocket metrics include indicators to identify both people impoverished and further impoverished by out-of-pocket health spending, using various poverty lines (e.g., the global extreme poverty line, a relative poverty line).

FIGURE 14.6 Out-of-pocket expenditure (% of current health expenditure)



Source: WHO Data Portal.

Q5 report having OOP costs. These findings align with both the thinking that healthcare needs increase with age and that lower income individuals may forgo care at higher rates for financial reasons.

Household survey analysis shows that households with elderly have 1.3 percentage points higher OOP health expenditure relative to households without elderly (Table 14.3). Households with elderly in the lowest income quintile spend 1.29 percentage points more than households without elderly in the same income quintile. In the richest income quintile, households with elderly spend 1.5 percentage points more than households without elderly in the same income quintile.

On average, a household with elderly that belongs to the bottom 20 percent spends 5.17 percent of welfare (based on household expenditure), whereas households in Q5 spend only 4.4 percent

TABLE 14.3 Comparison of average shares of OOP health expenditure between households with elderly in the poorest quintile versus households with elderly in the richer quintiles

	(1)	(2)	(3)	(4)	(5)
VARIABLES	sh_hexp_1	sh_hexp_1	sh_hexp_1	sh_hexp_1	sh_hexp_1
hh_older_65	0.0129***	0.0121***	0.0149***	0.0119***	0.0149***
	(0.0029)	(0.0017)	(0.0019)	(0.0011)	(0.0010)
hh_size	-0.0007***	-0.0001	-0.0005***	-0.0004**	-0.0008***
	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
Constant	0.0379***	0.0274***	0.0288***	0.0277***	0.0267***
	(0.0015)	(0.0014)	(0.0009)	(0.0009)	(0.0007)
Observations	50,191	58,894	64,584	71,737	88,508
R-squared	0.0048	0.0072	0.0127	0.0082	0.0143

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

FIGURE 14.7 Average share of out of pocket health expenditure by quintile and presence of persons age 65+



Source: Original calculations for this publication based on household survey data from World Bank ASPIRE.

of welfare – representing a 16 percent higher burden on poor households with elderly. Comparing average shares of OOP health expenditure between households with elderly in the poorest quintile versus households with elderly in the richer quintiles also shows that elderly poor devote a larger share of their income to OOP health costs relative to richer households with elderly (Figure 14.7).

Households with elderly in the poorest income quintile are more likely by 0.40 percentage points to be pushed below the poverty line ($3.2 per day) whereas richer households with elderly report no impact on their welfare due to OOP health spending. In addition, households with elderly and households without elderly have a 4 percentage points and 1.5 percentage points higher likelihood of incurring at least 10 or 25 percent of OOP expenditure on health respectively as a share of their welfare.

Welfare is calculated on a per capita basis at the household level, which means analysis assumes each family member receives an equal share of the overall household welfare. However, elderly members may not always receive an equal share, exposing elderly individuals to an even greater vulnerability than household survey results suggest.

In summary, households with elderly face higher healthcare costs in general across all income groups relative households without elderly. Poor households with elderly spend a larger share of their welfare on OOP health expenditures. As such, elderly in the bottom 40 percent of the income distribution face increased vulnerability as their healthcare needs – along with higher OOP health costs increase as they become older. Findings from this household survey analysis of low and lower middle-income countries suggest that elderly poor among these countries may choose to forgo healthcare at lower rates if they receive an adequate non-contributory pension that not only covers their basic living expenses but also provides for access to adequate healthcare.

CONCLUSIONS

To define a level of pensions as "adequate", we need to include considerations on access to health care. Well-designed programs can either offer a package of pensions plus health coverage or invest in improved public health and long-term care for the elderly. Not doing so exposes many of the programs launched in recent years to the risk of failure. This may be the case both of programs to provide universal pensions (without provisions for healthcare), and of the universal national health care system that is de-linked from any social protection benefits.

In the case of social insurance, the link between pensions and social health insurance for the elderly exists in many cases but is concerningly missing in others. In the cases where health insurance exists, it sometimes only covers the workers during the active life, but not after retiring. The link between pensions and health programs may prevent the lower income pensioners from falling in poverty. But, as explained in the main text, this can only apply to formal sector workers, and these are a minority of the workforce in most low- and middle-income countries.

The *Bismarckian* social insurance model has many advantages and is very effective in highly formalized economies, although even among those, societal ageing and the changing nature of work pose considerable challenges for the pay-as-you go financing model going forward. In recent years, an alternative to the Bismarckian social insurance model has been gaining popularity in the form of basic pensions, old age allowances, or simply an increased reliance on the general safety net. A separate program to provide healthcare for elderly has been adopted in several countries. The US Medicare program is one such example of a program is delinked from pensions, while extended programs for elderly such as the "*Programa de Atención Médica Integral*" (PAMI) – the Integrated Medical Assistance Program – adopted in Argentina in the early 1970s only apply to pension beneficiaries (in a fairly laxed manner).

Programs designed to expand social pensions or non-contributory programs should explicitly provide enough resources to cover the minimum expenses at poverty level, plus the projected out of pocket health expenses. However, the fiscal implications of providing adequacy pensions are stark and require careful analysis and projections to ensure fiscal sustainability. The approach proposed in this chapter may provide further evidence to support targeting fiscal support to non-contributory pension programs, as opposed to universal benefits.

REFERENCES

1. Center for Social and Demographic Research on Aging, University of Massachusetts Boston and Gerontology Institute, University of Massachusetts Boston. 2017. "The National Elder Economic Security Standard™ Index: Methodology Overview." *Center for Social and Demographic Research on Aging Publications*. 16.
2. Demarco, Gustavo C., Ernesto Brodersohn, Miglena Abels, Clément Joubert, and Emilio Basavilbaso. 2023. "Social Insurance among Informal Workers in South Asia." In *Hidden Potential: Rethinking Informality in South Asia*, edited by Maurizio Bussolo and Sidharath Sharma, 249–318. Washington, D.C.: World Bank.
3. Elder Index. 2022. The Elder Index™ [Public Dataset]. Boston, MA: Gerontology Institute, University of Massachusetts Boston. Retrieved from ElderIndex.org.
4. Ghannam, Alaa, and Ayman Sebae. 2021. "Healthcare Protection Policies during the COVID-19 Pandemic: Lessons towards the Implementation of the New Egyptian Universal Health Insurance Law." *Social Protection in Egypt: Mitigating the Socio-Economic Effects of the COVID-19 Pandemic on Vulnerable Employment*. https://fount.aucegypt.edu/faculty_journal_articles/876/.
5. Harasty, Claire, and Martin Ostermeier. 2020. "Population Ageing: Alternative Measures of Dependency and Implications for the Future of Work." ILO Working Paper 5. Geneva, Switzerland: International Labor Organization (ILO).
6. Neelsen, Sven, Patrick Hoang-Vu Eozenou, Marc-Francois Smitz, and Ruobing Wang. 2022. "The 2022 Update of the Health Equity and Financial Protection Indicators Database: An Overview." Health, Nutrition, and Population (HNP) Discussion Paper. Washington, D.C.: World Bank.
7. Packard, Truman, Ugo Gentilini, Margaret Grosh, Philip O'Keefe, Robert Palacios, David Robalino, and Indhira Santos. 2019. "Protecting All: Risk Sharing for a Diverse and Diversifying World of Work." Washington, D.C.: World Bank.
8. Palacios, Robert J., and David A. Robalino. 2020. "Integrating Social Insurance and Social Assistance Programs for the Future World of Labor." IZA Discussion Paper No. 13258. Bonn, Germany: IZA Institute of Labor Economics.
9. Rofman, Rafael, and Ignacio Apella. 2020. *When We're Sixty-Four: Opportunities and Challenges for Public Policies in a Population Aging Context in Latin America*. Washington, D.C.: World Bank.
10. Rofman, Rafael, Ignacio Apella, and Evelyn Vezza. 2015. "Beyond Contributory Pensions : Fourteen Experiences with Coverage Expansion in Latin America." Washington, D.C.: World Bank.
11. Scheil-Adlung, Xenia. 2013. "Health Protection: More than Financial Protection." In *Scaling up Affordable Health Insurance*, edited

by Alexander S. Preker, Marianne E. Lindner, Dov Chernichovsky, and Onno P. Schellekens, 13–48. Washington, D.C.: World Bank.

12. Skirbekk, Vegard, Joseph L Dieleman, Marcin Stonawski, Krystian Fejkiel, Stefanos Tyrovolas, and Angela Y Chang. 2022. "The Health-Adjusted Dependency Ratio as a New Global Measure of the Burden of Ageing: A Population-Based Study." *The Lancet Healthy Longevity* 3 (5): e332–38.
13. Wagstaff, Adam, Gabriela Flores, Marc-François Smitz, Justine Hsu, Kateryna Chepynoga, and Patrick Eozenou. 2018. "Progress on Impoverishing Health Spending in 122 Countries: A Retrospective Observational Study." The Lancet Global Health 6 (2): e180–92. https://doi.org/10.1016/s2214-109x(17)30486-2.
14. World Bank. 2022. The Atlas of Social Protection Indicators of Resilience and Equity (ASPIRE) dataset. https://www.worldbank.org/aspire.
15. World Health Organization (WHO). 2022. Global Health Observatory Data Portal. https://www.who.int/data/maternal-newborn-child-adolescent-ageing/indicator-explorer-new/mca/out-of-pocket-health-expenses-as-percentage-of-total-health-expenditure.

Prioritizing Action

Chapter 15
Priority Setting for NCD Control and Health System Investments

Chapter 16
Control of Non-Communicable Diseases for Enhanced Human Capital: The Case for Whole-of-Society Action



15

Priority Setting for NCD Control and Health System Investments

David Watkins [a,b], *Sali Ahmed* [a,b], *and Sarah Pickersgill* [b]

[a] Department of Medicine, University of Washington
[b] Department of Global Health, University of Washington

INTRODUCTION

As underscored in several background papers developed for the HLI Commission, noncommunicable diseases (NCDs) represent a major and growing threat to the health of the world's aging populations. Unfavorable trends in risk factors like smoking, alcohol use, unhealthy diet, and low physical activity, when combined with accelerations in population growth and aging, paint a picture of a future world dominated by a greater number of NCD cases and deaths in nearly all countries (Foreman et al. 2018; Watkins et al. 2018). Yet many NCD deaths are amenable to simple and relatively inexpensive interventions, such as provision of basic medical care for acute heart attacks, or they are largely preventable, for example through tobacco control policies (Prabhakaran et al. 2018).

Ever since the first UN High-Level Meeting in 2011, the global NCD agenda has faltered and has suffered from insufficient national and international resources (Nishtar et al. 2018). Only a handful of countries are on track to achieve the Sustainable Development Goal (SDG) target 3.4, which calls for a one-third reduction in premature mortality from NCDs between 2015 and 2030 (NCD Countdown Collaborators 2020). The COVID-19 pandemic made matters much worse by causing major disruptions to health systems. In the aftermath of the pandemic, the medium-term fiscal and macroeconomic outlook remains uncertain for many low-income countries (LICs) and middle-income countries (MICs) because of tepid growth rates and large government debts made worse by inflationary pressures (IMF 2022).

The challenge for ministries of health that want to act on NCDs will be to find ways of doing more with the same (or potentially fewer) resources. This is fundamentally a challenge to achieve greater efficiency in health systems. This chapter seeks to provide guidance on the sort of NCD interventions that could generate high returns for the money spent, thereby improving spending efficiency over the long run. These interventions could be considered top priorities for health benefits packages and universal health coverage systems. We argue that any new health sector resources available for NCDs should be spent on these interventions rather than on ones that are politically popular (e.g., chronic hemodialysis) or establish new markets for industry (e.g., novel on-patent chemotherapy agents) but do not generate much health per dollar spent.

We acknowledge that each health system is unique and that countries with different resource levels and disease contexts will have different priorities. The primary objective of this chapter is to present a framework for setting priorities around NCD interventions and demonstrate how it could be used to pare down a list of candidate interventions to a manageable set that fits within a given health budget.

IDENTIFYING CANDIDATE NCD INTERVENTIONS

This chapter builds heavily on previous projects the authors have led. The list of interventions presented here (see Table 15.1 below) is modified from recommendations that came from the Disease Control Priorities Project, specifically, the 3rd edition (DCP3), published between 2015 and 2018 (Jamison et al. 2018). The methods we use for modeling intervention cost and impact are adapted from a report we prepared for the NCD Countdown 2030 Collaborators that provided guidance to countries on how to get back on track to achieve the SDG 3.4 target (NCD Countdown Collaborators 2022). However, this chapter takes a broader view of NCDs than the Countdown report and considers any DCP3 intervention that can reduce NCD mortality, broadly defined, including surgical care and mental healthcare. The annex to this chapter provides an overview of methods.

From a cost and volume-of-care standpoint, these interventions represent a significant proportion of what health systems do for NCDs. For example, cardiovascular disease (CVD) primary prevention, diabetes management, and mental healthcare together address the plurality of primary care need for chronic disease in most countries (except for those heavily affected by HIV/AIDS). Still, most countries are nowhere near full implementation of these interventions. For example, fewer than half of persons with hypertension worldwide are on treatment, and in LICs like Mozambique the percentage is closer to 15 percent (NCD Risk Factor Collaboration 2021).

TABLE 15.1 Interventions considered in this chapter

Intervention cluster	Specific interventions
Interventions outside the health sector (risk factor reduction)	Tobacco excise taxes
	Alcohol excise taxes
	Smoking regulations and information/education/communication
	Alcohol regulations
	Sodium regulations and information/education/communication
	Trans fat bans
Outpatient cardiometabolic and respiratory disease care	Diabetes screening/treatment
	Cardiovascular disease primary prevention
	Aspirin for suspected acute coronary syndromes
	Cardiovascular disease secondary prevention
	Heart failure chronic treatment
	Chronic pulmonary disease treatment
Outpatient mental, neurological, and substance use disorder care	Injection drug use harm reduction measures
	Alcohol use screening/brief intervention
	Depression chronic treatment
	Bipolar disorder chronic treatment
	Schizophrenia chronic treatment
	Epilepsy acute and chronic treatment
First-level hospital cardiometabolic and respiratory disease care	Medical management of acute coronary syndromes
	Heart failure acute treatment
	Treatment of acute exacerbations of chronic pulmonary disease
First-level hospital surgical care	Screening and treatment of early-stage cervical cancer
	Management of bowel obstruction
	Management of appendicitis
	Repair of hernias
	Repair of gastrointestinal perforations
Referral hospital services	Percutaneous coronary intervention for acute coronary syndromes
	Advanced care for severe acute-on-chronic pulmonary disease
	Treatment of early-stage breast cancer
	Treatment of early-stage colorectal cancer

We first looked at the cost and impact of scaling up all the interventions in Table 15.1 to achieve 80 percent population coverage in all countries by 2050 or sooner. The gap in coverage and thus the "incremental cost" as a share of the current health budget would be modest for high-performing upper-MICs but very large for LICs with weak health systems. Table 15.2 presents our findings. Overall, fully implementing the package of interventions could avert up to 180 million deaths (or 2.7 billion disability-adjusted life-years [DALYs]) by 2050, at an incremental cost of US$ 5.4 trillion, translating to US$ 20,000 per death averted or US$ 2000 per DALY averted, the latter of which is just over one-third of GDP per capita per DALY averted for these countries.

TABLE 15.2 Cost and impact of all NCD interventions by 2050, by world region

Country income group	Deaths averted through 2050 (millions)	DALYs averted through 2050 (millions)	Incre-mental cost through 2050 (USD billions)	Total cost in 2050 (USD billions)	Projected public spending on health in 2050 (USD billions)	Total cost per capita 2050 (USD)	Total cost vs. projected public spending on health in 2050
LICs	12	240	140	17	28	14	59%
Lower-MICs	100	1600	1700	200	720	45	27%
Upper-MICs	70	860	3600	490	2500	190	20%
All LICS and MICs	180	2700	5400	710	3300	87	22%

Notes: DALYs = disability-adjusted life-years. Estimates are for a linear scale-up by 2 percent per year to a target of 80 percent coverage by the year 2050. (Not all countries would achieve 80 percent coverage if current coverage is very low.) Incremental costs and health gains are the difference between the status quo, in which coverage is assumed to remain constant, and this scale-up scenario. "Public spending on health" is from National Health Accounts data (general government expenditure on health from domestic sources). The total cost is the sum of the incremental cost and the cost of maintaining the status quo. Numbers may not add up due to rounding.

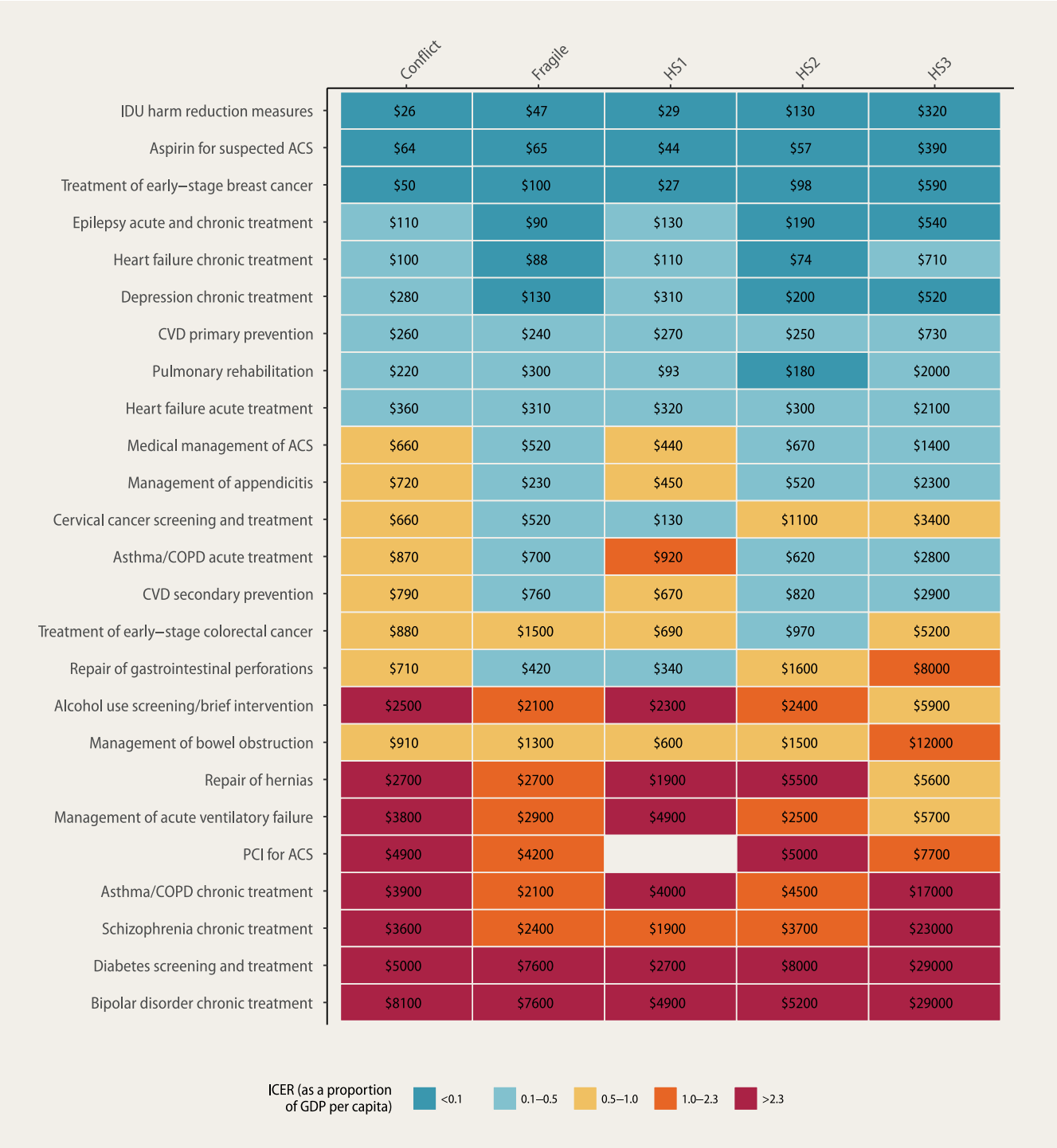
While the package overall would be very cost-effective, the budgetary consequences would be considerable. The final column in Table 15.2 shows the total cost for the year 2050 as a share of projected public-sector spending on health in 2050. This share would range from 20 percent in upper-MICs to 59 percent in LICs. The reason for this discrepancy is that most LICs and lower-MICs are under-spending on health, so without political action to allocate additional resources to the health sector, i.e., above and beyond the spending increases that would result purely from economic growth, these countries would struggle to afford the entire package of interventions. (We stress that our cost estimates assume the interventions are all provided to everyone and at no cost at the point of care, which is in keeping with the progressive universalist approach to health benefits package design but is far from reality in many countries that provide larger benefits packages to smaller segments of the population or with considerable out-of-pocket costs.)

A FRAMEWORK FOR PRIORITIZING NCD INTERVENTIONS

In our view, priority setting starts with an assessment of cost-effectiveness. We first looked at the cost-effectiveness of all the clinical interventions in Table 15.1, grouping LICs and MICs according to WHO's health system typology (Stenberg et al. 2017) to acknowledge differences in implementation capacity. Figure 15.1 summarizes our findings; the analytical methods are detailed elsewhere (NCD Countdown Collaborators 2022) and summarized in Annex 15.1 on methods.

Figure 15.1 shows that there is considerable variation in intervention cost-effectiveness by health system type—which is correlated with epidemiological, demographic, and economic differences—underscoring the importance of local analysis rather than reliance on international literature for cost-effectiveness assessments. About half of the interventions would be very cost-effective (blue tones) in nearly all settings. Some of the surgical and mental health interventions (e.g., emergent hernia repair, chronic schizophrenia treatment) would be on the borderline of cost-effective in most settings, whereas others (e.g., appendicitis management, chronic depression treatment) would be very cost-effective. Diabetes care would be the only intervention that would not be cost-effective in any setting. However, diabetes is a special case, because most of the health benefits of caring for people with diabetes are from CVD prevention (which is captured in the "CVD primary prevention" and "CVD secondary prevention" interventions) rather than glycemic control, which is the focus of this intervention. Implementing comprehensive diabetes care that includes glycemic control and CVD prevention would be cost-effective, though more costly than doing CVD prevention alone.

FIGURE 15.1 **Cost per DALY averted for 24 clinical interventions, by health system type**



Notes: ACS = acute coronary syndrome; IDU = injection drug use; CVD = cardiovascular disease; COPD = chronic obstructive pulmonary disease; PCI = percutaneous coronary intervention; ICER = incremental cost-effectiveness ratio; GDP = gross domestic product. The five health system types (x axis) are based on a typology used by WHO,[10] where "conflict" and fragile" include nations in active conflict or who are post-conflict or otherwise at risk of collapse (respectively); "HS1" includes stable countries with low resources, whereas "HS2" and "HS3" include stable countries with medium and high resources, respectively. The thresholds used for cost-effectiveness in the key are based on our review of different proposed cost-effectiveness thresholds in the literature, summarized elsewhere.[8] Use of these thresholds here does not imply our endorsement of them.

Table 15.1 also includes several interventions "outside the health sector" that produce health. In our view, cost-effectiveness analysis is an incorrect approach to assessing the efficiency of these interventions. In a related analysis we did for the Copenhagen Consensus Center, we did benefit-cost analyses of these interventions using standard methods for valuing health gains in economic terms and including the costs and benefits of the interventions outside the health sector (Watkins, Ahmed, and Pickersgill 2023). Table 15.3 below presents benefit-cost ratios for these policies, again aggregated by health system type for comparison purposes.

As the Table demonstrates, all these interventions are incredibly cost-beneficial, with tobacco control providing the most impressive returns. In fact, the benefit-cost ratios for tobacco are much higher than most cross-sectional analyses would suggest (Jha et al. 2012), because the benefits of cessation (and prevention of initiation) accumulate over decades (Jha et al. 2013). Because all these interventions are very cost-beneficial and inexpensive for governments to implement, we include them by default in our stylized, locally-tailored, high-priority packages (below).

Beyond cost-effectiveness, we consider three other criteria for identifying high-priority health sector interventions for NCDs: equity, financial risk protection, and implementation feasibility. Equity and financial risk protection have been endorsed by WHO (along with cost-effectiveness) as core criteria for designing health benefits packages (Ottersen and Norheim 2014). We view implementation feasibility as a critical criterion for NCDs, because many NCD interventions are complex and place high demands on health systems, and they may require considerable up-front investments or specialist training. Table 15.4 below summarizes our semi-quantitative assessment of each intervention's relative performance on these three criteria. The construction of the equity and financial risk protection indicators is summarized in DCP3 volume 9, chapter 3 (Watkins et al. 2017). The construction of the implementation feasibility indicator is summarized in the aforementioned NCD Countdown report (appendix, pp. 13-15, NCD Countdown Collaborators 2022).

The assessments above are intended to serve as inputs to country-level (or subnational-level) priority setting processes. Each health ministry will inevitably place different weight on each of these criteria, and most ministries will also consider other criteria alongside these (Eregata et al. 2020). Below we present a stylized approach that synthesizes these criteria in a systematic way and illustrates how they can be used to generate a final, high-priority package for each type of health system.

We start by grouping interventions into three categories based on cost-effectiveness: provisionally high-priority (<0.25x GDP per capita per DALY averted), provisionally medium-priority (0.25-1.0x), and provisionally low priority (>1.0x). The provisionally high-priority category is based on the most stringent cost-effectiveness threshold proposed in the literature (Ochalek, Lomas, and Claxton 2015). Interventions in this group would, along with the six intersectoral interventions (Table 15.3), be the starting point for most countries' high-priority packages.

Yet other interventions might merit inclusion in a high-priority package on other grounds. For example, interventions in the provisionally medium-priority group that are attractive in terms of their equity or financial protection characteristics

TABLE 15.3 Value for money among interventions outside the health sector

Intervention	Conflict	Fragile	HS1	HS2	HS3
Tobacco excise taxes	290	310	170	310	320
Tobacco regulations and IEC	250	270	97	270	300
Alcohol regulations	150	250	110	200	270
Alcohol excise taxes	110	190	52	130	210
Sodium regulations and IEC	64	42	NA	53	130
Trans fat bans	32	50	2.6	71	79

Notes: IEC = information, education, and communication. See footnote to Figure 1 for an explanation of the five health system types. The quantities presented in the cells are benefit-cost ratios from a societal perspective, with costs and benefits discounted at 5 percent and a time horizon of 2023-2050 for the analysis. Sodium policies are "N/A" in HS1 because average sodium consumption in these countries is already at WHO-recommended levels (Pickersgill et al. 2022).

(i.e., ++ or +++, per Table 15.4) could be moved to the provisionally high-priority group. On the other hand, interventions in the provisionally high-priority group that are challenging to implement (i.e., +, per Table 15.4) could be moved to the provisionally medium-priority or low-priority group. For illustration purposes, we moved these interventions into the provisionally medium-priority group for countries with weaker health systems (i.e., Conflict, Fragile, and HS1 types) but retained them in the provisionally high-priority group for countries with stronger systems (i.e., HS2 and HS3 types).

TABLE 15.4 Non-cost-effectiveness criteria for prioritizing clinical interventions

Intervention	Equity impact	Financial risk protection	Implementation feasibility
Aspirin for suspected ACS	+	+	+++
Heart failure chronic treatment	+	+++	++
Treatment of early-stage breast cancer	+	++	+
Epilepsy acute and chronic treatment	+++	+	+++
IDU harm reduction measures	++	++	+++
Depression chronic treatment	+	+	+++
CVD primary prevention	+	+	+++
Pulmonary rehabilitation	+	+	++
Heart failure acute treatment	+	++	++
Medical management of ACS	+	++	++
Management of appendicitis	+	+	+++
Asthma/COPD acute treatment	+	++	++
CVD secondary prevention	+	+	++
Cervical cancer screening and treatment	+	+	++
Repair of gastrointestinal perforations	+	+	+++
Treatment of early-stage colorectal cancer	+	++	+
Alcohol use screening/brief intervention	+	+	+++
Management of acute ventilatory failure	+	++	+
Management of bowel obstruction	+++	++	+++
Repair of hernias	+	+	+++
PCI for ACS	+	++	+
Asthma/COPD chronic treatment	+	+	++
Schizophrenia chronic treatment	+	+	+++
Bipolar disorder chronic treatment	+	+	+++
Diabetes screening/treatment	+	+	++

Notes: ACS = acute coronary syndrome; CVD = cardiovascular disease; IDU = injection drug use; COPD = chronic obstructive pulmonary disease; PCI = percutaneous coronary intervention.

Figure 15.2 shows the results of this stylized prioritization exercise. Again, these categorizations are meant to be illustrative rather than prescriptive. As the Figure indicates, such a high-priority package would contain between 15 and 18 interventions for given country and would, include all six intersectoral interventions.

We stress that categorizing interventions as medium- or low-priority does not automatically imply they should be de-implemented in countries. Oftentimes, interventions with these characteristics are already being provided, even in low-income countries, although often at low coverage and considerable out-of-pocket cost. What the high-priori-

ty categorization implies is that any new resources for NCDs (i.e., over and above current spending) should be devoted preferentially to scaling up these interventions to maximal coverage (80 percent or higher) and minimal out-of-pocket cost (20 percent or lower (McIntyre, Meheus, and Rottingen 2017)).

On the other hand, medium-priority interventions could be maintained at their current coverage and out-of-pocket cost levels until sufficient resources become available to scale them up; they might also be allowed to persist in the system if they help achieve longer-term health system objectives (see below). Low-priority interventions are a more heterogeneous category, however. Some might be allowed to persist and financed through cost recovery (Eregata et al. 2020). One example from our analysis would be bipolar disorder treatment. On the other hand, some low-priority interventions should be de-implemented, or not allowed to enter the system until sufficient cost controls are put in place. Many of the novel targeted cancer drugs fall into this category.

Prioritization of interventions also provides a framework for sequencing them over time. In general, intersectoral policies are so effective at prevention and are so inexpensive that they should almost always be rolled out during the earliest possible policy window. In the spirit of Primary Health Care (Watkins et al. 2018), we argue that interventions that are very cost-effective and can be delivered through primary care platforms by non-physician health workers should also be scaled up as early as possible. These two sets of interventions could be the targets of the bulk of national and international resources during the Sustainable Development

FIGURE 15.2 Final prioritization of NCD interventions, by health system type



Note: see footnotes in Figure 1 for acronyms and explanation of health system types. The colors above reflect the authors' summative judgment about the priority level of each intervention based on value for money and, in the case of clinical interventions, equity, financial protection, and implementation feasibility.

Goal period. Less cost-effective outpatient and hospital-based interventions could be phased in more slowly, perhaps with greater emphasis beyond 2030 once the first wave of NCD interventions has been sufficiently implemented.

The exception to this general approach is specialized NCD care. Building specialist capacity takes many years; if a national government wants to have a well-functioning cancer system in 2035, it needs to start building physician subspecialty programs and raising capital for large items like new hospitals, advanced imaging, and pathology services in 2025. Physicians are often the bottleneck to rolling out these programs, as the most specialized ones (e.g., cardiac surgeons) require a decade or more of postgraduate training. What this means for benefit packages and national NCD strategies is that a modest amount of new financial resources for NCDs during a given policy cycle should be set aside for capacity-building and long-term investments, with a focus on building the necessary capacity to deliver medium-priority interventions. Put more simply: even if treatment of breast or colorectal cancer are not high priorities for a country's benefits package now, they eventually will be. Delaying the necessary upfront investments in health workforce could set this country even further back in the future.

The good news is that, compared to the entire list of interventions in Table 15.1, the high-priority packages outlined in Figure 15.2 would still generate meaningful health gains but at lower cost. Table 15.5 presents the same estimates of cost and impact by country income group as in Table 15.2, but only for the high-priority packages. Overall, fully implementing these interventions could avert up to 150 million deaths (or 2.2 billion DALYs) by 2050, at an incremental cost of US$ 1.3 trillion, translating to US$ 5600 per death averted or US$ 620 per DALY averted, the latter of which is just over 10 percent of GDP per capita per DALY averted for this group of countries. The budgetary implications of this package would be more modest, ranging from 6.2 percent of total public-sector health spending in upper-MICs to 20 percent in LICs.

TABLE 15.5 Cost and impact of locally tailored high-priority NCD packages, by world region

Country income group	Deaths averted through 2050 (millions)	DALYs averted through 2050 (millions)	Incre-mental cost through 2050 (USD billions)	Total cost in 2050 (USD billions)	Projected public spending on health in 2050 (USD billions)	Total cost per capita 2050 (USD)	Total cost vs. projected public spending on health in 2050
LICs	8.8	180	51	5.5	28	4.6	20%
Lower-MICs	82	1300	470	57	720	13	7.9%
Upper-MICs	55	650	830	160	2500	61	6.2%
All LICS and MICs	150	2200	1300	220	3300	27	6.7%

Notes: see footnotes from Table 15.2, which are also relevant to this Table.

POLICY IMPLICATIONS

In this chapter, we present a framework for selecting interventions to prevent and treat NCDs in LICs and MICs. We look at 30 recommended interventions, which include 24 personal health services—most of which can be delivered through primary healthcare systems—and six "primordial prevention" interventions outside the health sector. We summarize the evidence around the properties of each intervention in the domains of value for money, equity impact, financial risk protection afforded, and feasibility of implementation. We demonstrate how a balanced use of these criteria could allow countries to accelerate process on NCDs, practically doubling or tripling the rate of intervention scale-up compared to the status quo (see annex) and averting 240-280 million deaths by 2050.

To achieve these health gains, MICs would need to be spending at least 6 to 8 percent of their health budgets, and LICs 20 percent of their budgets, on high-priority interventions by 2050. Table 15.6 provides "benchmark" spending levels on NCD interventions for the years 2030, 2040, and 2050, assuming full implementation of all high-priority and medium-priority interventions (see Figure 15.2) by 2050.

TABLE 15.6 Total cost per capita for priority NCD interventions by year and country income group

	2030		2040		2050	
Country income group	High	High + medium	High	High + medium	High	High + medium
LICs	1.7	2.7	3.0	4.8	4.6	7.3
Lower-MICs	6.2	10	9.8	16	13	22
Upper-MICs	38	61	52	87	61	100
All LICS and MICs	17	28	23	39	27	45

Notes: Costs are total costs, i.e., sum of current spending and incremental costs required to scale up to target coverage. Costs per capita increase over time because coverage increases at a modest 2 percent per year and because of population aging and a continued epidemiological shift towards NCDs. Numbers may not add up due to rounding.

While drugs, consumables, and equipment would comprise the plurality of costs, greater investment in health systems would also be needed. We looked at the additional health workforce and health facilities that would be required to fully implement the high-priority NCD packages (Table 15.7). The most striking finding from this analysis is that an additional 48 million nurses would need to be in the LIC and MIC workforce by 2050. This finding is consistent with the well-documented crisis in the global nursing workforce (Buchan and Catton 2023). An additional 5.8 million physicians and 79,000 health facilities would also be required for full implementation of the package. These findings suggest that, alongside greater required public contributions to universal health coverage schemes to cover the cost of human and physical capital, governments also need to invest in expanded pre-service training for the health workforce, especially in building more schools of nursing.

TABLE 15.7 Workforce and facility requirements for implementing the high-priority NCD package by 2050

Input	Current density (most recent year)	Required increase in density by 2050	Target density in 2050 for full implementation
Nurses	2.6 per 1000	7.3 per 1000	10 per 1000
Physicians	1.3 per 1000	0.88 per 1000	2.2 per 1000
Health facilities	4.9 per 100,000	1.2 per 100,000	6.1 per 100,000

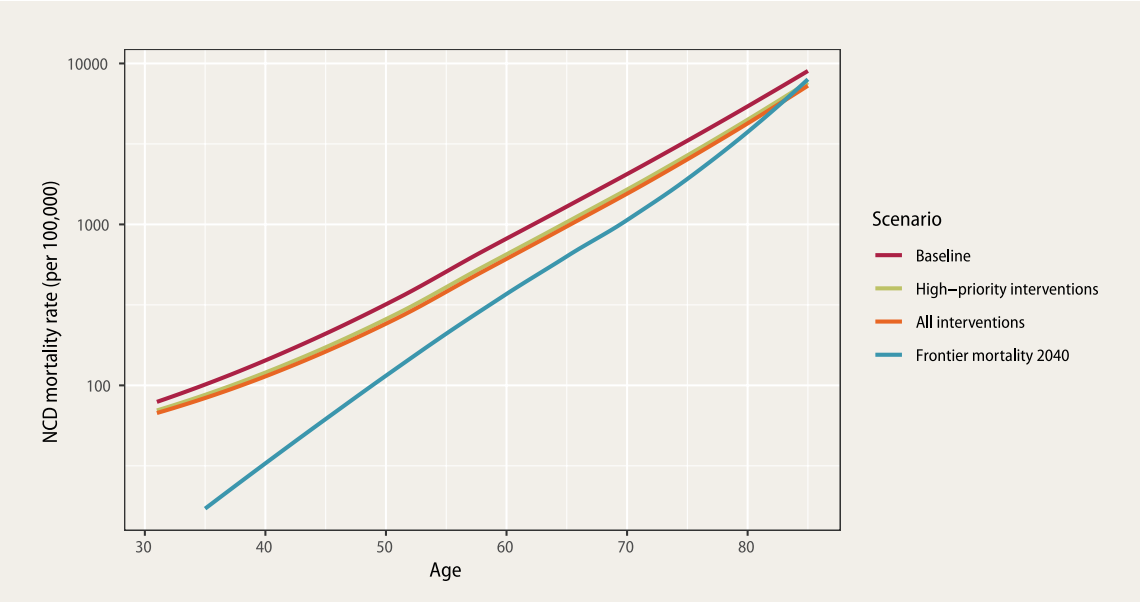
Notes: Most recent density estimates are for the year 2018 for health workforce and 2013 for health facilities, as per the WHO Global Health Observatory. Results are average values across all LICs and MICs. The latter two columns only reflect the increases needed to implement the NCD package; additional increases would be needed to scale up interventions for communicable diseases, injuries, and other health conditions. It is also possible that COVID-19-related burnout and accelerated retirements from nursing and medicine have reduced the density of health workers and larger increases will be required.

Still, these interventions could substantially advance the healthy aging agenda. Figure 15.3 shows how far the intervention packages could get LICs and MICs towards the avoidable NCD mortality frontier (Chang et al. 2024) by the year 2040. (In this analysis, the frontier is defined as the 20th percentile cause-specific mortality rate rather than the lowest observed rate.)

As the figure shows, the full NCD package and the high-priority subset would accelerate movement towards the NCD mortality levels projected for the best-performing countries. Compared to the baseline/status quo scenario, the progress towards the frontier would be 22 percent to 28 percent for individuals in their early 40s, 38 percent to 47 percent for individuals in their early 60s, and 57 percent to 71 percent for individuals in their early 80s. Roughly speaking, across all age groups, the HLI package would get the world about halfway to the mortality rates observed in the best-performing countries.

Still, there is a significant gap between achievable and avoidable mortality. Part of the reason the package has a greater impact at older ages (Figure 15.3) is that a greater share of NCD deaths at older ages are from causes addressed by the HLI package, whereas at younger ages there are other drivers of NCDs (e.g., liver disease from chronic infections, rheumatic heart disease, cancers other than those featured in the HLI package, etc.). Additionally, it is possible that there are other risk factors that are not addressed by

FIGURE 15.3 Contribution of NCD interventions towards avoidable all-cause mortality



the HLI package interventions that are driving NCD deaths in younger ages; for example, diets high in saturated fats and refined carbohydrates and low in fiber have been documented to account for early-onset colorectal cancer (Carroll et al. 2022), which is a rapidly increasing problem in most countries (GBD 2019 Diseases and Injuries Collaborators 2020).

In addition to reducing adult mortality (the focus of this chapter), these interventions could improve nonfatal outcomes by reducing the incidence of disease overall and by reducing the severity of chronic illness, especially for mental and substance use disorders. Still, there are other intervention options for countries seeking to improve nonfatal outcomes, such as post-stroke rehabilitation and custodial care for individuals with dementia. Assessing a broader set of interventions around healthy aging was also outside the scope of this work but will be an important area of emphasis in the upcoming 4th edition of Disease Control Priorities.

Identifying and prioritizing interventions is not enough: countries also need to implement them. This chapter does not cover implementation considerations except tangentially (see Table 15.4), but these issues are discussed in the aforementioned NCD Countdown report (NCD Countdown Collaborators). That report also contains a detailed assessment of the financing landscape for NCDs and provides some general guidance for ministries of health as well as the development assistance community.

The intersectoral interventions, while financially inexpensive to implement, require spending of political capital and anticipatory management of relationships with food, beverage, and tobacco industries that will probably lobby against them. On the other hand, bringing industry to the table can in some cases result in more ambitious policy targets and better implementation. For example, the South African government engaged with industry from the very beginning of its salt reformulation regulations, resulting in mandatory (as compared to voluntary) targets and encouraging preliminary findings on changes in dietary sodium consumption (Charlton et al. 2021). Additionally, doing more on tobacco and alcohol taxes can pave the way for developing a more comprehensive fiscal policy approach to NCDs that includes, for example, introduction of sugar-sweetened beverage taxes and removal of subsidies on high-energy density agricultural commodities. We note that sugar-sweetened beverage taxes appear to be cost-beneficial, but their impact on population health is modest compared to alcohol and tobacco taxes (Watkins et al. 2019).

We acknowledge several important limitations of this work, most of which were reviewed in the NCD Countdown report (NCD Countdown Collaborators). We did not have sufficient data to implement nonlinear cost functions or model economies of scope or scale, so our cost estimates will differ from the real world. We are still uncertain about the effect of the COVID-19 pandemic on NCD incidence and mortality as well as health sys-

tem resources in the medium term. We do not know much about the current coverage level of most of these interventions in many countries, requiring us to employ generic assumptions about the status quo scenario as well as the rate of scale-up required to achieve 80 percent population coverage by 2050. These data gaps hinder our ability to produce precise estimates of incremental costs and health gains.

In summary, we provide a set of recommendations to help countries achieve significant reductions in NCD mortality, helping them to achieve the SDG 3.4 target and post-SDG targets for NCDs. We anticipate that this guidance could help bring a necessary focus and fiscal discipline to national NCD strategies and plans. Additionally, our list of interventions and their associated health system investments could be used as benchmarks for future World Bank lending efforts to support NCD program development in lower-resource countries.

REFERENCES

1. Brouwer, Elizabeth D., David Watkins, Zachary Olson, Jane Goett, Rachel Nugent, and Carol Levin. 2015. "Provider Costs for Prevention and Treatment of Cardiovascular and Related Conditions in Low- and Middle-Income Countries: A Systematic Review." *BMC Public Health* 15 (1). https://doi.org/10.1186/s12889-015-2538-z.
2. Buchan, James, and Howard Catton. 2023. "Recover to Rebuild: Investing in the Nursing Workforce for Health System Effectiveness." Geneva, Switzerland: International Council of Nurses. https://www.icn.ch/sites/default/files/2023-07/ICN_Recover-to-Rebuild_report_EN.pdf.
3. Carroll, Kaitlin L., Andrew D. Frugé, Martin J. Heslin, Elizabeth A. Lipke, and Michael W. Greene. 2022. "Diet as a Risk Factor for Early-Onset Colorectal Adenoma and Carcinoma: A Systematic Review." *Frontiers in Nutrition* 9 (June). https://doi.org/10.3389/fnut.2022.896330.
4. Chang, Angela Y., Gretchen A. Stevens, Deigo S. Cardoso, Bochen Cao, and Dean T. Jamison. 2024. "The Economic Value of Avoidable Mortality." In *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington, D.C.: World Bank.
5. Charlton, Karen E., Barbara Corso, Lisa Ware, Aletta E. Schutte, Leanda Wepener, Nadia Minicuci, Nirmala Naidoo, and Paul Kowal. 2021. "Effect of South Africa's Interim Mandatory Salt Reduction Programme on Urinary Sodium Excretion and Blood Pressure." *Preventive Medicine Reports* 23 (September): 101469. https://doi.org/10.1016/j.pmedr.2021.101469.
6. Eregata, Getachew Teshome, Alemayehu Hailu, Zelalem Adugna Geletu, Solomon Tessema Memirie, Kjell Arne Johansson, Karin Stenberg, Melanie Y. Bertram, Amir Aman, and Ole Frithjof Norheim. 2020. "Revision of the Ethiopian Essential Health Service Package: An Explication of the Process and Methods Used." *Health Systems & Reform* 6 (1): e1829313. https://doi.org/10.1080/23288604.2020.1829313.
7. Food and DrugAdministration (FDA). 2014. "Food Labeling: Nutrition Labeling of Standard Menu Items inRestaurants and Similar Retail FoodEstablishments." Washington, D.C.: Food and Drug Administration. https://fda.report/media/116833/Food-Labeling--Nutrition-Labeling-of-Standard-Menu-Items-in-Restaurants-and-Similar-Retail-Food-Establishments---Final-Regulatory-Impact-Analysis.pdf (accessed 9 December 2022).
8. Foreman, Kyle J, Neal Marquez, Andrew Dolgert, Kai Fukutaki, Nancy Fullman, Madeline McGaughey, Martin A Pletcher, et al. 2018. "Forecasting Life Expectancy, Years of Life Lost, and All-Cause and Cause-Specific Mortality for 250 Causes of Death: Reference and Alternative Scenarios for 2016–40 for 195 Countries and Territories." *The Lancet* 392 (10159): 2052–90. https://doi.org/10.1016/s0140-6736(18)31694-5.
9. GBD 2019 Diseases and Injuries Collaborators, Cristiana Abbafati, Kaja M. Abbas, Mohammad Abbasi, Mitra Abbasifard, Mohsen Abbasi-Kangevari, Hedayat Abbastabar, et al. 2020. "Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990–2019: A Systematic Analysis for the Global Burden of Disease Study 2019." *The Lancet* 396 (10258): 1204–22. https://doi.org/10.1016/S0140-6736(20)30925-9.
10. International Monetary Fund (IMF). 2022. *World Economic Outlook, October 2022: Countering the Cost-of-Living Crisis*. Vol. 2022 (002). Washington, D.C.: International Monetary Fund.
11. Jamison, Dean T, Ala Alwan, Charles N Mock, Rachel Nugent, David Watkins, Olusoji Adeyi, Shuchi Anand, et al. 2018. "Universal Health Coverage and Intersectoral Action for Health: Key Messages from Disease Control Priorities , 3rd Edition." *The Lancet* 391 (10125): 1108–20. https://doi.org/10.1016/s0140-6736(17)32906-9.
12. Jha, Prabhat, Rachel Nugent, Stéphane Verguet, David Bloom, and Ryan Hum. 2012. "Chronic Disease Prevention and Control." *Copenhagen Consensus Challenge 2012 Paper*. Tewksbury, MA: Copenhagen Consensus Center. https://copenhagenconsensus.com/sites/default/files/chronicdisease.pdf.
13. Jha, Prabhat, Chinthanie Ramasundarahettige, Victoria Landsman, Brian Rostron, Michael Thun, Robert N Anderson, Tim McAfee, and Richard Peto. 2013. "21st-Century Hazards of Smoking and Benefits of Cessation in the United States." *The New England Journal of Medicine* 368 (4): 341–50. https://doi.

org/10.1056/NEJMsa1211128.

14. Mcintyre, Di, Filip Meheus, and John-Arne Røttingen. 2017. "What Level of Domestic Government Health Expenditure Should We Aspire to for Universal Health Coverage?" *Health Economics, Policy and Law* 12 (02): 125–37. https://doi.org/10.1017/s1744133116000414.
15. NCD Countdown 2030 Collaborators. 2020. "NCD Countdown 2030: Pathways to Achieving Sustainable Development Goal Target 3.4." *The Lancet* 396 (10255): 918–34. https://doi.org/10.1016/s0140-6736(20)31761-x.
16. ———. 2022. "NCD Countdown 2030: Efficient Pathways and Strategic Investments to Accelerate Progress towards the Sustainable Development Goal Target 3.4 in Low-Income and Middle-Income Countries." *The Lancet* 399 (10331): 1266–78. https://doi.org/10.1016/s0140-6736(21)02347-3.
17. NCD Risk Factor Collaboration, Rodrigo M Carrillo-Larco, Goodarz Danaei, Leanne M Riley, Christopher J Paciorek, Gretchen A Stevens, Edward W Gregg, et al. 2021. "Worldwide Trends in Hypertension Prevalence and Progress in Treatment and Control from 1990 to 2019: A Pooled Analysis of 1201 Population-Representative Studies with 104 Million Participants." *The Lancet* 398 (10304). https://doi.org/10.1016/s0140-6736(21)01330-1.
18. Nishtar, Sania, Sauli Niinistö, Maithripala Sirisena, Tabaré Vázquez, Veronika Skvortsova, Adolfo Rubinstein, Festus Gontebanye Mogae, et al. 2018. "Time to Deliver: Report of the WHO Independent High-Level Commission on NCDs." *The Lancet* 392 (10143): 245–52. https://doi.org/10.1016/s0140-6736(18)31258-3.
19. Ochalek, Jessica, James Lomas, and Karl Claxton. 2015. "Cost per DALY Averted Thresholds for Low- and Middle-Income Countries : Evidence from Cross Country Data." *Research Paper 122*. York, UK: Centre for Health Economics (CHE), University of York. https://doi.org/10.7490/f1000research.1113912.1.
20. Ottersen, Trygve, and Ole F Norheim. 2014. "Making Fair Choices on the Path to Universal Health Coverage." *Bulletin of the World Health Organization* 92 (6): 389–89. https://doi.org/10.2471/blt.14.139139.
21. Pickersgill, Sarah J., William T. Msemburi, Laura Cobb, Nicole Ide, Andrew E. Moran, Yanfang Su, Xinpeng Xu, and David A. Watkins. 2022. "Modeling Global 80-80-80 Blood Pressure Targets and Cardiovascular Outcomes." *Nature Medicine* 28 (8): 1693–99. https://doi.org/10.1038/s41591-022-01890-4.
22. Prabhakaran, Dorairaj, Shuchi Anand, David Watkins, Thomas Gaziano, Yangfeng Wu, Jean Claude Mbanya, Rachel Nugent, et al. 2018. "Cardiovascular, Respiratory, and Related Disorders: Key Messages from Disease Control Priorities, 3rd Edition." *The Lancet* 391 (10126): 1224–36. https://doi.org/10.1016/s0140-6736(17)32471-6.
23. Stenberg, Karin, Odd Hanssen, Tessa Tan-Torres Edejer, Melanie Bertram, Callum Brindley, Andreia Meshreky, James E Rosen, et al. 2017. "Financing Transformative Health Systems towards Achievement of the Health Sustainable Development Goals: A Model for Projected Resource Needs in 67 Low-Income and Middle-Income Countries." *The Lancet Global Health* 5 (9): e875–87. https://doi.org/10.1016/s2214-109x(17)30263-2.
24. United Nations (UN). 2022. WorldPopulation Prospects 2022. https://population.un.org/wpp/ (accessed 1 September 2022).
25. Vassall, Anna, Sedona Sweeney, Jim Kahn, Gabriela B. Gomez, Lori Bollinger, Elliot Marseille, Ben Herzel, et al. 2017. "Reference Case for Estimating the Costs of Global Health Services and Interventions." Seattle, WA: Global Health Cost Consortium, University of Washington.
26. Watkins, David A, Jinyuan Qi, Yoshito Kawakatsu, Sarah J Pickersgill, Susan E Horton, and Dean T Jamison. 2020. "Resource Requirements for Essential Universal Health Coverage: A Modelling Study Based on Findings from Disease Control Priorities, 3rd Edition." *The Lancet Global Health* 8 (6): e829–39. https://doi.org/10.1016/s2214-109x(20)30121-2.
27. Watkins, David A., Dean T. Jamison, Anne Mills, Rifat Atun, Kristen Danforth, Amanda Glassman, Susan Horton, et al. 2017. "Universal Health Coverage and Essential Packages of Care." Edited by Dean T. Jamison, Hellen Gelband, Susan Horton, Prabhat Jha, Ramanan Laxminarayan, Charles N. Mock, and Rachel Nugent. PubMed. Washington (DC): The International Bank for Reconstruction and Development / The World Bank. 2017. https://www.ncbi.nlm.nih.gov/books/NBK525285/.
28. Watkins, David A., Gavin Yamey, Marco Schäferhoff, Olusoji Adeyi, George Alleyne, Ala Alwan, Seth Berkley, et al. 2018. "Alma-Ata at 40 Years: Reflections from the Lancet Commission on Investing in Health." *The Lancet* 392 (10156): 1434–60. https://doi.org/10.1016/S0140-6736(18)32389-4.
29. Watkins, David, Sali Ahmed, Sarah Pickersgill, and Saleema Razvi. 2023. "Best Investments in Chronic, Noncommunicable Disease Prevention and Control in Low- and Lower–Middle-Income Countries." *Journal of Benefit-Cost Analysis*, July, 1–17. https://doi.org/10.1017/bca.2023.25.
30. Watkins, David, Jessica Hale, Brian Hutchinson, Ishu Kataria, Vasilis Kontis, and Rachel Nugent. 2019. "Investing in Non-Communicable Disease Risk Factor Control among Adolescents Worldwide: A Modelling Study." *BMJ Global Health* 4 (2): e001335. https://doi.org/10.1136/bmjgh-2018-001335.
31. World Bank. 2022. Antiretroviral therapy coverage (% of people living with HIV). Health Statistical Database/ https://data.worldbank.org/indicator/SH.HIV.ARTC.ZS (accessed 22 October 2022).
32. World Health Organization (WHO). 2020. Global Health Estimates: Life Expectancy and Leading Causes of Death and Disability. Global Health Observatory. Geneva: World Health Organization. https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates.

ANNEX 15.1

METHODS

Intervention selection and aggregation

The starting point of this analysis is a set of interventions recommended in the third edition of the Disease Control Priorities (DCP3) series (Jamison et al. 2018). DCP3 was a set of nine volumes containing 172 chapters that covered all major areas of global health interest. The volumes were published over 2015-2018, with the final volume being a synthesis of the previous eight volumes. DCP3 chapters underwent peer review in a process overseen by the US National Academy of Medicine. Each chapter covered a particular health topic (e.g., tuberculosis, cancer screening, neurological disorders) and synthesized the evidence in a series of recommended interventions that (i) provide good value for money, (ii) are feasible to implement in low- and middle-income countries, and (iii) address a significant cause of death or disability.

These criteria were applied to systematic reviews of economic evaluations of health interventions done in low- and middle-income country settings, supplemented by other information such as clinical and implementation studies and expert judgment. The latter was especially important, because robust cost-effectiveness information is lacking for many services that are being provided, and topical expertise is needed to be able to make sense of the literature. For example, DCP3 did not identify any published studies of the cost-effectiveness of cardiopulmonary resuscitation, but this intervention was recommended because it is an essential part of the emergency healthcare system and is nearly impossible to study using conventional economic evaluation techniques. In other words, DCP3 strove to avoid both "false negatives" and "false positives" (Jamison et al. 2018).

DCP3's final list of recommended interventions was separated into 218 health sector interventions and 71 intersectoral interventions. The entire list of interventions is available in a series of appendices accompanying the DCP3 capstone paper in the Lancet (Jamison et al. 2018). For this analysis, we selected 30 interventions that are proven to reduce mortality from NCDs and can achieve meaningful impacts by 2050. HPV vaccination for adolescent girls, for example, is highly cost-effective but has at least a 30-year lag between administration and attainment of any meaningful health benefits, so it was not included in our analysis, which was focused on the next 25 years. Our analysis looks at both clinical and intersectoral interventions through a benefit-cost lens.

Modeling intervention costs

Our cost estimates build on those done for a previous publication from the Disease Control Priorities Project (Watkins et al. 2020) and the aforementioned NCD Countdown report (NCD Countdown Collaborators 2022). Costs borne by governments in implementing the intersectoral policies were estimated on a per-capita basis, using published costing studies or grey literature (e.g., government budget reports). For the clinical interventions, the focus was on unit costs (e.g., cost per patient-year of chronic treatment, cost per episode for acute care, etc.) to healthcare sector. All interventions were assumed to be publicly financed (i.e., through universal health coverage systems), so out-of-pocket costs currently paid by households would be shifted to governments and accounted for in our estimates.

We primarily sourced unit cost data for the clinical interventions from DCP3's systematic reviews of cost and cost-effectiveness studies (see, e.g., a review of cardiovascular disease treatment costs by Brouwer et al. 2015). Since NCD costing studies are few, we selected the highest-quality study that we identified that most closely reflected the medical components of the intervention in question. All costs were updated to 2020 US dollars using procedures recommended by the Global Health Costing Consortium (Vassall et al. 2017). They were then extrapolated to other countries in two stages. First, we decomposed costs into traded and nontraded components. Traded components were assumed to be constant across countries. Nontraded components were adjusted based on ratios of gross national income (GNI) per capita across countries. As described in the DCP3 costing paper and its appendix (Watkins et al. 2020),this approach has several limitations but represents the most feasible approach for a global-level modeling study. Our costs were meant to be illustrative of the magnitude and range of costs across LICs and MICs rather than precise estimates used for budgeting country-level NCD programs. Country-level empirical (micro)costing of the 30 inter-

ventions was outside the scope of this chapter.

Unit costs were then multiplied by the population requiring each intervention and further by the target coverage level of the intervention each year. For example, the cost of an intervention costing $20 per patient-year that addressed a chronic disease with a prevalence of 1 million cases and a current coverage of 30 percent was calculated as $20 * 1,000,000 * 30 percent = $6,000,000. The "incremental" cost of increasing coverage of that intervention by a certain amount would be calculated as the difference in coverage year over year. We defined full coverage of each intervention as 80 percent of the population covered by the year 2050, consistent with DCP3 and WHO assumptions (Stenberg et al. 2017; Jamison et al. 2018). Epidemiological and demographic data used to estimate population in need were taken from the WHO (WHO 2020), UN Population Division (UN 2022), and Global Burden of Disease 2019 Study (GBD 2019 Diseases and Injuries Collaborators 2020). Coverage data were taken from the literature, WHO, or expert opinion.

As Table 15.2 shows, different countries currently have different levels of coverage for the various NCD interventions, so the incremental cost and impact (below) of achieving 80 percent target coverage will be different. We imposed a standard 2 percent per year increase in coverage for all interventions and countries in our model, meaning that they all increase coverage at the same rate but reach 80 percent at different time points (and some do not reach 80 percent by 2050, especially LICs). The assumption of a 2 percent annual increase is based on recent trends in hypertension coverage (1.0-1.5 percent annual increases in well-performing countries (NCD Risk Factor Collaboration 2021)) and in antiretroviral drug therapy coverage (4-5 percent annual increases (World Bank 2022)). Hence a 2 percent increase reflects an acceleration of progress on access to NCD care but within reason, considering that NCD programs do not have the same resources or political momentum as HIV/AIDS.

For the non-health sector interventions, there are two major types of costs that are borne outside the government/healthcare sector. The first type is the cost to firms of implementing government regulations. Again, we used literature-based estimates of these costs and extrapolated them across countries, like we did for the clinical interventions (above). The second type of cost is the forgone consumer surplus due to taxes and regulations on unhealthy products. As outlined in our paper for the Copenhagen Consensus Center (Watkins, Ahmed, and Pickersgill 2023), we used recommendations from US-based regulatory impact analyses (FDA 2014) to inform our approach, which used an offset parameter that was applied to the estimated economic benefits from improved health (see below). For tobacco and alcohol policies, the offset value was 0.9, and for sodium and trans-fat policies, it was 0.5.

Modeling intervention health and economic outcomes

We quantify improvements in health as a reduction in mortality and disability rates, and therefore total deaths and disability-adjusted life-years (DALYs), following the scale-up of an intervention. To do this, we used a population model we developed for the NCD Countdown report (NCD Countdown Collaborators 2022). In brief, this model combined demographic projections (UN 2022) – (including population counts and all-cause mortality rates) with cause-of-death data (WHO 2020)[28] and disease incidence and prevalence rates (GBD 2019 Diseases and Injuries Collaborators 2020). The baseline projection that we used as a reference for calculating intervention-specific health gains was calibrated to the UN Population Division medium projections, representing a business-as-usual scenario for intervention implementation.

Changes in disease-specific mortality and disability rates were a function of (i) the effectiveness of the intervention on these outcomes, usually expressed as a rate ratio or hazard ratio, and (ii) the change in intervention coverage. Effectiveness data were usually taken from clinical trials, favoring meta-analytic estimates when available. We did our own searches for effectiveness data for the NCD Countdown report (see appendix). Intervention-specific effectiveness parameters are detailed in the online appendix (see Github URL below). We multiplied each literature-based effect size by 0.70 to account for imperfect implementation in real-world settings (NCD Countdown Collaborators 2022).

To calculate the economic value of reduced mortality and disability, we multiplied projected DALYs by the standardized time series estimates for the value of a DALY that were used throughout the Copenhagen Consensus project. One potential benefit of tobacco and alcohol taxes is a gain in revenue to governments. We took a societal perspective on costs and benefits, so these revenue gains are fully offset by additional costs to consumers—i.e., they are, functionally, transfer payments.

All input data, including citations of the literature used to estimate the cost of each intervention, are available at https://github.com/Disease-Control-Priorities/CCC.

16

Control of Non-Communicable Diseases for Enhanced Human Capital

The case for whole-of-society action

Ramesh Govindaraj[a] and Sundararajan Srinivasa Gopalan[b]

[a] Health, Nutrition, and Population, Africa Region, World Bank
[b] Independent Researcher

INTRODUCTION

This chapter has been prepared as background to the Healthy Longevity Initiative (HLI), under the ambit of the Health, Nutrition, and Population (HNP) Global Practice of the World Bank Group (WBG). Under this initiative, a series of papers were commissioned on various aspects of healthy longevity, most of them focusing on different facets of non-communicable diseases (NCDs), such as the current status of the problem, its economic burden, the financing of interventions, fiscal instruments for controlling NCDs, behavioral aspects, relationship with the labor market, long-term care needs, and the gender dimension. Although of direct relevance, these aspects are dealt with only briefly in this chapter as these are covered in other chapters of this compendium. This chapter focuses specifically on a "whole-of-society" (WoS) approach to preventing and mitigating NCDs.

Its main objectives are:

i. Briefly review the current status of NCDs, their economic costs, and their impact on human capital;

ii. Argue for WoS efforts to address NCDs, in view of the two-way relationship of NCDs with relevant economic sectors; and

iii. Make recommendations on the way forward on WoS efforts.

Scope and limitations

The influential 4x4 framework on NCDs proposed by the World Health Organization (WHO) focused on four sets of diseases, i.e., cardiovascular diseases (CVD), diabetes mellitus, chronic respiratory diseases, and cancers, along with four behavioral risk factors (tobacco use, harmful use of alcohol, unhealthy diets, and physical inactivity). WHO subsequently expanded this to a 5x5 framework, including mental health issues among the set of diseases and air pollution as a key risk factor. This limited focus helped in advocacy but was not intended to neglect or downplay the importance of a host of other NCDs. In this chapter, a broader, more complete definition of the term "NCDs" is considered, i.e., "any disease/disability that is not transmissible through infection," including other endocrine disorders (beyond diabetes), malnutrition (both under- and over-nutrition), auto-immune diseases, chronic kidney disease, various occupational hazards, and injuries – both accidental and intentional. The rationale for broadening the scope is that it brings the relationship between NCDs and non-health sectors into sharper focus and further strengthens the case for WoS action against NCDs.

As this chapter was prepared against the backdrop of the COVID-19 pandemic, it includes a section on the two-way links between NCDs and COVID-19, in order to glean lessons on the value of a WoS approach to NCDs in the post-COVID-19 era.

The chapter is primarily based on desk reviews, online research, and informal interviews with technical experts at the WBG and other development entities, with some inputs from internal and external reviewers. The main sources include WHO documents, WBG documents, technical journals, and the World Bank's operational database. Examples and country case studies presented in the paper are meant only to be illustrative and not comprehensive.

Since this work is commissioned by the WBG, the review of global experience on a WoS approach to NCDs includes a special focus on WBG operations. A self-examination of how far the approach has been adopted by the institution is germane to the paper's scope and message.

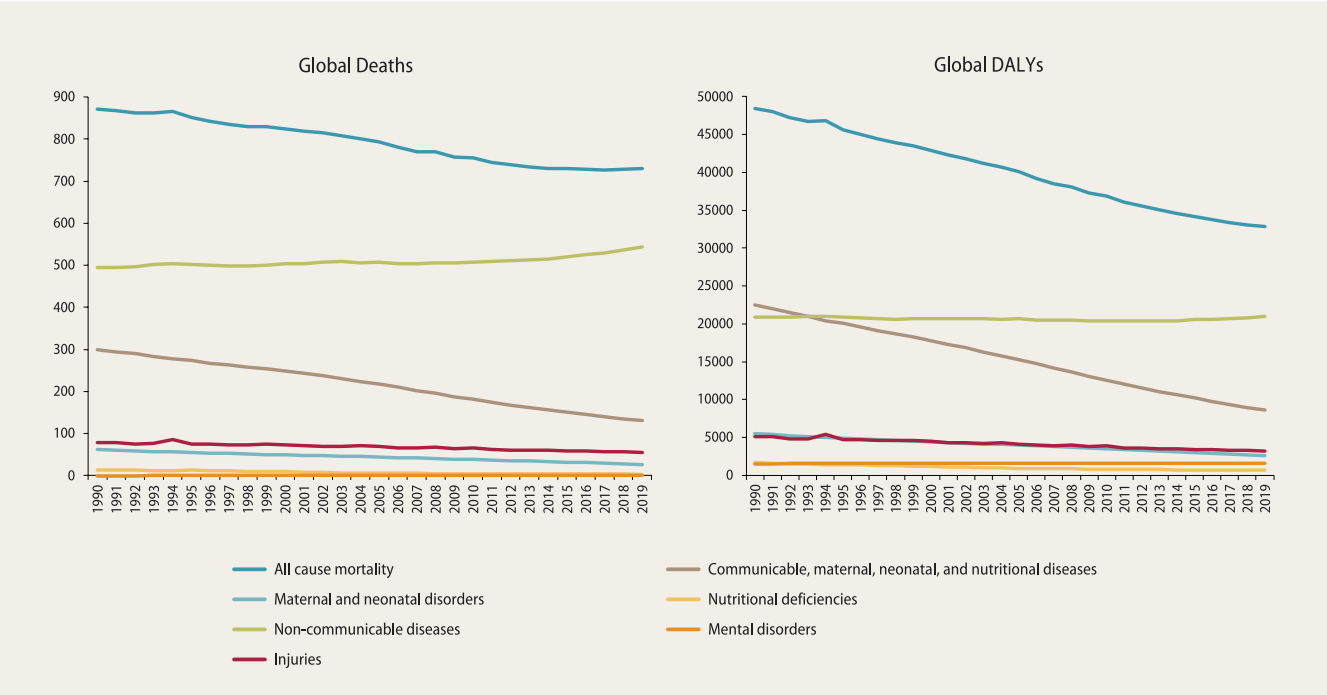
WHY FOCUS ON NCDs?

NCDs are making an increasingly significant contribution to the burden of disease globally, including in the developing world. Key NCD risk factors are widely prevalent across the world and are responsible for a large share of the current total of disability-adjusted life years (DALYs) lost. NCDs affect all age groups and both sexes (encompassing the entire range of gender identities) but have a disproportionate impact on older populations. By virtue of their effects on human capital, NCDs are increasingly among the important constraints to economic

growth. NCDs have a differential impact on men and women. Assessing the economic impact/financial burden on societies or individuals of NCDs—either individually or collectively—is a challenging task, as is the computation of NCD expenditures. But it is clear that the economic impact of NCDs—both due to lost productivity and lost lives—is large and growing. NCDs also compromise future economic and human development because of the inter-generational impacts of poverty and ill-health.

NCDs are making an increasingly significant contribution to the burden of disease globally, including in the developing world (Figure 16.1). According to the latest available Global Burden of Disease (GBD) report, 42 million deaths (74 percent of global mortality) and the loss of 1.62 billion disability-adjusted life years (DALYs), are attributable to NCDs, 63.82 percent of total DALYs (IHME 2019; The Lancet 2020). This is not counting 4.2 million deaths and 249 million DALYs lost to injuries – which should be included in the definition of NCDs. NCDs constitute the bulk of the disease burden in high-income countries (HICs), which have largely controlled communicable diseases (CDs), with the notable exception of emerging infections (the most recent of which is the coronavirus disease 2019 or COVID-19). However, 78 percent of NCD deaths occur in low- and middle-income countries (LMICs) – (WHO 2021). While low-income countries continue to wrestle with older and newer pathogens, they are also seeing a rise in NCDs, thus having to manage a double burden of NCDs and CDs. Notwithstanding the severe impact of the ongoing COVID-19 pandemic on human lives and economies, the disease burden caused by NCDs continues to be equally—if not more—consequential for human capital. In fact, the effects of COVID-19 are often compounded and worsened by co-morbidities, most of which are NCDs. Therefore, even as health systems are still grappling with the pandemic, it is timely to consider the multifaceted challenges and solutions resulting from NCDs.

FIGURE 16.1 Trend in global deaths and disease burden by major cause (annual rate, 1990 - 2019)

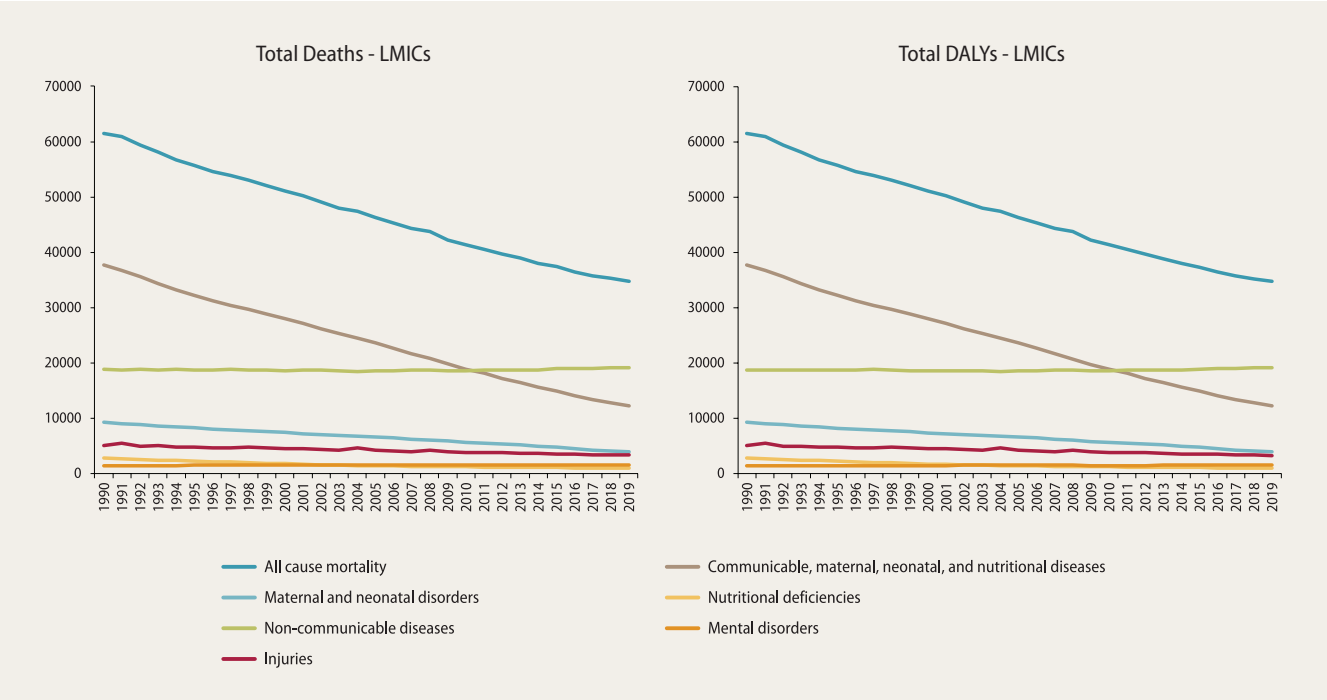


Source: IHME Global Burden of Disease (2019). [Accessed: July 15, 2022]
Note: The rate of mortality is defined as the number of deaths due to cause divided by the mid-year population.

Figure 16.2 shows the increase in mortality rates and lost DALYs due to NCDs in LMICs from 1990 to 2019. Conversely, during the same period, the shares of mortality and lost DALYs attributable to communicable diseases and maternal causes declined steadily.

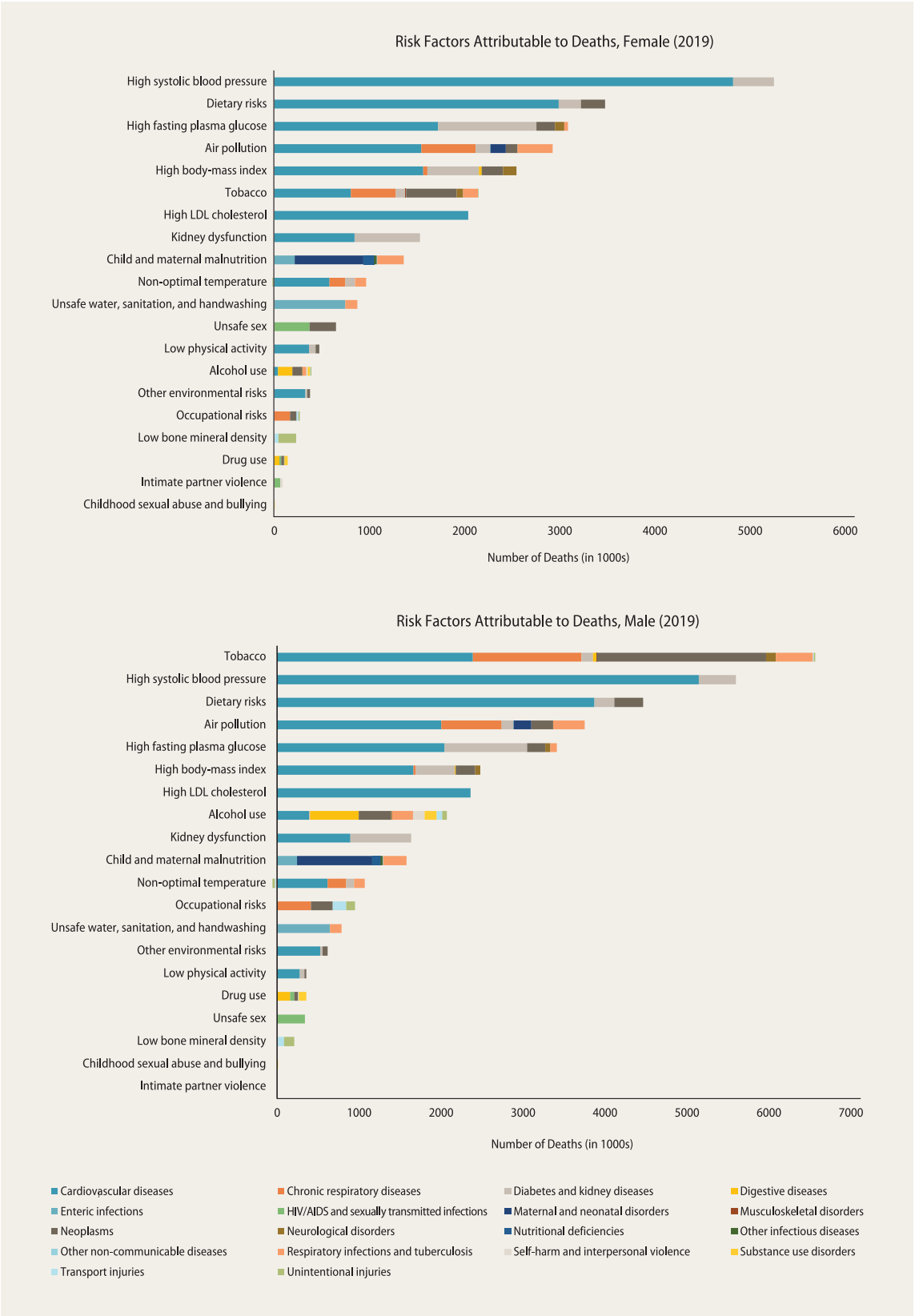
Key risk factors for NCDs are highly prevalent globally (WHO 2021). Alcohol abuse contributes to 11 percent of the global death toll; 28 percent of adults have a sedentary work/lifestyle; salt intake is extremely high, at an average of 9-12 grams per day; each year, more than 180,000 deaths are attributed to high sugar consumption globally; more than 7 million deaths are attributed to tobacco products and smoking, and roughly 7 million deaths are linked to road traffic accidents. 22 percent of adults are estimated to be hypertensive; 650 million people are estimated to be obese; and the prevalence of diabetes has nearly quadrupled in the past 40 years. Air pollution ranks fourth among the risk factors contributing to deaths – both among males and females. Globally, 6.5 million annual deaths are estimated to be due to air pollution. Figure 16.3 shows that most of the top 10 risk factors causing deaths are related to NCDs.

FIGURE 16.2 Trend in deaths and disease burden by major cause in LMICs (annual rate, 1990 - 2019)



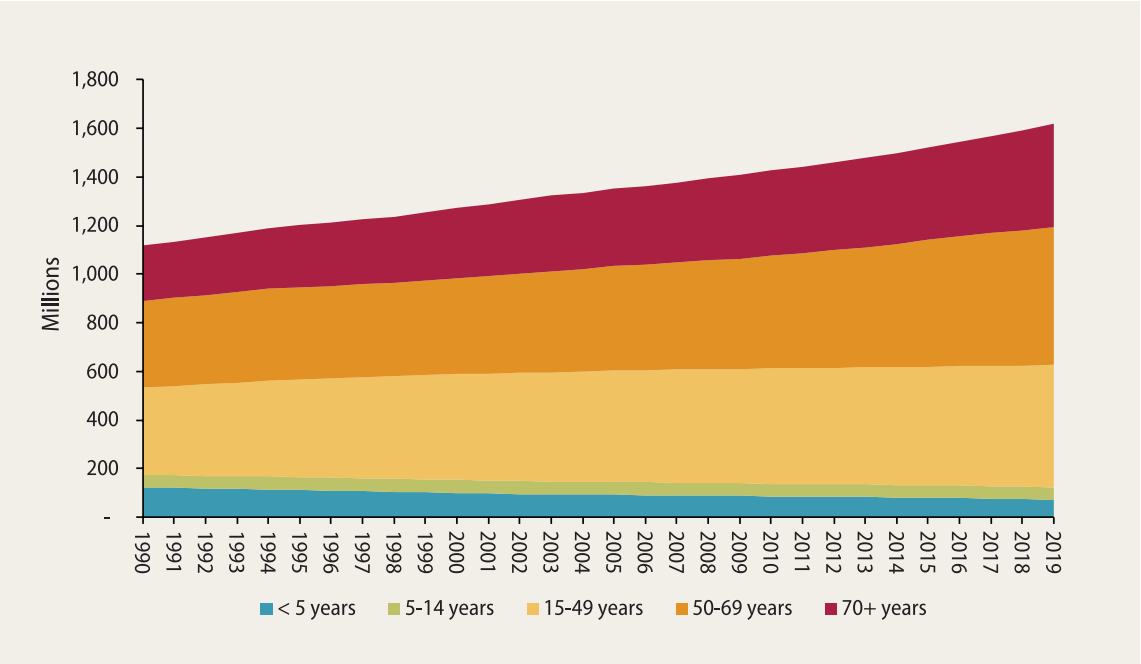
Source: IHME Global Burden of Disease (2019). [Accessed: July 15, 2022]
Note: The rate of mortality is defined as the number of deaths due to cause divided by the mid-year population.

FIGURE 16.3 Global Deaths Attributed to Major Risk Factors, by sex, 2019



Source: Adapted from Murray et al. 2020

FIGURE 16.4 Global disease burden from NCDs by age, 1990 to 2019



Source: Adapted from IHME/Our World in Data 2020 [Accessed: July 15, 2022]
Note: Disease burden is measured in disability-adjusted life years (DALYs) measured as the sum of years of life lost and years lived with disability.

NCDs affect all age groups and both sexes but have a disproportionate impact on older populations (Figure 16.4).

By virtue of their effects on human capital, NCDs are an important constraint to economic growth. As the world's population has aged at dramatic speed, governments have been increasingly concerned about how to maximize the contribution of the older population to all aspects of human capital. This is particularly important, as the proportion of older adults has risen in virtually all countries, and especially in developing countries. Accordingly, governments are now engaging in policy interventions to make the additional years healthy and optimally productive, in order "to develop and maintain the functional ability that enables well-being through middle and older ages" (WHO 2020a). One significant aspect of longevity is that the productivity of older, knowledgeable, healthy adults enhances and increases the pool of human capital, thereby contributing to economic growth. Though NCDs pose a powerful threat to countries' human capital, productivity, and future economic growth, they have received relatively little attention in a concerted intersectoral manner.

Gender impacts

NCDs have a differential impact on men and women. In addition to certain cancers (e.g., breast, cervix, ovarian, and prostate) that are gender-specific, the exposure to risk factors for many other NCDs has been found to differ by gender. According to research by the Pan-American Health Organization (PAHO), "Women are significantly more likely to be obese than men. PAHO's 18-country study found that 40 percent of women in Canada and over 70 percent of women in Nicaragua and Belize are overweight or obese. Women's higher rates of obesity lead to their increased vulnerability to NCDs, particularly diabetes" (PAHO 2011). Worldwide, 48 percent of adult men smoke compared with 12 percent of women (WHO 2010), thus increasing men's risk of lung cancer. Women experience less apparent and often different symptoms of CVD than do men and, consequently, are less likely to be diagnosed and treated appropriately (DeVon et al. 2008). Apart from the differential risks and prevalence rates of NCDs, gender disparities in terms of financial security, employment, household decision-making power, and socio-cultural factors which determine gender roles and health care access are likely to be critical factors that could impact

women and men differently. PAHO (2011) recommends three approaches to address NCDs in a gender-sensitive manner: (i) pro-poor and gender-sensitive health policies; (ii) use of primary health care for NCD prevention and control; and (iii) investment in girls, women, and their health. Chapters 8 - 11 of this compendium delve deeper into gender issues relevant to NCDs.

Economic aspects

Assessing the economic impact and financial burden of NCDs on societies or individuals is a challenging task, whether the diseases are considered singly or collectively. The computation of NCD expenditures is also difficult. This is due to issues with definition (e.g., which diseases and risk factors to include), estimating the prevalence of specific NCDs/risk factors, and attributing expenditures specifically to prevention and management. The problem is compounded when expenditures are incurred, and the impact is dispersed, across economic sectors. Most costs/expenditures and financial/economic NCD burden calculations are, therefore, estimates derived from various modeling exercises. Chapters 3 and 4 discuss the economic aspects of NCDs, and therefore this paper does not present a comprehensive review of this subject.

The Chile Expenditure Study. One exception to the typical estimations that is worth highlighting, however, is a unique report on Chile by the Ministry of Health, PAHO, and the Economic Commission for Latin America and the Caribbean, which provides some estimates of expenditures on NCDs by selected ministries, highlighting clearly the multisectoral nature of such expenses. It shows that Chile's Ministry of Social Development reported spending 0.7 percent, the Ministry of Sports 22.8 percent, the Ministry of Interior and Public Safety 0.1 percent, the Ministry of Environment 11.8 percent, the Ministry of National Assets 0.1 percent, and the Ministry of Health 3.5 percent of their respective budgets in 2013 on NCDs. In absolute terms, the Ministry of Health spent the most on NCDs, as could be expected. All told, the government spent 1.4 percent of its budget on NCDs (Cuadrado et al. 2015).

The study has limitations, but the approach holds considerable promise. It focuses only on primary prevention activities, including health promotion. This grossly underestimates total expenditures on NCDs, as the largest share of expenditures would be on care (including long-term care) and treatment (curative as well as palliative). The cost of treatment and the continuum of care is more difficult to estimate, due to challenges in attribution of medical care costs to diseases, and in tracking life-long costs. It is also not clear whether the study included recurrent expenditures or only the capital costs. If recurrent costs are not included (as "programs" are usually funded from the investment budget and typically don't count routine recurrent costs such as salaries and consumables), that would be another source of underestimation. Notwithstanding these limitations, the effort invested in the Chilean study is laudable, and it is worth replicating/expanding in other countries around the world.

It is clear that the economic impact of NCDs—both due to lost productivity and lost lives—is large and growing. Childhood malnutrition can adversely impact the learning and earning potential of affected children and would have a negative effect on human capital in the medium- to long-term. Labor units lost to NCD deaths and the direct medical costs of treating NCDs can be expected to reduce the quality and quantity of the labor force and human capital. Economists increasingly express concern that NCDs will result in long-term macroeconomic impacts on labor supply, capital accumulation, and GDP worldwide with the consequences being most severe in developing countries. A study on the macroeconomic burden of NCDs in the United States estimated that the economic burden of all NCDs in 2015-2020 is US$265,000 per capita, and that the total NCD burden roughly corresponds to an annual tax rate of 10.8 percent on aggregate income (Chen et al. 2018). A recent study on the association between NCD morbidity and employment status in the Republic of Korea found that chronic disease increased the risk of unemployment markedly, with CVD and cancer having the most profound negative effect (Kwon et al. 2020).

NCD risk factors such as tobacco smoking, obesity, and heavy drinking have negative economic impacts, including through effects on adult earnings. The capacity of health care systems to manage the consequences of increased risk factors, and the diseases associated with them, ultimately determines changes in morbidity and mortality. Accounting for the effects of health care systems would require including health outcome measures–such as the child stunting and adult survival rates used in the human capital index (HCI)–as additional proxies for latent health status (World Bank 2020b). As an example of the economic impact of NCDs, avail-

able evidence indicates that the estimated cost of new cancer cases in 2009 was US$286 billion globally (Bloom et al. 2011). This estimate is based on the cost-of-illness approach and includes treatment and care costs, research and development costs associated with cancer control, and foregone income due to inability to work.

NCDs also compromise future economic and human development because of the inter-generational impacts of poverty and ill-health. For example, poor nutrition may not only lead to NCD-related morbidity in the affected individuals, but it could also impair in-utero growth and compromise fetal development, thus harming the next generation. Taking a life-course approach to the issues of poverty and NCDs that acknowledges the connections between social and health conditions over the lifespan is, therefore, useful.

IMPACT OF THE COVID-19 PANDEMIC ON NCDs

The COVID-19 pandemic has thrown into sharp relief the intricate relationship between COVID-19 and NCDs. COVID-19 has significant bi-directional links to NCDs. Many of the interventions required for fighting the pandemic are also those required to fight NCDs. During the pandemic, many countries have seen the value of stronger tobacco and alcohol controls. The COVID-19 pandemic, often compounded by NCDs, has clearly had a significant negative impact on human capital around the world through disruptions to education and the loss of jobs and lives. The pandemic also caused major disruption to NCD control programs and services, highlighting the critical intersection of health systems resilience and health emergency preparedness and response.

COVID-19 has significant bi-directional links to NCDs**.** On the one hand, co-morbidities, most of which are NCDs, and risk factors such as obesity and hypertension increase the severity of illness and mortality risks of COVID-19; on the other, prolonged economy-wide restrictions imposed by most countries to contain the spread of COVID-19 have resulted in reduced access to critical care for NCD patients, thus accentuating the associated morbidity and mortality. Lockdowns due to COVID-19 outbreaks might worsen the problem of diabetes mellitus by curtailing access to medication and other care, and in some cases reducing physical activity. Patients with diabetes have had at least twice the risk of severe COVID-19 (and death) compared to non-diabetic individuals (Chan et al. 2021). Most importantly, COVID-19, by the sheer magnitude of its societal impact, touching almost every sector of the economy, has compelled humanity to mount whole-of-society responses (albeit with varying degrees of effectiveness), much as the Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) did in most of Sub-Saharan Africa in 1990s. This experience could be very valuable, as it offers a platform to extend the same WoS approach beyond the pandemic.

During the COVID-19 pandemic, many countries have seen the value of stronger tobacco and alcohol controls, an important step towards reducing NCDs. There have also been national efforts to safeguard and improve nutrition as a means to bolster general immunity, while at the same time contributing significantly to NCD prevention and control. Many of the interventions and conditions required for fighting the pandemic are also those required to fight NCDs (The Lancet 2020): disease surveillance, a strong civil society, robust public health, clear communication, and equitable access to resilient universal health care systems. COVID-19 could provide new insights into interactions between the immune system and NCDs, and potentially change the way we understand and treat these diseases. On the other hand, it might also generate new long-term disabilities that will add to the NCD burden.

Based on a recent WHO survey of 107 countries, three-quarters of countries reported a considerable degree of disruption of NCD services due to COVID-19 (WHO 2020a). Two-thirds of countries reported that ensuring the continuity of NCD services was included in the list of essential health services in their national COVID-19 response plan. Twenty-eight countries reported that there was additional funding allocated for NCDs in the government budget for COVID-19 response. The pandemic has exposed the consequences of failing to address several of the risk factors predicting COVID-19 incidence and outcomes. In England and Wales, the excess risk of dying from COVID-19 was 2.4 times higher for females and 1.9 times higher for males with longstanding health problems (ONS 2020). Obesity alone posed a 1.9 times higher risk of dying from COVID-19, after adjusting for all other comor-

bidities (Williamson et al. 2020). A large prospective South African study showed that higher physical activity levels predicted substantially lower severity and mortality from COVID-19 (Steenkamp et al. 2022).

The pandemic has amplified the importance of recognizing gaps in how we care for those living with multiple chronic diseases (Hajat and Kishore 2018), with studies showing the presence of multiple co-morbidities in the majority of COVID-19 deaths (Agarwal et al. 2022). The neglect of the health services for older adults has manifested in declining life expectancy in developed countries such as the United Kingdom (UK) and the United States of America (USA), together with a greater number of years spent in poor health (Marmot et al. 2022). The impact of the pandemic on families and the related isolation of individuals from their loved ones have exposed and, in some cases, worsened trends in mental health and substance abuse (Ettman et al. 2022). For two years, screening programs for cancers, primary prevention programs for tobacco and alcohol, and health promotion efforts supporting active lifestyles ceased or were deferred in many settings.

The COVID-19 pandemic has clearly had a significant negative impact on human capital around the world, through disruptions to education and the loss of jobs and lives. These disruptions have been compounded by the adverse effect of the pandemic on NCD management. The double impact of COVID-19 and NCDs on human capital around the world is therefore a matter of serious concern.

RATIONALE FOR A WHOLE-OF-SOCIETY APPROACH TO NCDs

Most health problems have a multifactorial causation and consequently warrant a multidimensional approach, but this is even truer for NCDs. This section clarifies, conceptually, what is meant by "society-wide action" or a "whole-of-society (WoS) approach," as compared to other terms such as "multisector," "intersectoral," and "whole-of-government (WoG)." WoS is a comprehensive concept going beyond the WoG approach to include non-state actors (for-profit and non-profit), communities, households, and individuals. The need to involve all branches of government (the judiciary, the legislative, and the executive) and political leaders from opposition parties is emphasized, as the latter play a critical role in supporting or opposing any government initiatives. A framework for the bidirectional relationship of cause and effect linking NCDs with various sectors is presented. In practice, the goal of broad inclusiveness implied in WoS approaches needs to be balanced with the requirement of shaping an effective alliance for change. This may involve some selectivity, especially in the early stages of a change process, in order to achieve results.

Most health problems have a multifactorial causation and consequently warrant a multidimensional approach. This is perhaps even truer for NCDs, as social, economic, environmental, gender, demographic, and other dimensions contribute significantly to the risk of suffering from NCDs and to the eventual outcomes faced by those afflicted. Therefore, medical/health interventions, by themselves, are far from sufficient to address NCDs and their negative impacts on human capital and on the quality of life; to be effective, they need to be complemented by social, legal, educational, environmental, and other actions. In addition to the causation of NCDs, their impacts, too, straddle several sectors and, in fact, the economy as a whole. The multidimensional nature of the problem and its impact, and the resulting need for WoS solutions, are at the core of this paper. In particular, multiple chronic conditions (MCC) are often prevalent in the same individual, and the COVID-19 pandemic showed that persons with two or more co-morbidities are at a much greater risk of hospitalization and death, warranting an immediate focus on MCC, which have not received sufficient attention to date (Yach 2022). However, while arguing for non-health sectors' actions, the health sector's particular responsibility to address NCDs cannot be ignored. For instance, while non-health sectors are critically important in the prevention of NCDs, the treatment and long-term care of these diseases and ensuring continuity of care are squarely within the purview of the health sector.

Before addressing the main substantive topics of this paper, it is helpful to clarify conceptually what is meant by "society-wide action" or a "whole-of-society approach." This term has been consciously chosen, in preference to others such as "multisectoral," "intersectoral," "interdisciplinary," and "whole-of-government," which have been used with varying connotations—often without sufficient clarity and often interchangeably—by proponents

of the idea that many health problems cannot be effectively addressed by the health sector or ministries of health alone. Every one of these terms has a legitimate place in our lexicon, but with significant differences in meaning.

- ***Multisectorality*** entails several sectors of the economy—usually represented by various ministries of government—working together towards a common goal. Such cooperation across sectoral ministries is not easy to accomplish; most governments are organized into bureaucratic silos, making working across sectors particularly challenging. As a result, special efforts are needed to overcome these hurdles and obtain multisector involvement.

- ***Intersectoral*** is a term that goes beyond multisectorality, in that not only are multiple sectors involved, but they are also actively interacting with each other, coordinating effectively, and cooperating towards a common goal (NCD prevention and control, in our case). If multisector involvement is challenging, intersectoral coordination is even more difficult. But without such cooperation and coordination, interventions against NCDs are unlikely to be optimally effective.

- ***Whole-of-government*** approaches (sometimes referred to as "Health in all") connote broader engagement than only the various sectoral ministries. They include an aspect that is often overlooked, i.e., the political economy of any serious initiative. Since many preventive measures against NCDs are behavioral, they need broad-based acceptance from the population, and therefore warrant a concerted effort across the political spectrum, i.e., non-partisan buy-in. "Whole-of-government" would also mean the inclusion of all branches of government, not just the executive branch, to which "multisectoral" or "intersectoral" approaches tend to limit themselves.

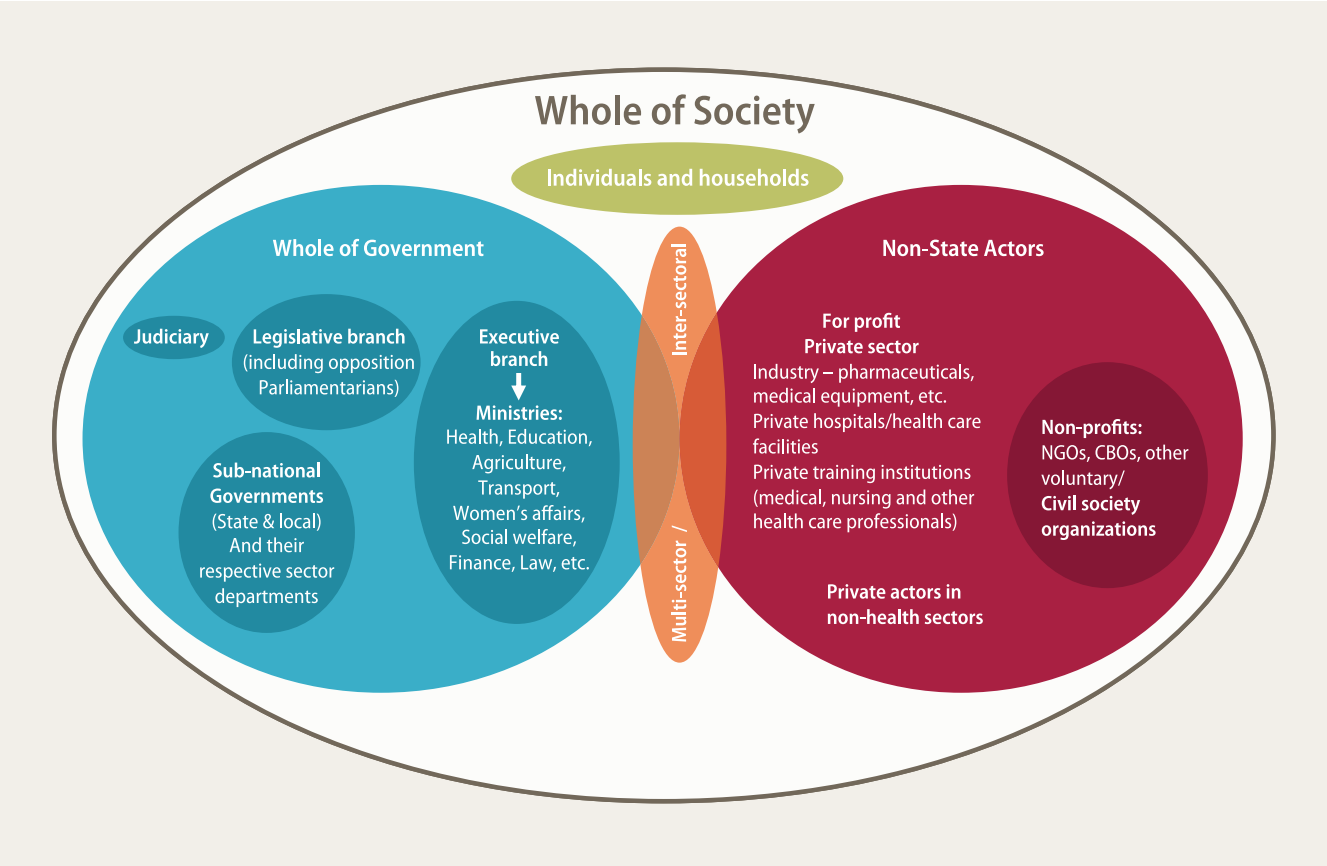
It is worth elaborating on the concept of involving all branches of government. Typically, in every government, economic sectors are represented by different line ministries, and efforts to involve the "whole government" seek to involve all these ministries; but this approach considers only the executive branch of the government and can hardly be called "whole-of-government" (let alone "whole-of-society," as explained in the next paragraph). There are at least two problems with this limited approach: (a) it ignores the important roles to be played by the legislative branch and the judiciary in NCD control; and (b) it ignores the opposition political parties, which may currently be out of power but would be important stakeholders if they take the reins of power and may even be influential while sitting in the opposition benches of the country's legislature, parliament, or congress. Especially in countries where the legislative branch is controlled by one political party, while the executive branch is held by another, it is easy to see that the involvement of just one branch would be inadequate. The judiciary, ignored in most initiatives, could play a vital role as well; in many instances, "judicial activism" could be the main force behind important legal measures – for instance, when political imperatives have stymied action by the legislative branch. For example, in some countries the courts have taken it upon themselves to pull up the executive branch for neglecting the environment. Taking *suo moto* cognizance of issues of public interest, courts can and have taken such actions and will likely continue to do so. In other instances, groups seeking to weaken public health measures have also used the courts (World Bank 2022). The most recent example of public health interventions being undermined if political forces and opinion-makers fail to align with public policy manifested as political hurdles placed in the way of measures to control the SARS-CoV-2 virus. Public health strategies including lockdowns and mask mandates in public places, and even vaccination, have been targeted by lawsuits and political prohibitions in some jurisdictions.

WoS concepts go beyond whole-of-government efforts, as they must involve non-state actors as well. Many of the causal determinants of NCDs require the active participation of the private sector, industry, and civil society organizations such as non-governmental and community-based organizations. Strong efforts to develop public-private partnerships and community mobilization are crucial to the success of NCD control programs.

The scope of a WoS approach is depicted in Figure 16.5, which shows a Venn diagram highlighting the all-encompassing nature of the term "whole-of-society." This term comprises all parts of the government with all its branches, including political leaders who might not currently hold power; different types of non-state actors, both commercial and non-profit; civil society organizations, opinion leaders, and community organizations; and, last but

not least, the individuals and households that constitute the society. In short, what distinguishes the term "whole-of-society" from other designations like multisector, intersectoral, and whole-of-government is its comprehensive scope and inclusive nature. In practice, the goal of broad inclusiveness implied in WoS approaches needs to be balanced with the requirement of shaping an effective alliance for change. The purpose of such an alliance of key stakeholders is to work together to achieve shared objectives. Other stakeholders, including those opposed to the objectives, ultimately need to be consulted and their views taken into account. However, some selectivity in participation, particularly at early stages of the change process, is likely to be required for a WoS strategy to succeed.

FIGURE 16.5 Components of a "whole-of-society" approach



Source: Original figure for this publication

It is important to stress that policy action on NCDs is the culmination of a constant negotiation amongst the executive, legislative, and judicial branches of government and non-state actors. In other words, the process is profoundly political, and institutional structures and processes are key to how policies are elaborated and implemented. As noted, it would be a mistake to ignore the important roles of legislative and judicial processes in policy making, as well as in the implementation of policies and programs. These roles are at least as important as that of the executive in determining the course of NCD policies. Indeed, as elaborated below, so-called "judicial activism" has played a pivotal role in promoting action on NCDs and their risk factors in many countries, when the legislative or the executive branch has been slow to act or has faced resistance from political vested interests. By the same token, broad agreement across the political spectrum is important to build a consensus on appropriate NCD-related policies and ensure continuity in the implementation of policies and programs across successive administrations. Similarly, the role of sub-national actors, particularly in federal systems, has not been given sufficient

importance in the literature on WoS approaches to NCD prevention and mitigation.

There are many reasons for the expanding role of the judiciary in national health policies. These include the inability of the legislative and executive branches of government to develop explicit policies in some settings, the growing share of national resources devoted to health care, and the increasingly litigious nature of society globally (Anderson 1992). Proponents of judicial intervention have suggested a number of advantages of the courts' becoming involved in social policy issues: the promotion of minority rights, the promotion of more humane conditions in social institutions, restrictions on bureaucratic arbitrariness, and, more generally, the promotion of positive social change (Kagan 1991). On the other hand, it has also been suggested that judges may not always have the technical background or experience necessary to evaluate complex social policy issues; that the decentralized nature of the judicial system can lead to inconsistent treatment of similar cases; that the focus of the courts' review is often narrow (Anderson 1992); and that, more generally, "excessive reliance on the courts, instead of self-government through democratic process, may deaden a people's sense of moral and political responsibility for their own future" (Cox 1976).

These arguments notwithstanding, there are several instances of courts in developed and developing countries intervening in lieu of governments—based on human rights and interpretation of the constitution—to promote or impede public health interventions. For example, responding to public interest litigation on air pollution, the judiciary in India has asked governments in many cases to constitute national and state regulatory boards or environmental courts, or issued directions to remind statutory authorities of their responsibility to protect the environment. Similarly, expressing serious concern over the large number of deaths due to road traffic accidents in the country, the Supreme Court of India in 2001 made wearing seat belts mandatory for front seat occupants in cars and directed the chief secretaries of the states and union territories in India to implement the order. However, it was only in 2005 that the Union government passed a law that made front seat belt use in cars mandatory, while the draft rules for the mandatory use of rear seat belts were developed as recently as September 2022. In contrast, courts have sometimes limited the government's ability to use emergency powers to promote public health and protect people. Examples include court rulings on the mask mandate for public transportation advocated by the United States Centers for Disease Control and Prevention and the "vaccine-or-test" mandate from the United States Occupational Safety and Health Administration.

This chapter alludes to the many benefits of establishing a national political consensus on social and health policies. However, the public response to the COVID-19 pandemic in the United States and Brazil, for example, has been highly politicized. More generally, although it is well known that party identification can shape basic political perception, there have been increasing concerns about the politicization of science globally. This includes partisan divisions around the world over public health issues such as vaccination, genetically modified organisms, and climate change (Kerr, Panagopoulos, and van der Linden 2021). Responses to NCDs and their risk factors are no exception. Cases in point include the polarization of views in various countries on the use of alcohol and sugar-sweetened beverages, gun control, and other issues.

The polarization of views observed at the national level also plays out at the global level. Developed countries that export alcoholic beverages often complain about the perceived "array of new and existing tariff and non-tariff barriers in export markets" in the developing world. Health protection and labelling, particularly for food and drink, are emerging as a dominant theme in many of the "specific trade concerns" that countries raise in international fora, highlighting the balance governments must strike between trade and health in areas such as reducing obesity, discouraging unhealthy eating and alcohol abuse, and protecting children, for example, by regulation or by helping consumers to make better informed choices for themselves; we would contend that this choice between trade and health is a false one, and health must not be traded for commerce in unhealthy goods.

On the importance of sub-national actors in how policies and laws relevant to NCDs are interpreted and implemented in countries with federal systems, the United States provides a striking example. The United States Constitution gives states broad authority on a variety of issues, including health regulations. For example, Section 2 of the Twenty-first Amendment to the Constitution has been interpreted by the courts and others as giving broad authority over the regulation of alcoholic beverages to the states and limiting the power of the national government to intrude upon state alcohol-

ic beverage control policies. States, in turn, can and in many cases have delegated authority to counties and localities. As a result, the availability of alcoholic beverages, their prices, and the terms and conditions under which they can be obtained (for example, whether a county is "dry," or whether a state itself exercises a monopoly on the sale of wines and spirits) have varied substantially across the country.

As part of the WoS approach, the role of the private sector is also critical, particularly in LMICs where the private sector is often the primary provider of health and health services. The section on engaging non-state actors in this chapter deals with the engagement with non-state actors, including for-profit and non-profit entities, in some detail.

Overall, the case for a WoS approach has been made by many influential authors, a sample of which is provided in Box 16.1 below.

BOX 16.1 Rationale for WoS approach – a sample of arguments

1. The argument for the involvement of non-state actors is strongly advanced by *Galambos and Sturchio* in their book on "Non-Communicable Diseases in the Developing World," (Galambos, Sturchio, and Whitehead (2013); and several relevant studies may be found in "The Road to Universal Health Coverage" by Sturchio, Kickbusch, and Galambos (2019).
2. The *United States National Academy of Medicine*, in its "Global Roadmap for Healthy Longevity," defines healthy longevity as the state in which years in good health approach the biological life span, with good physical, cognitive, and social functioning. The report argues that healthy longevity enables well-being across populations and urges that all-of-society transformation is needed to ensure that ageing societies worldwide thrive. Among actions critical for healthy longevity, it highlights supporting productive engagement in work, volunteering, and lifelong education; reducing ageism; promoting social inclusion and financial security; improving housing, public spaces, infrastructure, and transportation; increasing the coordination and affordability of equitable healthcare; and investing in public health (National Academies of Medicine 2022).
3. *Mahat and Thapa*, in an article in the *Journal of Nepal Medical Association,* state that countries that are trying to take a multisectoral approach in addressing NCDs often encounter challenges in operationalizing it. The authors recommend nuancing the multisectoral approach to NCDs in order to better inform its application. They note that often it is limited to the formation of high-level steering committees, which are rarely functional, thus warranting more robust institutional mechanisms. With limited technical capacity, and even less control over financial resources, ministries of health seem to play a weak role in driving a multisectoral approach. The authors identify political commitment and leadership as the most important factors for a successful implementation of whole-of-society and whole-of-government approaches, with the development of common knowledge and understanding along with evidence generation as other critical factors (Mahat and Thapa 2019).
4. *George Alleyne and Sania Nishtar*, in their work titled "Sectoral Cooperation for the Prevention and Control of NCDs," attempt to separate multisector from intersectoral action and postulate that the former refers to action involving the various sectors of government, while 'intersectoral' refers to the interactions among the government, civil society, and the private sector (Alleyne and Nishtar 2013).
5. *Leppo and colleagues*, in their book *Health in All Policies – Seizing Opportunities,* describe how various sectors could incorporate health in all of their policies – the so-called 'health-in-all policies' approach. They focus on relevant issues such as health equity, workplace health, mental health, nutrition, alcohol, and tobacco (Leppo et al. 2013).

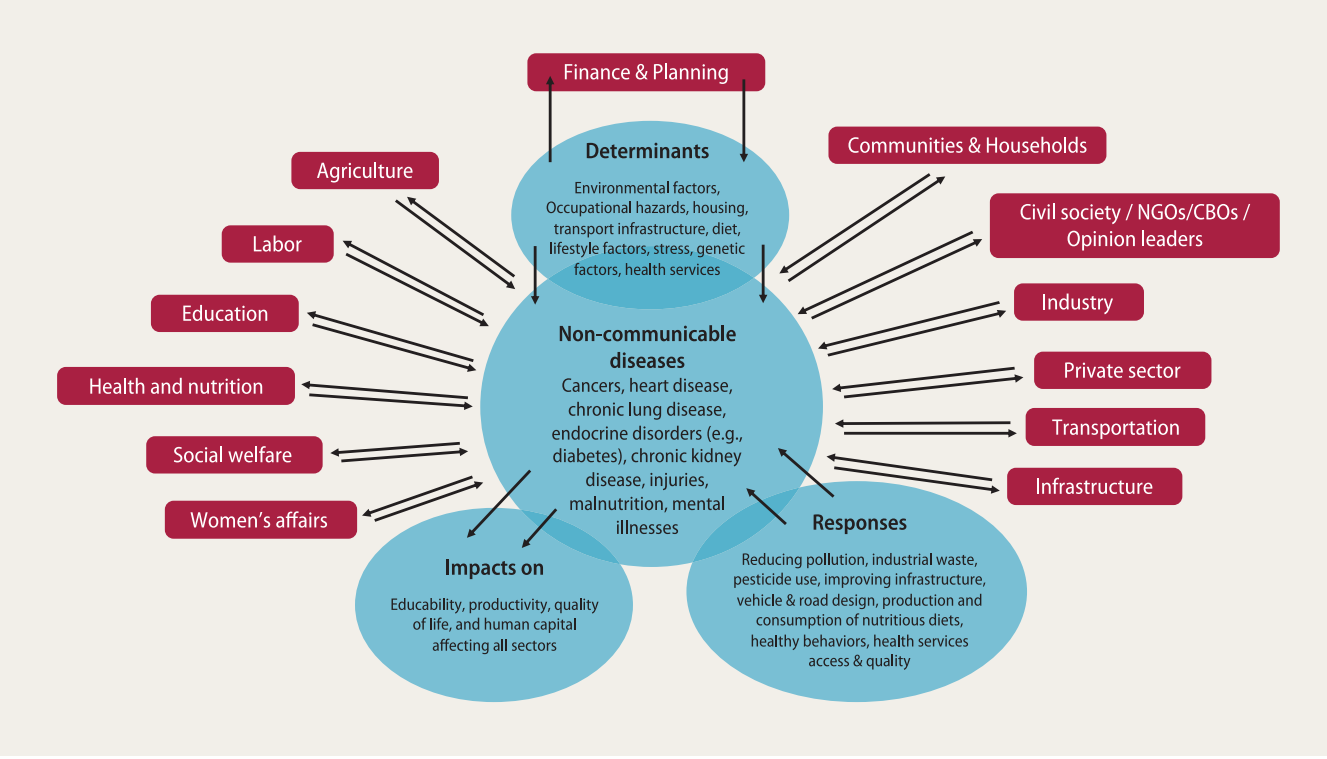
Table 16.1 summarizes the bi-directional relationship between selected non-health sectors and NCDs. These are just a selected set of sectors that clearly exemplify such relationships. Additional sectors are included in a proposed framework that shows schematically the bi-directional relationship between various sectors of the economy and NCDs (Figure 16.6).

TABLE 16.1 Bi-directional relationship between selected non-health sectors and NCDs – some illustrations

Sector (Examples)	How are NCDs affected by?	How do NCDs affect?
Education	Since NCDs are lifestyle diseases, education influences knowledge, attitudes, and practices, including positive health seeking behaviors.	NCDs adversely affect educational outcomes both indirectly (impact on teachers/parents) and directly (malnutrition, type 1 diabetes, accidents/injuries, visual impairments).
Social Protection & Labor	Inadequate labor laws, occupational health and industrial safety measures, and social assurance/insurance programs can cause NCDs or exacerbate their negative impacts.	NCDs impact jobs, livelihoods, and labor productivity.
Agriculture	Increased availability and affordability of diverse foods can decrease NCD prevalence. Use of insecticides/pesticides can cause NCDs.	NCDs can affect agricultural production, profits, and financial sustainability.

A literature review did not yield a comprehensive framework capturing the two-way cause-effect relationship between NCDs and relevant sectors of the economy, in order to demonstrate the rationale for a WoS approach. The few frameworks relevant to NCDs available in the literature appear to have been developed for other purposes (e.g., to monitor NCD interventions). Therefore, an original framework for multisectoral causes and impacts of NCDs is proposed in Figure 16.6 and further elaborated in the paragraphs that follow.

FIGURE 16.6 Framework for multisector causation and impact of non-communicable diseases



Source: Original figure for this publication

Education. The education sector is highly relevant to all health issues, especially those that require healthy behaviors for prevention and control, since inculcating good knowledge, attitudes, and practices relevant to health from an early age becomes essential. NCDs are frequently seen as "lifestyle diseases" – since healthy lifestyles often constitute the most effective preventive device against them. Therefore, the relevance of the education system to NCD control and prevention is self-evident. There is also a relationship in the other direction, i.e., NCDs can adversely affect education outcomes both through their debilitating impact on parents and teachers and by directly afflicting children. Examples of common childhood NCDs include but are not limited to: malnutrition (including childhood obesity); type I diabetes among children; accidents and injuries at home, school, or on playgrounds; pediatric asthma; and visual impairments – mostly refractive errors or a deficiency of vitamin A. Early identification of NCDs among children and their timely management are often best achieved in the education system, which clearly implies a critical role for teachers as well as parents.

Social protection and labor. Given the potentially devastating impact of NCDs on livelihoods (Kankeu et al. 2013), their links to social safety nets and the work of labor ministries become vitally important. Lack of access to adequate social protection can exacerbate the negative effects of chronic debilitating illness on the affected individuals and their families. Therefore, there is a clear need to develop social protection programs targeting those who suffer from or are affected by NCDs. Occupational health and industrial safety are areas where the labor ministry needs to ensure appropriate interventions that could contribute to the prevention and mitigation of NCDs, especially those which are linked to occupational hazards such as industrial pollution, exposure to toxic chemicals, and risks of accidents and injury.

Agriculture and urban policy. Work undertaken by Lepp, Puska, and others in North Karelia in Finland (e.g., Puska and Jaini 2020) showed how NCDs could be addressed through specific agricultural changes (reduced support for dairy, more for fruits and vegetables); city planners' pushing physical activity; and, critically, strong and consistent leadership by health leaders. Some of that work was globalized by WHO in the 1990s, with WHO's European and Eastern Mediterranean Regions in particular building on these initiatives.

Transportation. As we consider injuries among NCDs, and as road traffic accidents are a significant cause of injuries around the world, the involvement of the transportation sector becomes critical to ensure road safety, both in terms of the design of transportation infrastructure and in terms of improved behaviors – through education as well as regulations.

Environment. Air pollution is a significant NCD risk factor (added to WHO's 4x4 framework when it was expanded into a 5x5 framework). It stands to reason that the ministry of environment and relevant private sector actors work together to address this and other environmental factors contributing to NCDs.

Commerce/trade. Nearly every good or service that gets traded–internationally, as well as domestically–has an impact on health, positive or negative. Regulating the trade of specific goods with proven deleterious health effects, especially through NCDs, is clearly an area that requires the involvement of this sector/ministry.

Law/justice. Many interventions against NCDs require a legal framework to be in place, e.g., traffic safety, access to alcohol, tobacco, narcotics, firearms, just to name a few. Therefore, the involvement of this sector is self-evident.

Finance. In addition to the critical function of resource allocation to various ministries, ministries of finance have a key role to play in taxation, which is relevant to interventions that seek to raise the tax on unhealthy commodities such as alcohol, tobacco, sugary drinks, etc., and possibly earmarking such additional revenues to the control of NCDs.

ENGAGING NON-STATE ACTORS (FOR-PROFIT AND NON-PROFIT)

A strong case exists for coopting and engaging non-state actors in preventing, managing, and controlling NCDs. But public-private partnership on NCD prevention and control cannot be premised merely on good intentions; bringing the private sector on board requires a clear-eyed approach on the part of governments, bearing in mind the risks emerging from the profit motive of commercial entities that diverge from public health interests. Several examples of innovative and mutually beneficial public-private partnerships focused on the prevention and control of NCDs are presented, although they are limited in scale and scope. The important role that the non-profit private sector (NGOs and CSOs) can play is stressed, particularly given their ubiquitous presence in LMICs, particularly in the poorest regions and countries of the world, and their comparative advantage with regard to community mobilization.

There are several reasons why it makes sense, and is in fact necessary and potentially mutually beneficial, for state actors to co-opt and engage with private sector actors in preventing, managing, and controlling NCDs. The private sector has at least four motivations to invest in NCDs: (i) its commitment to its employees (keeping the workforce healthy), (ii) its profit motive (new products and new markets), (iii) its social responsibility (doing the right thing) – (Hancock, Kingo, and Raymond 2011), and (iv) its recognition that such investment in the well-being of consumers has long-terms benefits for economic development, which in turn is good for business. The private sector (except of course those industries producing and selling goods that harm human health) is thus uniquely positioned to catalyze and enhance multi-stakeholder efforts to address NCDs at the global, national, and local levels. The private sector also has several key attributes—motivation, geographical presence and reach, resources, convening power, and credibility with local communities—that make it a potential partner in this effort. Aside from NCD service provision, the private sector also offers special capacities, including the creation and adoption of innovations (Laryea and Cueni 2019), greater production/cost efficiencies, new technologies, strong research capabilities, and supply chain capacity, that can be leveraged to optimize WoS NCD efforts. The role of private actors in NCDs is not limited to service provision and should include a significant emphasis on financing, as well, i.e., the mobilization of private funding for NCD interventions—either as a part of corporate social responsibility or even as a core objective. Effective control of NCDs could yield tangible benefits to the private sector, in terms of employees' health and productivity, for example. In a report of the Center for Strategic and International Studies (CSIS) project on US Leadership in Development, Sturchio and Goel make a strong case for involving the private sector in public health globally, while acknowledging the existence of distrust and skepticism in several quarters; the authors go beyond the issue of whether the private sector needs to be engaged and attempt to address the question of how such engagement could be put to best use (Sturchio and Goel 2012).

Authors associated with the United States National Institutes of Health have made a strong case for partnership with the private sector, distinguishing between "interacting, engaging, and partnering" (Collins, Mikkelsen, and Axelrod 2019). Their analysis stresses the need for working actively with the private sector for the prevention and control of NCDs, rather than merely promoting an interaction between the public and private sectors. The authors suggest several possible opportunities for such engagement/partnership. First, since the private sector already plays a dominant role as a provider of NCD services, especially in the curative domain, they recommend that governments mounting a comprehensive NCD control and management strategy leverage these already existing capacities through effective public-private partnership (PPP) models. Second, they suggest that a broader engagement with industry could be forged to address CVD and other NCDs, going beyond the private sector's role in service provision and encompassing domains such as technological innovation, controlling input costs so as to reduce the economic burden, conducting high-quality research, improving supply chains, and more. Third, the authors note that moving from private sector engagement to multi-stakeholder partnerships calls for the development of new rules of the game, especially if the private sector is to be involved through mechanisms other than contracting; such rules include requiring complete and regular reporting of epidemiological data, linking of patient information, telemedicine, and other innovations. Finally, the authors propose the WHO

Global Coordination Mechanism as an example of an innovative platform for multi-stakeholder engagement at the global level. Similar coordination mechanisms are required at the national level.

Public-private partnership on NCD prevention and control cannot be premised merely on good intentions; bringing the private sector on board requires a clear-eyed approach on the part of governments (Allen and Bloomfield 2016). It is important to recognize that the interests of the industries that produce tobacco products, processed foods, or pharmaceuticals often diverge from those of public health. Thus, coopting these industries to work towards the larger interests of the society can pose significant challenges. Involving private sector partners with diverging interests comes with risks as well as benefits for public health objectives. Clear policy goals, identification of value-added, creation of appropriate engagement platforms, establishment of statutory/regulatory frameworks, and documented agreements on reporting and benefit-sharing are critical for effective public-private collaboration on NCDs. One area where the private sector's role appears vital is fighting malnutrition. In their article titled "Can the food industry help tackle the growing global burden of undernutrition?", Yach et al. (2010) argue: "If we are to combat global undernutrition successfully, efforts must be sustained by multiple stakeholders from various sectors. Only through new and innovative public–private sector partnerships can we truly make a difference". Large corporations in the food and beverage industries wield substantial market power which can translate into political influence. Worldwide, the top 10 packaged food companies account for 15.2 percent of sales, while the top 10 soft drink companies account for 52.3 percent of sales. In recent years, 10 major multinational food and beverage companies have worked together within the International Food and Beverage Alliance (IFBA) to increase their commitments to public health. While engaging industry "heavyweights" is important, for best results, major multinational companies need to be joined by the myriad of small- and medium-sized enterprises in developing and implementing programs to improve the health of the public (Alexander, Yach, and Mensah 2011).

Globally, there are several examples of innovative and mutually beneficial public-private partnerships focused on the prevention and control of NCDs, but many of these efforts have been limited in scale and scope. Such efforts can be categorized as: (a) single-company efforts addressing NCDs broadly, e.g., by Novo Nordisk, Vitality, and Teva; these firms usually partner with NGOs and have some relationship to the countries or cities in which they work; (b) multi-company efforts addressing one or more risk factors: e.g., IFBA, supported by the 10 largest multinational food companies; and (c) a coalition of public and private entities addressing CVD, asthma, and diabetes. These initiatives are usually a response to WHO or governments, and they often engage NGO partners. However, they rarely achieve scale for two main reasons: companies need to be encouraged to cooperate and find the non-competitive aspects of a relationship where they can all win together; and they need government leaders who understand how markets work and know how to leverage regulations that encourage change. WHO now actively encourages public-private approaches through its new unit focused on the "commercial determinants of health." Box 16.2 presents some illustrative examples (IARD 2019; Laryea and Cueni 2019).

It is worth underlining the important role that the non-profit private sector can play, particularly given its ubiquitous presence in LMICs, especially in the poorest regions and countries of the world. In an article in the British Medical Journal, Katie Dain, a Commissioner on the WHO Independent High-Level Commission on NCDs and co-chair of the WHO Civil Society Working Group for the Third United Nations High Level Meeting (HLM) on NCDs, argues that HIV/AIDS, Ebola, and the climate crisis provide good examples for civil society engagement (Dain 2019). Dain's article is a part of the "Solutions for Prevention and Control of NCDs" collection, a collaborative output of the WHO Global Coordination Mechanism on NCDs and the BMJ. Defining civil society in the broadest terms, Dain asserts that the international community has been slow to recognize and meaningfully engage civil society organizations in the response to NCDs. She identifies supportive legal, social, and policy environments and the documentation of best practices as essential prerequisites and exhorts the United Nations (UN) and governments to "walk the talk" in this regard and the NCD community to hold governments to account. In this context, it is notable that a major review of public-private partnerships seeking to develop quality and affordable new technologies for health highlighted the general neglect of NCDs and mental health (Bulc and Ramchandani 2021).

BOX 16.2 Examples of Public-Private Partnerships for Non-Communicable Diseases

- *Access Accelerated*: A platform consisting of 20 biopharmaceuticals; civil society organizations, e.g. UICC, WHF, NCD Alliance, and City Cancer Challenge; and international agencies, e.g., PATH and the World Bank.
- *"Ask, Listen, Learn"*: Responsibility.org, alongside a team of educators specializing in elementary and middle-level education, developed "Ask, Listen, Learn" with the goal of increasing conversations between parents and kids about alcohol and reducing underage drinking. The program encourages open, factual conversations between parents, educators, and children about alcohol, and informs kids about the dangers of underage drinking.
- AstraZeneca launched *Healthy Heart Africa* in 2014 to reach 10 million hypertensive patients across Africa over the ensuing 10 years in an effort to address the World Health Organization's target of reducing premature CVD deaths by 25% by 2025.
- The British insurance company *Bupa's Global Chief Medical Officers Network* is an alliance of clinicians and executives whose mission is to improve health and wellbeing globally by engaging private sector leaders not typically included in the health conversation in dialogue with governments, civil society, and multilateral agencies to share best practices.
- The *Global Smoke-free Worksite Challenge* is a partnership between Johnson & Johnson, the Mayo Clinic, the American Cancer Society, the US Department of Health and Human Services, and others to reduce tobacco in the workplace.
- *IARD drunk driving project in the Dominican Republic*: The International Alliance for Responsible Drinking (IARD) engaged a wide range of government and private stakeholders – along with academia, NGOs, civil society – and helped lead meetings and workshops about road safety issues. These events allowed many Dominican road-safety agencies and experts to become aware of others' work and expertise.
- *International Food and Beverage Alliance* (IFBA) is a global alliance of twelve food and beverage companies, dedicated to advancing health and nutrition. Their engagement with WHO led to changes in food and beverage marketing to children across many companies. The Healthy Weight Commitment Foundation was a partnership with the Robert Wood Johnson Foundation, the US President's Office, and academia.
- Eli Lilly launched the *Lilly NCD Partnership* in 2011, committing US$30 million over five years to leverage public-private partnerships to combat NCDs in Brazil, India, Mexico, and South Africa.
- *Merck's Capacity Advancement Program*, established in 2012, is a public-private partnership with Ministries of Health, heath facilities, local communities, universities, and the media to expand diabetes-related health care professional capacity in Africa.
- In partnership with Medtronic, the NGO Partners In Health (PIH) launched the *NCD Synergies Initiative* to facilitate collaboration among low-income countries facing similar challenges in their national strategic planning to address NCDs.
- *Novo Nordisk and several state governments in India* have collaborated to improve diagnosis, treatment, and care for diabetes patients. A major impact of Novo Nordisk has been in initiating the Oxford Health Alliance, which built many public-private partnerships, launched a multi-city effort toward ending diabetes, and supported the UN resolution on diabetes that led to the UN NCD resolution. These actions show how some private sector actors have for decades steadily supported a wide range of policy, advocacy, training, and specific projects related to NCDs, including creation of the World Diabetes Alliance.
- *The Pan American Forum for Action on Non-Communicable Diseases* is a public-private partnership whose goal is to address the NCD epidemic in the Americas by implementing and promoting the Pan American Health Organization (PAHO) strategy for prevention and control of NCDs.
- The *Pfizer Global Health Challenge* program has pledged more than US$47 million to support cancer- and tobacco-control organizations to combat NCDs.
- The *Workplace Wellness Alliance*, launched in 2010 as a response to the World Economic Forum Meeting in 2008, aims to make wellness a priority in the workplace to improve employee health and productivity.

WHAT HAS BEEN ACHIEVED SO FAR, AND WHAT HAVE WE LEARNED?

Several examples of WoS approach to NCD control are presented and lessons are gleaned from them. Concrete empirical evidence of the effectiveness of a WoS approach for NCDs is hard to come by because most of the examples are limited in scope, and/or did not include rigorous impact evaluations. However, experience shows that it is vitally important to mitigate three factors that usually impede inter-ministerial cooperation: (a) financial rules, which make it difficult for one ministry to share resources with another; (b) turf battles regarding roles and responsibilities and leadership; and (c) lack of domain knowledge in relevant ministries. Other lessons include: (i) the importance of genuine involvement and active participation of the relevant sectors from the beginning of the process; (ii) identifying clear roles and responsibilities for every sector; (iii) the need for an appropriate institutional home for coordination—physically as well as organizationally; and (iv) the need for a special effort to include non-state actors (i.e., the for-profit private sector, non-profit organizations, civil society, and community-based groups).

This section presents examples of WoS approaches that have been adopted in different contexts, based on a review of available knowledge, and derives lessons from these experiences. The approaches described below encompass regional and national NCD programs, as well as programs targeting specific NCDs or individual risk factors for NCDs. It should be stressed that what is presented is just a sample of such efforts/studies around the world, and not an exhaustive review. The selection is limited by the amount of available evidence about programs that adopted a truly comprehensive approach involving the whole society in actions against NCDs; among such programs, it is even more difficult to find those with rigorous impact evaluations that could provide the required evidence of effectiveness.

The global commitment to combat NCDs and calls for whole-of-society action are not new. In 2011, the first HLM of the United Nations General Assembly, in its political declaration, highlighted the importance of prevention and control of NCDs. This was followed by similar declarations in 2014, 2018, and 2019. The WHO, for its part, put out a Global Action Plan for 2013-20 (NCD GAP), accompanied by nine voluntary, global NCD targets for 2025 and 25 indicators to track the progress made.[1] In 2015, as part of the Sustainable Development Goals (SDGs), SDG 3a exhorted all countries to strengthen the implementation of the WHO Framework Convention on Tobacco Control, while with SDG 3.4, countries committed to reduce premature mortality from NCDs by one-third and promote mental health and well-being. In 2018, WHO also published a document titled "Saving Lives, Spending Less: A strategic response to noncommunicable diseases," which laid out for the first time the health and economic benefits of implementing the most cost-effective and feasible interventions to prevent and control NCDs (WHO "best buys") in low- and lower-middle-income countries. While all these global initiatives did call for WoS actions, that has remained mostly on the level of rhetoric, with little concrete action taken to adopt such an approach. The NCD Alliance, citing a new NCD Countdown 2030 Report published by *The Lancet*, highlights the slow progress towards SDG target 3.4, pointing out that many countries are falling behind on global commitments to tackling premature deaths from chronic diseases (NCD Alliance 2020b).

Our overarching finding, based on a literature search, is that concrete empirical evidence of the effectiveness of a WoS approach for NCDs is limited. Unlike nutrition and HIV/AIDS, there is a paucity of policy evaluations and assessments of the impact of WoS frameworks/approaches on tackling NCDs, or even of the impacts of specific risk factor initiatives on health outcomes. Few studies have examined important aspects like the political economy of NCDs or undertaken rigorous institutional analyses. Nor have there been evaluations of the implications of emerging health risks, such as pollution or climate change, for NCD burdens or national responses to these diseases. The evidence is particularly scanty in LMICs. A partial exception concerns tobacco taxation and action on sugar sweetened beverages (SSBs), though these too have only been studied in limited settings. Figure 16.7 shows that action against tobacco and SSBs had to involve legal action, taxation, and engagement of the private sector. Of course, consumers had to be convinced of the importance of these measures and accept them for the measures to be successful. Many countries lack the necessary regulatory framework to implement such initiatives, and where regulations exist, enforcement may be weak.

1 The decision WHA72(11) in 2019 extended the period of the action plan to 2030 to ensure its alignment with the 2030 Agenda for Sustainable Development.

FIGURE 16.7 Global policy actions relevant to sugar-sweetened beverages



Source: Presentation on "Evidence base for actions by national actors on regulation of sugar sweetened beverages" by Prof. Yik Ying Teo of the Saw Swee Hock School of Public Health, National University of Singapore at the Prince Mahidol Award Conference (PMAC) 2019.

It is also noteworthy that global investments in combating NCDs have been relatively low, despite the potential for good returns on such investments in terms of both health outcomes and economic benefits. A discussion paper by the NCD Alliance titled "Bridging the gap on NCDs: from global promises to local progress" identifies significant resource gaps in the first decade of the SDGs and points out that global commitments in this area have not yet been followed up (NCD Alliance 2020a). It is critically important that gaps between the resources needed and those actually available to countries be assessed and remedied if global commitments are to be translated into substantive actions on the ground. Such an effort to fill the resource gap calls for effective mobilization of financial and human resources from private as well as public sectors. This is an area where a WoS approach would be essential.

Global/regional initiatives

Thakur and colleagues reviewed progress and challenges in achieving NCD targets for the SDGs. They found that only 14 of 181 countries had improved their national monitoring on tobacco use (SDG target 3.a), although tobacco use is "steadily declining." Progress has been made across countries in reducing global suicide rates, from 12.9 (2000) to 10.6 (2016) per 100,000. Progress on reducing harmful alcohol consumption (target 3.5), however, has been stagnant. Moreover, road traffic accidents increased from 1.31 million in 2013 to 1.35 million in 2016 (target 3.6 per 100,000 population). In the case of tobacco, success with increasing excise taxes demands complex health-finance-commerce agreements within governments. A WoS approach is needed to resolve this. An intervention that requires adequate priority is smoking cessation through cheap and effective nicotine replacement therapy (NRT) – (Thakur et al. 2021).

The World Health Statistics 2020 show that the world is not on track to achieve the objectives of the NCD GAP and SDG target 3.4 on NCDs. Despite the global attention paid to NCDs over the past two decades, progress toward reducing the burden of NCDs has been slow. In 2020, only 31 UN Member States were on track to achieve a 33 percent reduction in the risk of premature mortality from NCDs by 2030 against a 2015 baseline (SDG target 3.4.1). Progress towards the nine voluntary global targets set for 2025 against a 2010 baseline is also off track. Further-

more, with the exception of tobacco use, there has not been a significant change in the trends for NCD risk factors across WHO regions over the past decade (WHO 2020b). On the positive side, Thakur et al. (2021) noted that India adopted the WHO Global Action Plan for NCDs 2013-2020 and developed its own national action plan with indicators, including a target of reducing the number premature deaths by 25 percent by 2025. While the Global Action Plan lists nine targets and 25 indicators, India has set a tenth target to address household air pollution.

WHO's "best buy" strategies. The WHO's "best buy" interventions are a menu of policy options and cost-effective interventions for the prevention and control of major NCDs. The menu has six objectives, the implementation of which, by Member States, is expected to promote the achievement of the nine NCD targets by 2025.

A geopolitical analysis of 151 countries with regard to NCD policy implementation, however, observed that, though most countries have endorsed WHO's NCD "best buy" policies, relatively little is known about global implementation patterns and about the geopolitical factors affecting implementation (Allen et al. 2020). The analysis found that the mean NCD policy implementation score was 49.3 percent in 2017, with Costa Rica and Iran scoring highest (86.1 percent) and Haiti and South Sudan scoring lowest (5.5 percent); between 2015 and 2017, the scores rose in 109 countries but regressed in 32 countries. The most commonly implemented policies were clinical guidelines, graphic warnings on tobacco products, and NCD risk factor surveys. Nutrition-related policies saw gains, while those related to alcohol and physical activity were the most likely to have been less effectively implemented or even dropped.

Similarly, assessing progress under Health 2020 in WHO's European Region, Zuidberg et al. (2020) found a wide variation of the '*Health 2020 Index*'. Scores ranged from 82.8 in Sweden to 30.0 in Turkmenistan, and the study noted a clear east-west gradient, with countries in the west performing better than those in the east. While all quintiles showed improvement in terms of premature mortality, mortality from external causes, life expectancy and infant mortality, there was a uniform lack of progress on overweight.

A review of multisectoral action in NCD prevention policy development in five Sub-Saharan African countries (Cameroon, Kenya, Malawi, Nigeria, and South Africa) concluded that such multi-sectoral action is possible in African countries but identified various challenges in bringing sectors together to develop policies to address the increasing NCD burden in the region (Juma et al. 2018). Stronger coordination mechanisms with clear guidelines, including approaches for capacity-building and resource generation, were identified as prerequisites. Such mechanisms should include approaches for capacity building and resource generation to enable multisectoral action in NCD policy formulation, implementation, and monitoring of outcomes. Other recommendations included increasing NCD awareness among various sectors, a health sector leadership role, and implementation strategies to counter "industry interference" that blocks NCD prevention measures (Juma et al. 2018).

Another review of NCD policies in Africa synthesized the findings of 21 studies and found inadequate studies on NCD policy, unsatisfactory NCD-related policy development, poor policy implementation, lack of policy equity to combat NCDs, and lack of data (Kassa and Grace 2022). It also identified inadequacies in awareness, funding, and inter-sectoral coordination and recommended that policy makers strengthen the inclusion and implementation of "best buy" strategies identified by WHO.

Multisectoral Action Plans (MAPs) and National Strategic Plans. Perhaps inspired by the examples of HIV/AIDS and nutrition, multisectoral action plans and/or national strategic plans against NCDs have been attempted in some countries. An example of concrete steps towards multisectoral action against NCDs is the development and promotion of the NCD MAP toolkit by WHO, to assist policymakers and program managers in developing, implementing, and monitoring national multisectoral plans. It covers the main steps from situation assessment, stakeholder engagement, and setting national NCD targets to implementation and monitoring and evaluation. "Best buys" form the basis for NCD Multisectoral Action Programs (MAPs) in many countries of the world.

In Türkiye, for example, the MAP for NCDs 2017-2025 has two phases. The underlying determinants of NCDs and the risk factors mean that multisectoral, whole-of-government, and WoS responses are required to prevent and control them. The influence of public policy in sectors such as trade, taxation, agriculture, urban development, and food production is frequently required for health gains to be made in the area of NCDs. Intersectoral action can be complex and challenging but there is a sense in Türkiye that adequate experience now exists about which institu-

tional processes promote intersectoral policy practice.

In the Caribbean countries, all the NCD MAPs include at least nine of the 14 WHO "best buys" policy options, and all include the "best buys" related to smoke-free environments, unhealthy diet, physical activity, and cervical cancer screening. Countries in this region strongly emphasize improving awareness and strengthening and enforcing policies, legislation, and regulations to enable risk factor prevention and control, especially relating to unhealthy diets. A study of Barbados' Multi-sectoral National NCD Commission reported that, while the country was successful in engaging with leaders in civil society organizations and the private sector, the engagements among different government ministries were limited (Unwin et al. 2016). It has been noted that the mechanisms required for cooperation between sectors within the government are different from those required for cooperation between different parts of the society, and between the government and nonstate actors. Therefore, it is important to find appropriate mechanisms for both "whole-of-government" and "whole-of-society" approaches.

In Malaysia, an analysis of the 2010-2014 National Strategic Plan for NCDs found that there has been a strong unification of "whole-of-government" and multisectoral involvement in the prevention of NCDs. However, the lack of measurable indicators and evaluation criteria has hampered assessment of the progress achieved. The new 2016 to 2025 plan has therefore highlighted overarching principles, including multisectoral action, evidence-based strategies, use of a lifecycle/life-course approach, and empowerment of people and communities. The Malaysian government also conducted a SWOT analysis of its National Strategic Plan for NCDs 2010-2014, and found the following:

- **Strengths**: a) The unification of "whole-of government" and multisectoral involvement of other agencies in the prevention of NCDs.
- **Weaknesses**: a) Lack of indicators and evaluation criteria; b) No specific target for each strategy outlined; c) No specific measurable achievements in each strategy.
- **Opportunities**: a) Development of public-private partnerships; b) Document recognized worldwide and highlighted as an example by WHO; c) Provided the mandate to implement policies and programs relating to prevention and control of NCDs.
- **Threats**: a) Lack of support from other agencies; b) Political change may affect the direction of the overall agenda.

Illustrative national initiatives

Japan. Multisectoral cooperation in NCD control in Japan has been well established and practiced. "*Health Japan 21*," initiated in 2000, was the third national health promotion campaign aimed to establish professional health care teams at primary care level. In Japan, decision-making and implementation of NCD control are usually based on evidence (Wu et al. 2017). Survey data are used to predict trends in NCDs and related behavioral risk factors, and to evaluate the effects of prevention and control strategies and measures. Implementation of "*Health Japan 21*" across different areas has provided evidence for the government to make further decisions. The Japanese government also provides specific funds to support applied research on NCD control.

Japan has a horizontal management system of NCDs under a decentralized model (Shibuya et al. 2011) as highlighted in Table 16.2. The system has contributed much to the success of NCD control in Japan. Various major actors also participated in creating and implementing NCD policies in Japan, including the central government, ministries, local government, community health care professionals, insurers, and private industries. One distinctive point of Japan's health care system is the prominence of community health workers (Kabayama et al. 2014). Another noteworthy aspect of *Health Japan 21* (2013–2022) is the active engagement of the private sector. The plan includes a target to, "increase the number of corporations that deal with health promotion and educational activities." Between 2012 and 2022, the number of corporations that were expected to achieve the proposed target rose from 420 to 3,010. As part of *Health Japan 21*, under the leadership of the Ministry of Health, Labor, and Welfare also launched the Smart Life Project to encourage three concrete strategies: (i) proper exercise, (ii) appropriate dietary habits, and (iii) smoking cessation. The project encourages corporations to take the necessary measures for tackling NCDs and commends corporations with outstanding outcomes.[2]

2 Government of Japan, Ministry of Health, Labor, and Welfare. Health Service Bureau.

TABLE 16.2 NCD Control and Prevention System in Japan

"Healthcare at age 40+ years, medical care at age 70+ years"

Key features: Law-based MS governance + Decentralized NCD management + Focus on primary prevention ("Lifestyle Diseases")

Development	Unhealthy lifestyle →	Risk Status →	NCD →	Rehabilitation
Focuses	Overeating Smoking Drinking Not exercising Living with Stress	Overweight High blood pressure High glucose High TC	Cancers Diabetes CVD Stroke	
Actions	Health Japan 21	Specific health check/ guidance Cancer screening	Surveillance Treatment	Selfcare Long-term care
Systems	A national health promotion and disease prevention initiative	Mass screening program	Cancer registry Health system • Health insurance • Healthcare delivery	Long-term care system
Acts/Laws	Health Promotion Act	Act on Assurance of Medical Care for the Elderly Health Promotion Act	Cancer Registration Promotion Act Health Insurance Act Act on Assurance of Medical Care for the Elderly	The Long-term Care Insurance Act

Source: Wu et al. (2017)

China. In China, NCD control measures mainly include three aspects: (i) surveys or surveillance of NCDs and related risk factors, (ii) health education and health promotion in the general population, and (iii) comprehensive interventions in high-risk populations (Table 16.3). Of the three aspects, management of high-risk populations is the most important in China. NCD control tasks were designed to be shared by multiple organizations in the Chinese context, including national and local Centers for Disease Prevention and Control (CDC), hospitals, institutions of health education, and the Institute of Maternal and Children Healthcare. In addition, the National Cancer Center, National Center for Cardiovascular Disease, Prevention Office for Endemic Diseases, and other academic organizations are also involved in NCD control.

China also recognizes the importance of multisectoral cooperation in NCD control. In 2012, 15 Chinese government ministries jointly issued the "*Work plan on NCD prevention and control in China (2012-2015)*" to propose mechanisms of multisectoral cooperation and define responsibilities of relevant sectors. The publication of the work plan was a landmark for NCD control in China. However, due to the lack of political incentives and effective mechanisms, along with conflicts of interest, multisectoral cooperation in NCD control remains a partially fulfilled promise of the central and local governments. One of the major risk factors that remain inadequately addressed in China is tobacco in contrast with the rapid decline in tobacco use in Japan (Wu et al. 2017).

TABLE 16.3 Major NCD Management Initiatives in China

Key features: Surveys of NCDs/risk factors + High-risk population focus + Multiple agencies involved but not truly WoG

Issuing Institutes	Types of Policies	Topics	Number of Policy Documents			
			Overall	1984-1999	2000-2008	2009 & after
General Office of the Communist Party of China	Decisions, Opinions, Reports, Notices	Medical reform; Population aging; Sports; Rural healthcare service; Tobacco control.	11	1	5	5
National People's Congress	Laws and Regulations	Environment protection; Air pollution; Advertisement; Sports; Nationwide fitness program; Food safety; Social insurance; Occupational disease prevention; Health insurance for minors and elderly.	10	5	1	4
State Council of China	Regulations, Decisions, Opinions, Outlines, Reports, Plans, Rules, Notices	Medical reform; Population aging and pension service; Health development planning; Planning for national economic and social development; Health service; Food and nutrition; Nationwide fitness program; Patriotic health movement; Mental health; Medical and healthcare service.	29	1	6	22
Ministry of Health	Decree of Minister, Opinions, Guidelines, Standards, Regulations, Protocols, Rules, Outlines, Bulletins, Plans, Reports, Notices	Medical reform; Disease prevention (CVD, Cancers, Diabetes, Dental hygiene, Mental health, Osteoporosis, etc.); Health literacy; Health education; Tobacco control; Health talent team construction; New rural cooperative medical system; Medicines; Medical rescuing; Elderly health; Floating population health.	50	0	14	36
Other Ministries	Decree of Minister, Opinions, Notices, Standards, Outlines, Protocols, Rules, Regulations	Medical reform; Medical insurance; Medical rescuing; Aging pension; Student sports; Chinese medicine; Food safety; Tobacco control; Health of persons with disabilities; Community health; Nationwide fitness program, and others.				
Total			164	13	51	100

Source: Wu et al. (2017)

The "*Healthy China 2030*" strategy, issued in 2016, proposed a basic roadmap of "work together and share together." The plan involves efforts from the supply and demand sides and the involvement of societies, industries, and individuals, creating a powerful force to promote health. The plan will greatly improve multisectoral cooperation for NCD control in China. China has established a nearly perfect reporting system for infectious diseases, but not for NCDs. For example, the country's cancer registry system covers only about 300 cities or counties; surveillance of behavioral risk factors has been carried out every three years since 2009; and the CVD registry system was just recently initiated.

A comparative review of NCD control efforts in China and Japan concluded that, while the two countries share certain similarities, differences in their respective approaches are reflected in results (Wu et al. 2017). Relevant similarities between the two countries include legislative and policy approaches, standardized management of NCDs, and multisectoral cooperation. However, differences between the countries' health systems and NCD control priorities have resulted in large divergences in epidemiological status and disease burden. The authors suggest that China and Japan could benefit from increasing exchange of ideas, experiences, knowledge, and technologies.

Singapore. In Singapore, the Healthy Living Master Plan (HLMP) Taskforce was formed in September 2012 to facilitate integration of nationwide efforts to enable healthy living (Figure 16.8). One of the main aims of this Taskforce was to review the current health promotion and disease prevention landscape in Singapore, primarily in the context of the country's high rates of NCDs. The Taskforce sought to formulate a systematic plan that took into

consideration the inputs of various public agencies and community organizations, along with public consultation, and strengthened interagency collaboration by building on existing infrastructure and ideas. The HLMP Taskforce adopted an inclusive and integrative approach by involving the community in a co-creation process. All these elements led to a master plan that outlined strategies to ensure that all Singaporeans have access to a healthy lifestyle, so that healthy living becomes natural and effortless for everyone. The HLMP consolidated healthy living initiatives and ideas from public and private agencies and the community, including the Regional Health Systems (RHS), to build momentum in influencing behavior change for better health.

To achieve the vision of "healthy living every day," the strategy was to have seamless connections across Singapore, in terms of the physical environment, between people, and between the government and the citizens. This was to be carried out through three anchor strategies that influence the adoption of healthy behaviors, namely: (i) building a healthy workplace ecosystem through a worker-centric and sector-centric approach, facilitated by tripartite partnerships; (ii) integrating physical and social environments in the community setting, by working across government and with the community; and (iii) creating greater awareness for healthy living among the young.

FIGURE 16.8 Singapore's Healthy Living Master Plan



Source: Presentation on "Whole-of Government Strategies for NCDs" by Prof. Yik Ying Teo of the Saw Swee Hock School of Public Health, National University of Singapore at the Prince Mahidol Award Conference (PMAC) 2019.

While this study was unable to find any systematic evaluations of the HLMP, it has been suggested that Singapore's concept of chronic disease management and the plan's three-level theoretical framework are successful. The HLMP may provide useful lessons and serve as a positive example for the rest of the world (Su et al. 2019).

In addition to the HLMP, in the face of an impending diabetes epidemic, Singapore launched a new strategic campaign in 2016, announced by the then Minister of Health in a parliamentary speech, which was referred to as the "War on Diabetes" (Figure 16.9). This campaign highlights the important role played by "champions" (in this case the Minister of Health) towards a specific goal. It sought to rally the entire nation to rein in Singapore's diabetes and obesity epidemics. The government established a multi-ministry task force to conceptualize and implement a series of programs, focused mainly on encouraging Singaporeans to take individual responsibility for their health while adopting a whole-of-society approach to promote regular exercise, healthy dietary habits, early disease detection, and better disease treatment (Bee, Tai, and Wong 2022).

FIGURE 16.9 Singapore's "War on Diabetes"



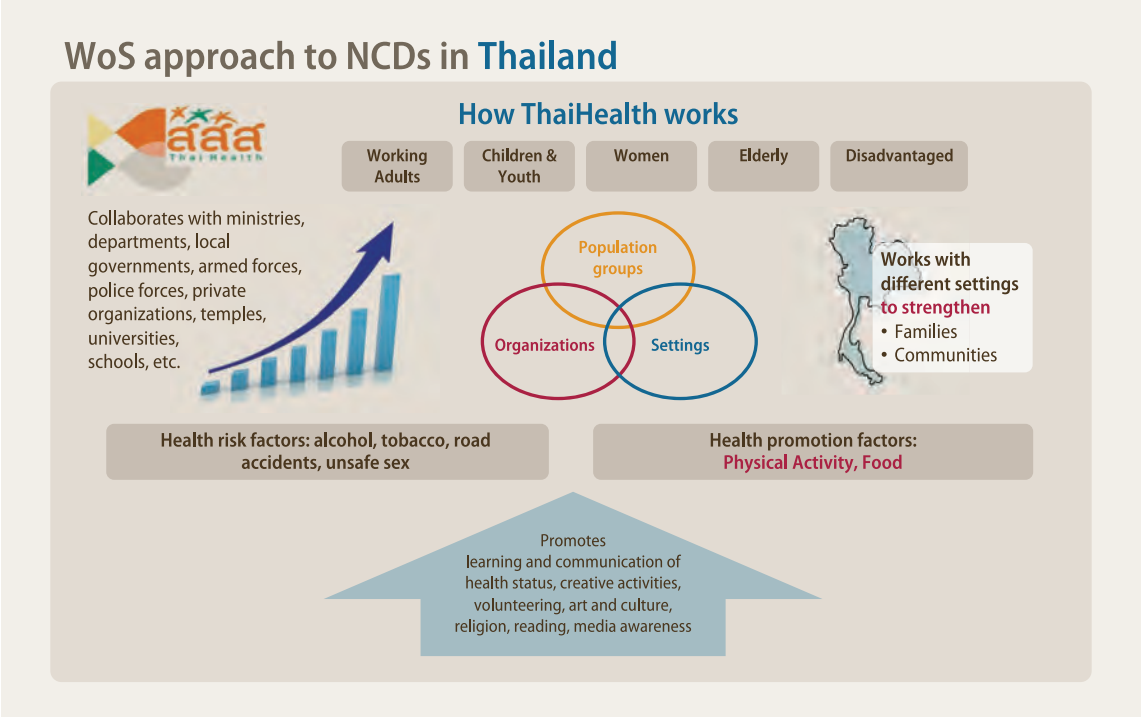
Source: Presentation on "Turning Discovery into Healthier Communities" by Prof. Yik Ying Teo of the Saw Swee Hock School of Public Health, National University of Singapore at the Prince Mahidol Award Conference (PMAC) 2019.

Singapore's five-year effort in its "War on Diabetes" has not yet impacted the prevalence of diabetes and obesity. However, overall, significant progress has been seen in many areas. The proportion of Singaporeans engaging in regular leisure-time exercise increased from 29·4 percent in 2017 to 33·4 percent in 2020. Consumers have also shifted to buying healthier versions of food products, pushing up the retail share of healthier food products by more than 1·5 times compared with five years ago. There have also been significant improvements in disease management, with the rate for major lower extremity amputations declining from 116 to 66·3 per 100,000 patients from 2015 to 2019. Going forward, Singapore's "War on Diabetes" will be moving into a new phase, with a stronger focus on preventive health. Through the *Healthier Singapore* strategy[3], the Singapore Government will support upstream efforts to keep individuals healthy and drive early intervention. For continuity of care, each resident will enroll with a family physician, who will support them throughout their life for different health care needs.

Thailand. Thailand established its *ThaiHealth* health promotion program in 2001, the first initiative of its kind in Asia. The effort followed the launch of similar organizations in some high-income countries, notably Australia, New Zealand, and Switzerland (Figure 16.10). Created under Thailand's Health Promotion Foundation Act 2001, and particularly relevant to the high NCD rates in the country, *ThaiHealth's* mission is to support and develop health promotion processes leading to good health for Thai people and society. It pursues this goal by supporting rather than replacing groups and organizations already working on public health issues. *ThaiHealth's* approach to health promotion is framed around a capacity building model in line with its enabling Act, which emphasizes building capacities in communities, government and non-governmental organizations, public interest organizations, state enterprises, and other agencies to plan, develop, and conduct their own health promotion programs (Caroll, Wood, and Tantivess 2007).

3 the Singapore MoH's strategy for championing the national shift towards a population health approach, the details of which were announced at the Committee of Supply 2022 by the Minister for Health, Mr. Ong Ye Kung.

FIGURE 16.10 Thailand's ThaiHealth Program



Source: Presentation by Pairoj Saonuam on "ThaiHealth" at Prince Mahidol Annual Conference (PMAC) 2019. Pairoj Saonuam is the Assistant Chief Executive Officer, Thai Health Promotion Foundation (ThaiHealth) and the acting Director of Promoting Healthy Lifestyle Section, Thai Health Promotion Foundation.

By all accounts, *ThaiHealth* has been able to play an active role in supporting and accelerating the commitment to health promotion espoused in the NHDP, Healthy Thailand, and the Joining Forces for Health Promotion Policy. An internal review noted that ThaiHealth is operating at a level commensurate with other such programs when they were five years old.[4] The initiative is particularly proactive and advanced in its workings with networks and partners, policy development, and engagement with community groups. In these areas, *ThaiHealth* could be seen as a role model for others. Conversely, the areas of evaluation and health inequalities have been less comprehensively addressed by ThaiHealth relative to its counterparts in other countries.

Overall, the internal review concluded that it is difficult to isolate and quantify the results directly attributable to ThaiHealth. The reviewers confirmed that there have been notable downward trends in a number of risk-related behaviors since the establishment of ThaiHealth, including the use of tobacco, and injuries and deaths associated with road accidents. An analysis of program activities in relation to the issues of tobacco, alcohol, road safety, physical activity, and other health risk factors revealed a significant level of activity being generated by ThaiHealth; strategies included research, awareness and education, social mobilization, capacity building, and policy development. But the review also noted a tendency for ThaiHealth to merely document success descriptively, without hard data, which made it difficult for the reviewers to gauge the actual impact of activities on health-related attitudes, knowledge, intentions, and behaviors. This issue was identified as an area warranting greater attention in the future.

Programs targeting NCD risk factors

Parry, West, and Laxminarayan (2009) present an analytical and simulation framework for assessing the optimal levels and welfare effects of alcohol taxes and drunk-driver penalties, accounting for both externalities and how policies interact with the broader fiscal system. Their main findings are that, across a wide range of plausible scenarios, the fiscal component of the optimal (revenue-neutral) alcohol tax is positive and quantitatively important. In many cases,

4 Presentation by Pairoj Saonuam at PMAC 2019.

it is larger than the externality-correcting component of the optimal tax, particularly if alcohol demand is fairly inelastic. Therefore, under most parameter scenarios, fiscal considerations significantly reinforce the case for raising alcohol taxes. The authors claim that even modest increases in alcohol taxes can produce substantial welfare gains; they reckon, for example, that doubling the current tax from 12 to 24 percent of producer prices generates estimated annual welfare gains of around US$3 to 10 billion or more.

A review on Colombia's experience with tobacco taxes found that tobacco tax hikes reduced the number of smokers (from 4.51 to 3.45 million smokers) and smoking intensity, resulting in a drop in the number of cigarettes smoked in Colombia (from 332.3 to 215.5 million 20-stick packs) – (Maldonado et al. 2022). Such reduction is expected to decrease premature mortality, health care costs, poverty, and people facing catastrophic expenditure on healthcare, to increase health, income, and gender equity, and to strengthen domestic resource mobilization even in the presence of illicit cigarettes.

In a systematic review of 86 studies and a meta-analysis of 62 studies, taxes on SSB were associated with higher prices of targeted beverages (tax pass-through of 82 percent) and 15 percent lower SSB sales, with a price elasticity of demand of −1.59 (Andreyeva et al. 2022a). No negative changes in employment were identified. The authors opine that these findings suggest that while, SSB taxes may work as intended in reducing demand for SSBs through higher prices, further research is needed to understand their associations with diet and health outcomes and heterogeneity of consumer responses. In another review of 54 studies and meta-analysis of 15 studies (Andreyeva et al. 2022b), subsidies for fruits and vegetables were associated with increased fruit and vegetable sales, with a price elasticity of −0.59, whereas changes in consumption were statistically insignificant. Evidence on other outcomes of food taxes and subsidies was limited, and the review suggested that additional research is needed to ascertain the implications of such policies for consumption, diet, and health outcomes.

For the past four years, South Africa's largest health insurer has operated an innovative program called *HealthyFood* for its members. Participants receive a 25 percent rebate on healthy foods (as defined by international dietary guidelines) in 800 supermarkets nationwide. More than 300,000 middle-income South Africans are participating. So far, the results are compelling—although the studies are often sponsored by industry and must be validated objectively. Lowering the costs of healthy foods in supermarkets not only increases the quantity of fruits, vegetables, and whole grains that people eat, but it also seems to reduce people's consumption of less nutritionally desirable foods. The South African program offers encouraging evidence that lowering the cost of healthier foods can motivate people to substantially improve their diets. Behavior changes also seem to be proportional to price changes (Strum and Yach 2013).

Barton and Grant (2013) review the progress of the European Healthy Cities program in a report entitled "Urban Planning for Healthy Cities" and emphasize the need for careful planning (Barton and Grant 2013). The study finds that the number of cities achieving a good level of understanding and activity in healthy urban planning has risen very substantially over the study period. In particular, those achieving effective strategic integration of health and planning have increased. The authors identify the development of planning frameworks which advance public health concerns in a spatial policy context driven often by market forces as a key challenge and posit that a health-in-all-policies approach could be valuable.

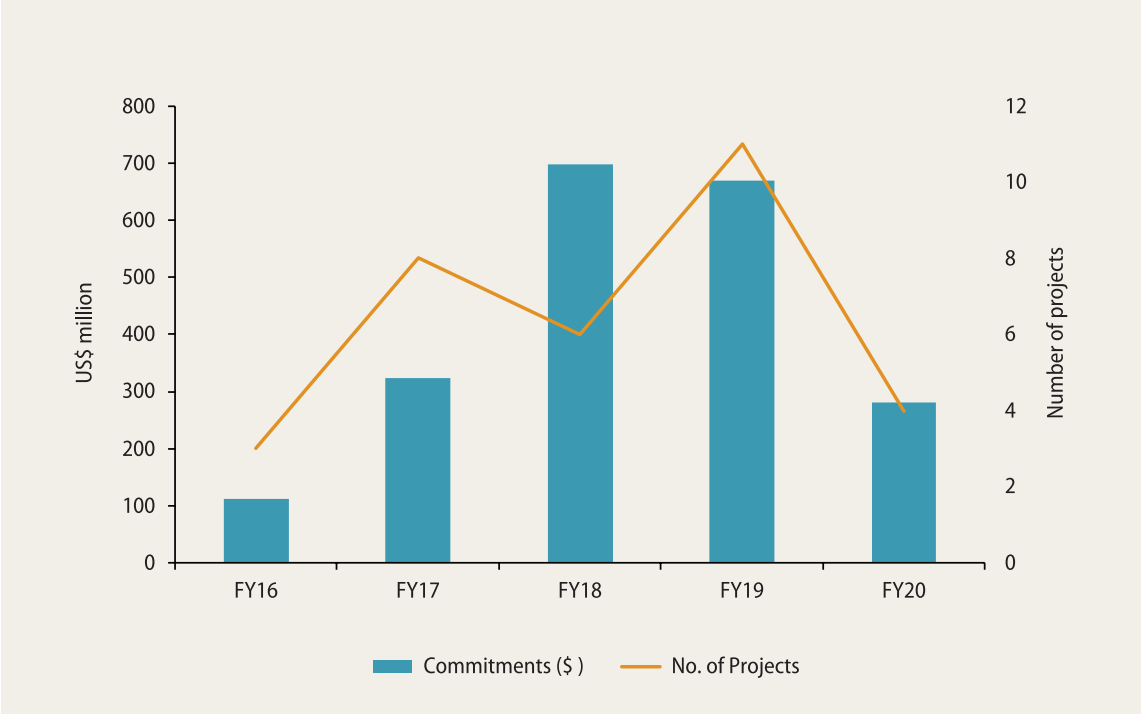
Lencucha, Drope, and Chavez (2015) reviewed whole-of-government approaches to NCDs, specifically with regard to tobacco control in the Philippines and found two salient challenges: (i) the inclusion of industry representation on Philippines' Inter-Agency Committee (tobacco) and (ii) the attempt to consolidate the responsibilities of different departments through a policy of "balance" between health and commercial interests. The authors conclude that whole-of-government approaches hold promise for policy coherence across sectors, but that not all such approaches best serve health objectives. They also emphasize the importance not only of structural features of whole-of-government approaches but also the institutional culture and entrenched political and economic interests. The authors strongly recommend that whole-of-government approaches should exclude representatives of tobacco, food, and alcohol industries in view of their conflicts of interest with the health objectives at hand; they point to the risk of co-option between the regulated and regulators to buttress their arguments. This clearly leads to a debate about specific aspects of NCD control where public-private partnerships would be helpful, and what kinds of design elements may need to be adopted in these cases.

World Bank Group (WBG)-financed operations

In this section we examine the World Bank Group's support to addressing NCDs through its investment projects and development policy lending. A review of World Bank Group investments by Merrick et al. (2012) showed that in the preceding 22-year period, the World Bank had approved 1,499 relevant projects, of which 947 (63 percent) were in the non-health sectors but supported health. It should be noted that at US$16.3 billion, financing for these non-health projects was equivalent to 36.5 percent of the US$44.6 billion that was channeled to advance health goals through more conventional health-sector projects during the period. The top five non-health sectors that received funding for health activities were: social protection, economic policy, transport, education, and the urban sector. The authors concluded that the Bank has both the instruments and the demand for tackling health problems through other sectors. However, accompanying the many successes that they observed, they also found missed opportunities. In particular, the authors concluded that the Bank's clients may not be fully served with the existing structure of sectoral oversight, budget incentives, or knowledge systems. They therefore recommended a shift from "accidental" or "opportunistic" multisectoral approaches to a more "strategic" approach.

The World Bank's investment lending. A review of the World Bank's investment lending for this study showed that, between FY16 to FY20, a total of 32 Bank-financed operations that focused on tackling NCDs were initiated, amounting to a total commitment of over US$2 billion. The investment volume and number of projects peaked in FY18 and FY19, respectively (Figure 16.11). Such investment included both '*hardware*' (e.g., infrastructure, equipment) and '*software*' (e.g., training and capacity development of health workforce). In such a macro analysis of these investments, it is difficult to break down the elements of investment, but it is important to stress that investments in the *hardware* would not be effective without concomitant strengthening of the *software* inputs, particularly human resources.

FIGURE 16.11 World Bank investment lending for NCDs between FY16 and FY20



Source: Original figure for this publication based on a review of the World Bank's portfolio of new IDA and IBRD commitments for FY16-FY20.

Investment Project Financing (IPF). Between FY16 and FY20, 10 IPF operations had a large – i.e., greater than 50 percent of lending – focus on NCDs (see Table 16.4). Twenty-four percent of the IPF projects contributing to NCD control were in the Eastern Europe and Central Asia Region, 8 percent in Africa, 7 percent each in Latin America and the Caribbean and the South Asia Regions, 5 percent in the Middle East and North Africa, and 4 percent in the East Asia and Pacific Region.

The projects focused on various activities including: (i) health systems strengthening, (ii) health service delivery, (iii) NCD risk reduction, and (iv) early detection and screening of NCDs. Health system strengthening and quality improvement in healthcare services and delivery have been the overarching themes among the WBG's NCD projects. There are also a handful of projects that explore links between NCDs and nutrition, early childhood development, and service delivery in fragile, conflict-affected, and violence (FCV) settings.

TABLE 16.4 WBG IPF Operations with a >50 percent focus on NCDs

Project ID	Project Name	Region	Country	Lead GP / Global Themes	Commitment (US$ Million)
P163721	Sri Lanka: Primary Health Care System Strengthening Project	South Asia	Sri Lanka	Health, Nutrition & Population	200.00
P164452	Integrated Public Provision of Health Care Services	Latin America & the Caribbean	Nicaragua	Health, Nutrition & Population	60.00
P163387	Jordan Emergency Health Project	Middle East and North Africa	Jordan	Health, Nutrition & Population	177.20
P163345	Supporting Effective Universal Health Coverage in Argentina	Latin America & the Caribbean	Argentina	Health, Nutrition & Population	300.00
P169677	Growing Up Healthy Together: Comprehensive Early Childhood Development In El Salvador	Latin America & the Caribbean	El Salvador	Health, Nutrition & Population	250.00
P167581	Andhra Pradesh Health Systems Strengthening Project	South Asia	India	Health, Nutrition & Population	328.00
P133193	Protecting Vulnerable People Against Noncommunicable Diseases Project	Latin America & the Caribbean	Argentina	Health, Nutrition & Population	303.82
P163476	Lebanon Health Resilience Project	Middle East and North Africa	Lebanon	Health, Nutrition & Population	95.80
P162069	Nigeria- Accelerating Nutrition Results	Africa	Nigeria	Health, Nutrition & Population	225.00
P166783	Saint Lucia Health System Strengthening Project	Latin America & the Caribbean	St. Lucia	Health, Nutrition & Population	20.00

Source: Based on a portfolio review of World Bank investment lending between FY16 and FY20.

Through these projects, the World Bank provided support to a broad range of activities and interventions extending beyond the health sector, including: (i) legislation for specific products, e.g., tobacco and alcohol; (ii) performance-based financing (PBF); (iii) cash transfers; (iv) community-based approaches; (v) aging and aged care; and (vi) taxation and excise duties. While the majority of projects were led by the Health, Nutrition, and Population (HNP) Global Practice, some NCD interventions were also included in projects led by the Education, Transport, Macroeconomics, Trade and Investment, and Finance, Competitiveness, and Innovation (FCI) Global Practices. Many of the non-health interventions have worked well, if only on a small scale. It should be noted, however, that although some of the World Bank operations involved more than one sector ministry, *few can be*

said to have adopted a deliberate WoS approach.

The following sub-sections summarize some salient aspects of the reviewed IPF operations focusing on NCDs, which may serve as useful case studies.

Health

i. Primary health service expansion:

- In **India,** the Andhra Pradesh Health Systems Project (P167581) drew in its design on the experience of tackling NCDs in low- and middle- income countries. The project considered global evidence suggesting that patients with NCDs that require care over a long period can only be managed equitably through health systems based on primary health care. The project adopted a total risk approach to screening for NCDs, enabling early detection that is administered to those visiting primary health clinics. Cost-effective methods of screening, such as visual inspection with acetic acid (for cervical cancers), are being adopted as the appropriate option (World Bank 2019b; Kak 2019).

- World Bank support in **Jordan** (P170529) and **Yemen** (P167195), is supporting the countries' governments to improve coverage and quality of primary health care, including early detection and preventive interventions that contribute to reducing the burden of disease of NCDs (World Bank 2019c, 2019d).

- In **Sri Lanka**, the Primary Health Care System Strengthening Project (P163721) aims to increase the utilization and quality of primary health care services, with an emphasis on detection and management of NCDs in high-risk populations. The Ministry of Health supports screening of women for cervical cancer, targeting women between ages 35 and 45 years. Two key lessons from the global experience with addressing NCDs through primary care that Sri Lanka brings to its program include: (i) after tobacco cessation (an agenda on which Sri Lanka has long been ahead of the curve), the outpatient management of cardiovascular risk factors such as hypertension and diabetes. This has been the single most effective intervention to reduce mortality due to NCDs in advanced health systems, accounting for up to 25 percent of longevity gains over several decades. In other words, hospital-based care has played a much smaller role in overall health improvement than is commonly thought; and (ii) significant progress in reducing cardiovascular risk factors and other cost-effective NCD control measures has been achieved in advanced health systems with widely varying institutional designs for primary care payment and organization. This points to the importance of providing the right clinical interventions in the right setting to achieve impact, rather than focusing exclusively on macro-level institutional reform initiatives (World Bank 2018c).

- In **St. Lucia**, the Health System Strengthening scheme (P166783) focuses on strengthening NCD management at the primary care level. It aims to strengthen the quality of care for diabetes and hypertension based on standard care protocols and provide financial rewards for health facilities according to the achievement of results (World Bank 2018d).

- In **Türkiye**, NCD prevention and treatment have been integrated into primary care services, which are delivered at Family Medicine Centers and community health centers with support from the Bank's Health Systems Strengthening and Support Project (P152799). While the system is set up to be proactive and plan for NCD management, challenges also lie ahead on the coverage of NCD prevention, screening, diagnosis, and curative services. There is also a need to better link NCD prevention with performance-based financing at the primary care level as well as to integrate standard clinical pathways to deal with NCDs in the e-health system (World Bank 2015).

ii. Community-based approaches:

- In **Tamil Nadu,** India's sixth most populous state, NCDs account for nearly 70 percent of deaths and 65 percent of DALYs lost. The World Bank has provided a US$287 million loan to strength management of NCDs, with a focus on population-based screenings of NCDs among the eligible population (P166373, World Bank 2019a).

- In **Anhui province, China**, a Bank-financed project (P154716) also put emphasis on community-based and home-based services and delivery and management of nursing care to ensure cost-efficiency, consumer satisfaction, and quality of care (World Bank 2018b).

iii. Performance-based financing:

- In **Nicaragua**, results-based financing would support the improvement of maternal and child health care services and promote the prevention of NCDs (P164452). Diabetes, hypertension, and cervical cancer are the main investment priorities, along with monitoring mechanisms to ensure that diagnosed beneficiaries receive the necessary care. Partners have found that performance agreements are a useful tool for establishing a results-oriented culture (World Bank 2018a).

- In **Tajikistan**, the World Bank is supporting the government's performance-based financing scheme (P170358) to improve the coverage and quality of basic primary health services in rural health facilities in 10 districts. On the supply side, the Ministry of Health contracts rural health centers to enhance both the quantity and quality of NCD services, providing coverage in about 450 health facilities to around 15 percent of the country's population (World Bank 2019f).

iv. Evidence-based approaches:

- In **Samoa**, the development of evidence based NCD management has paved the way to guide health workers through the clinical decision-making process. The Samoa Health Strengthening Program for Results (PforR) (P164382) discussed the mobile-app patient tracking system and eHealth framework with the Ministry of Health. Consequently, a health data aggregation and visualization tool was initiated in Samoa in 2020 and, despite delays due to the COVID-19 pandemic and changes in government, was made fully operational in mid-2021 (World Bank 2019e).

Economy and fiscal policy

i. Taxation:

- In **Samoa**, the Government has committed to increasing the excise tax on tobacco products. According to the latest (2017) WHO data, the total tax incidence of the most-sold cigarette brand in Samoa was 51.6 percent of the retail price, with the excise tax accounting for 38.5 percent of retail price. This is significantly below WHO's recommendation of at least 70 percent excise tax share in the final consumer price of a tobacco product. Concurrently, the World Bank has recommended that the Government of Samoa take nutritional content into account when designing excise taxes on food, particularly in the context of a new excise tax policy that was to be introduced in January 2021. While there have been hurdles to implementation, such as the COVID-19 pandemic, the Government of Samoa has taken several steps on tobacco taxation, such as the current Tobacco Policy and Action Plan (2014-2024), the Tobacco Excise Bill of 2018, as well as the more recent Excise Bill Amendment approved in July 2023 (Government of Samoa 2019, 2023; Sagapolutele 2018; Tong 2023).

Political economy

i. Government stewardship:

- In **El Salvador**, the Promoting Human Capital in Health project (P169677) supports the expansion of the line of care for selected NCDs to all of the country's health networks that tested in three networks under an earlier (and ongoing) NCD Project (P164356). A critical building block is strong political commitment at the highest level of government and within the Ministry of Health to enhance the efficiency of service delivery and improve the quality of health care (World Bank 2018e, 2020).

- In **China's Anhui Province**, the World Bank financed its first-ever project focusing exclusively on the development of an elderly care service system (P154716). Supporting development of government stewardship capacity is the first and foremost requirement to expand social service provision (World Bank 2018b).

ii. "Whole-of-government" mechanisms within the "whole-of-society" approach:

- We have already alluded above to the vital importance of fostering "whole-of-government" approaches separately from the broader rubric of "whole-of-society" approaches. This principle has become abundantly clear in the implementation of World Bank projects globally.

Development Policy Lending (DPL) operations. Among the approved DPLs from 2005 to FY20 Q3, there were four prior actions that directly addressed policy reform and intervention on NCDs, ranging from public health to budgetary and legal dimensions (Table 16.5). The specific prior actions identified include launching performance-based contracting at primary health care level, adjusting excise duty, and approving an Alcohol Control Bill to minimize the harmful effects of alcohol.

TABLE 16.5 DPL operations relevant to NCDs supported by the World Bank Group, 2009-2019

FY	Project ID	Region	Country	Type	Prior Action
2009	P106502	AFR	Cabo Verde	IDA	Approved the "Strategy for Combating NCDs" as evidenced in the letter issued by the Recipient's Minister of the Presidency and Council of Ministers, State Reform, and Defense.
2011	P116451	ECA	Armenia	IBRD/ IDA	The Borrower has issued a Government Protocol Decree #3 dated January 29, 2010, on NCDs and launched performance-based contracting at primary health care level, including defined NCD services.
2015	P149963	EAP	Tonga	IDA	The Recipient's Ministry of Finance and National Planning has, through its 2014/2015 Budget Statement, adjusted the excise duty regime in line with the NCD health policy.
2019	P165928	EAP	Samoa	IDA	The Recipient, through its Cabinet, has approved the Alcohol Control Bill, to minimize harmful effects from the consumption and abuse of alcohol.

Source: Based on a portfolio review of World Bank's Development Policy Lending between 2009 and 2019.

IFC's engagement with the private sector. The International Finance Corporation (IFC), the private sector arm of the World Bank Group, supports public-private partnership (PPP) activities relevant to NCD control and prevention. Examples include: (i) in **Mexico**, IFC brokered investment in *Clínicas Del Azúcar*, which manage diabetes and hypertension for mid- to lower-income populations through a growing network of clinics with digital overlay (Box 16.3); (ii) in **South Africa**, strong contacts have been developed with Discovery Health/Vitality, which is using data to track NCD risk for insured populations, implementing supportive care programs, and incentivizing the insured to live and eat healthily (this model could be replicated for social health insurance programs); (iii) in **Asia**, IFC has invested with MiCare, a third-party administrator working with social and private health insurers; the firm is using data to assess disease and population risks and help plan a range of care and support interventions; (iv) investment in one of the larger groups in **Georgia**, where 85 percent of all health services are provided by the private sector to the Government's National Health Insurance Fund (Box 16.4); and (v) in **Spain**, IFC has supported an innovative PPP model in which the private sector was contracted to provide comprehensive health services to a population, from primary care through to hospital services.

BOX 16.3 Clínicas del Azúcar: a retail approach to diabetes care

Bringing disruptive innovation to chronic disease management in Mexico

In Mexico, diabetes is an epidemic, and it is the leading cause of death. In the State of Nuevo Leon, where Guadalupe is from, complications from diabetes have led to a spike in suicides, in part because the cost of treatment is high and getting care is challenging.

Clínicas has pioneered an innovative concept for diabetes care in Mexico. Its one-stop-shop model incorporates a high-quality, multi-disciplinary health team under one roof. Coordinated care for diabetes and hypertension is provided by specialized doctors, nurses, nutritionists, and psychologists. Working together, they provide patients with a comprehensive diet and exercise strategy that helps to control blood sugar levels and prevent complications. The model has been successful, but to reach even more patients, Clínicas is integrating behavioral science, big data analytics, artificial intelligence technology, and a mobile app. This will help preserve its low-cost structure and reduce the financial burden for patients. The approach helps patients better manage complex conditions and results in fewer complications that require costly hospital treatment.

As of July 2019, Clínicas had established 15 locations in four states, making it the largest private provider of specialized diabetes and hypertension care in Mexico. With a staff of 220 health specialists, of which more than two-thirds are women, it had treated more than 103,000 patients and prevented about 20,000 complications. More than 63 percent of patients had met their goals for maintaining blood sugar levels and had their diabetes under control. This is well above the rate in Mexico's public sector and is comparable to international norms.

Source: Casanova 2019.

BOX 16.4 Georgia Healthcare Group: universal health care delivered through the private sector

Making modern health care affordable in a small country

For 70 years, the healthcare system in Georgia was funded and delivered through the state. But after the collapse of the Soviet Union in 1991, investment, along with quality of care, declined sharply. The Soviet model of care was hospital-centric, and there was an oversupply of hospitals, beds, and doctors, yet there was a dramatic shortage of nurses. The market was fragmented. Medical staff were not well trained, and there were significant problems with quality and even simple hygiene. As a result, Georgia struggled for decades with high mortality rates. While mortality has improved in recent years, there continues to be a high incidence of hepatitis C and tuberculosis. Meanwhile, cardiovascular disease, cancer, and diabetes cases are rising and adding to the burden on the health system.

Georgia Healthcare Group (GHG), a publicly traded company on the London Stock Exchange (LSE), was founded in 2015 as the holding company of the EVEX brand. The first EVEX hospital was opened in 2008. GHG has grown rapidly to become the largest health care provider in Georgia through its fully integrated network of hospitals, clinics, pharmacies, and health insurance. As of June 2018, GHG's ecosystem covered 75 percent of the geographic areas it served. It operated 37 referral and community hospitals with 3,320 beds, accounting for about one-third of the market. Beginning in 2015, it started to ramp up clinics to promote efficient provision of primary care. It currently has 12 clusters of 17 district polyclinics and 24 express outpatient clinics. In 2016, it entered the pharmacy space. Through acquisitions, it has become the largest pharmaceutical retailer and wholesaler in the country with nearly 260 pharmacies. Through its insurance company, Imedi-L, it provides health insurance to 157,000 people, making it the second-largest health insurer in the country.

In September 2016, IFC had an opportunity to play a catalytic role in GHG's growth. With US$25 million of debt funding, IFC supported renovation of two acquired hospitals in Tbilisi and other facilities, as well as the expansion of outpatient services (polyclinics) across the country. The funding also supported introduction of new specialized services, including diagnostics, pediatrics, cardiology, and oncology. These investments promoted access to specialized services, some of which did not previously exist in Georgia. In addition to overhauling facilities, GHG is improving its medical quality by standardizing processes and working on implementation of Joint Commission International (JCI) accreditation requirements to improve patient safety and quality. GHG is the largest employer in Georgia with about 15,500 full time employees, including 3,600 physicians and 3,300 nurses. It is training the next generation of doctors through 24 residency programs and is continually training its doctors, nurses, and other medical professionals. In 2017, GHG had GEL 747.8 million (US$298 million) in gross revenues. About 67 percent of gross revenues for the healthcare services segment were derived from universal health coverage (UHC).

Source: Casanova 2019.

OPPORTUNITIES AND CHALLENGES FOR A WOS APPROACH: WHAT HAVE WE LEARNED?

Opportunities

a. The COVID-19 pandemic has placed a spotlight on the health sector and its weaknesses, showing how under-funded the sector has been globally. There is a growing realization that the health sector needs to be strengthened and made more resilient if the world is to face future pandemics—and more broadly acute or chronic health emergencies from any cause—in a more effective manner. This might well be an opportune moment, if used strategically and efficiently, for the health sector to demand and obtain more resources to avoid the serious systemic failures faced by almost every country during the pandemic.

b. Another stark fact that emerged from the pandemic is the need to tackle NCDs better, as almost all the comorbidities that led to hospitalizations and deaths were NCDs. This is also an opportunity to emphasize the inadequate investments that have gone into preventing, controlling, and managing NCDs, for which—over the medium to long term—health systems around the world will pay a price; and

c. Although WoS approaches are far from easy to implement, it is evident that, when a problem affects the whole country/economy, and

when the causes are multifaceted, there is no alternative but for the society to stand up to fight them concertedly. Experiences from HIV/AIDS, nutrition, climate change, and most recently COVID-19 could provide appropriate platforms for NCD efforts to build on.

Challenges

Experience shows that three factors usually impede inter-ministerial cooperation, which is critical for governments to provide leadership to WoS approaches:

a. financial rules, which make it difficult for one ministry to share resources with another;

b. turf battles regarding who is responsible for the domain in question, who gets the credit and resources for it, and who takes the lead. For instance, it is often observed that nutrition is "everybody's responsibility but nobody's business." NCDs are not quite in the same category, as they are clearly under the purview of ministries of health; however, effective NCD action requires coordinated efforts across various ministries; and

c. the lack of domain knowledge in relevant ministries. Ministries of health typically have the technical knowledge on how to control NCDs, but the other relevant ministries usually don't have experts in that field, rendering efforts on their part suboptimal.

Lessons Learnt

The adage "think globally, act locally" can be aptly modified for this context as: "think inter-sectorally, act sectorally." This is, however, easier said than done. Though examples of multisector actions and intersectoral coordination towards the goal of controlling NCDs are few and far between, valuable lessons do emerge from experience with such approaches toward other health problems, such as HIV/AIDS, malnutrition, early childhood development, and disability management projects and programs. These health issues have long been recognized—more so than other health problems—to be multidimensional in causation and impact. As a result, several countries have experimented with ways of achieving such coordinated action. MAPs were quite widely adopted, especially in African countries in the late 1990s to early 2000s, strongly supported by the World Bank. Multi-sector Nutrition Action Plans have also been put in place by several countries around the world. Notwithstanding such efforts, getting different sectors to work together towards a common goal has been extremely challenging, and achieving effective coordination among the sectors involved even more so.

The authors' experience and involvement in some of these initiatives have yielded the following important lessons:

a. It is important to ensure genuine involvement and active participation of relevant sectors right from the beginning of the process, rather than a cursory attempt to involve the sectors at a late stage; multisector involvement should be ensured in planning, implementation, and monitoring. Having a well-known and/or highly respected champion(s) considerably enhances the likelihood of success in the WoS approach;

b. Identifying and leveraging a mutuality of interest among societal actors can go a long way in fostering cooperation and collaboration, particularly since there is no overriding authority that can mandate or enforce coordination. The rapidity with which a COVID-19 vaccine was brought to the market is a striking example of how mutuality of interest might/should be leveraged;

c. Identifying clear roles and responsibilities for every sector, including the selection of a specific sector as the lead sector, is critical to the success of the program, to avoid the situation of "everybody's business but nobody's responsibility"; and

d. An appropriate institutional home for coordination—physically as well as organizationally—is a key pre-requisite. Such an institutional home may or may not be in the health sector.

The lead agency or ministry. In most government bureaucracies, there would be no difficulty in accepting the health ministry as the lead ministry for programs with a health objective. However, for WoS interventions, the requisite coordination authority is usually not vested with the health ministry, because generally no single line ministry

would have the authority to convene and coordinate other line ministries. Similarly, funding flows from one line ministry to another line ministry would be next-to-impossible in most bureaucracies. Therefore, a ministry or body above the line ministries—e.g., Planning and Finance, the Prime Minister's Office, or the President's Office—might often be chosen to house the coordination function. Such an approach, however, is double-edged. While vesting the coordination function in a higher-level entity addresses the issue of convening power, coordination committees chaired by the Head of State or Head of Government may well be too high-ranking and may not meet frequently enough due to competing demands on their time. Therefore, unless the problem is seen as a national one—as HIV/AIDS was in several African countries in the 1990s and as COVID-19 is today—and the Head of State/Head of Government personally champions the cause of addressing it, coordinated action may remain more on paper than in practice.

Coordination costs resources. Usually, a committee is set up for coordination, but unless sufficient resources – human and financial – are provided, e.g., in the form of an adequately staffed secretariat, these committees cannot function effectively. There is a difference between committees and units/departments to fulfill the coordination/oversight function. Committees are generally staffed by persons who have other full-time jobs, and therefore can give only partial attention to the task of the committee. Usually, therefore, it is better to establish a unit or department, rather than ad-hoc committees, to oversee the program. For instance, Nepal set up an autonomous multisectoral entity expressly for the coordination of its HIV/AIDS response, which included the active participation of civil society and affected population groups.

Engaging non-state actors. A special effort is needed to include non-state actors (i.e., the for-profit private sector, non-profit organizations, civil society, and community-based groups). In addition to turf battles between government ministries, often the relationship between government ministries and non-state entities is a contentious one, as highlighted above. Many governments look at the private sector and civil society with suspicion, and vice versa. Although there are several examples of public-private partnerships and government-NGO partnerships in the health, nutrition, and population sector globally, many of these efforts have faced serious challenges. Some have managed them successfully, with others less so.

In summary, the following challenges to WoS approaches for NCDs are worth noting:

- Limited data/knowledge on NCDs/risk factors/WoS approaches, hampering decision-making;
- Absence of political will and national/regional platforms for WoS approaches to NCD mitigation in many countries;
- Limited budgetary allocations and competition for resources limiting cooperation/collaboration;
- Inadequate awareness among relevant sectors on roles and responsibilities;
- Limited MoH ability to coordinate both policy design and policy implementation;
- Inadequate inclusion of, and interaction between, all three branches of government, as typically even efforts to involve the "whole government" tend not to include the legislative and judicial branches;
- Weak health systems, which constrain prevention/management of NCDs;
- Limited social inclusion, with widespread geographical, social, gender-based, and financial inequities in the accessibility, availability, and affordability of NCD services; and
- Differing motivations and interests among public and private sectors and difficulties in "balancing" health and commercial interests.

THE WAY FORWARD

WoS approaches need to be tailored to the context, because what works in one country or region may not be effective in another. Wide variations in context and scope/scale globally render any generic prescription impossible. A critical first step would be to recognize the importance of the economic burden of NCDs, as well as the bidirectional relationships between NCDs and all parts of any society and dealing with NCDs effectively as a global public health threat. Assuming such recognition exists, one can outline general principles and provide broad recommendations on the way forward. We formulate a set of high-level recommendations below.

The way forward on how to adopt a WoS approach to NCD prevention and control could be presented as the following ten I's:

i. ***Involvement of key stakeholders from the outset, leveraging any congruence of interests, to build an effective alliance for change:*** Comprehensive WoS national action plans or strategies need to be developed at the country level to combat NCDs. Key sectors and actors should be part of planning, implementation, and monitoring of WoS action plans, to ensure broad-based ownership of the approach while efficiently advancing shared objectives. Dissenting groups must be consulted and their concerns acknowledged, but some selectivity in early participation may be important for success. The presence of one or more champions or stewards can provide a significant impetus to WoS efforts.

ii. ***Inclusion of non-state actors:*** NCD programs require sustained efforts to include non-state actors (for-profits, non-profits, civil society, community-based groups) within a mutually agreeable policy, operational, and regulatory framework.

iii. ***Identification of clear roles and responsibilities on NCDs for every sector and actor:*** A sector must be designated as the lead, to avoid NCD action's becoming "everybody's business but nobody's responsibility."

iv. ***Institutionalization of mechanisms for coordination and cooperation:*** Effective coordination requires an institutional home–physically and organizationally. Without strong institutional arrangements, WoS approaches would remain rhetorical.

v. ***Investment in coordinated and concerted WoS actions:*** Resources – human and financial – are key for effective functioning of coordination platforms. To ensure that sufficient resources are available to actualize WoS strategies and plans, strong mobilization efforts will be required from both public and private sectors. A definitive way to ensure commitment of every sector to the WoS approach could be to earmark a part of their annual budget towards a common pool dedicated to the prevention and control of NCDs.

vi. ***Innovation:*** Constant innovation will be necessary to ensure the successful and sustained implementation of a WoS approach to NCDs, overcoming the challenges outlined in earlier sections of this paper. In this regard, different innovations have been described in the literature.[5]

vii. ***Information sharing:*** This may proceed by establishing or leveraging institutionalized knowledge-exchange platforms — such as North-South and South-South cooperation, twinning arrangements, and regional/global clearing houses — to exchange experiences, transfer technologies and skillsets, and mount/sustain a concerted response against NCDs.

viii. ***Incorporation of lessons learned from global experiences,*** so as not to "reinvent the wheel," to adopt best practices, and to avoid repeating mistakes made by early adopters.

ix. ***Interventions to be prioritized:*** Prioritized implementation of interventions to address NCDs and risk factors—as part of an essential benefits package of health services—should be based on a systematic burden of disease assessment, the cost-effectiveness of the relevant interventions, and societal value choices to keep the effort tractable.

5 See for example: https://innoverce365.com/types-of-innovation-strategies/

x. ***Indicators of success and failure need to be monitored continuously:*** Any WoS effort is likely to involve a process of "learning by doing"; this necessitates a strong emphasis on data and measurement for effective decision-making, with course corrections as necessary. Operational research for periodic assessments of programmatic interventions needs to be institutionalized, with a view to recognizing and resolving implementation issues. In addition, impact evaluations need to be built into program design to make sure that lessons are learned, documented, and considered on a continuing basis.

REFERENCES

1. Alleyne, George, and Sania Nishtar. 2013. "Sectoral cooperation for the prevention and control of NCDs." In *Noncommunicable Diseases in the Developing World: Addressing Gaps in Global Policy and Research*. Edited by Galambos, Louis, Jeffrey L. Sturchio, and Rachel Whitehead. Baltimore: Johns Hopkins University Press.
2. The Lancet. 2020. "COVID-19: A New Lens for Non-Communicable Diseases." Editorial. *The Lancet* 396 (10252): 649. https://doi.org/10.1016/s0140-6736(20)31856-0.
3. Agrawal, Utkarsh, Amaya Azcoaga-Lorenzo, Adeniyi Francis Fagbamigbe, Eleftheria Vasileiou, Paul Henery, Colin R Simpson, Sarah J Stock, et al. 2021. "Association between Multimorbidity and Mortality in a Cohort of Patients Admitted to Hospital with COVID-19 in Scotland." *Journal of the Royal Society of Medicine* 115 (1): 22–30. https://doi.org/10.1177/01410768211051715.
4. Alexander, Eleanore, Derek Yach, and George A Mensah. 2011. "Major Multinational Food and Beverage Companies and Informal Sector Contributions to Global Food Consumption: Implications for Nutrition Policy." *Globalization and Health* 7 (1): 26. https://doi.org/10.1186/1744-8603-7-26.
5. Allen, Luke N, Brian D Nicholson, Beatrice Y T Yeung, and Francisco Goiana-da-Silva. 2020. "Implementation of Non-Communicable Disease Policies: A Geopolitical Analysis of 151 Countries." *The Lancet Global Health* 8 (1): e50–58. https://doi.org/10.1016/s2214-109x(19)30446-2.
6. Allen, Luke, and Ashley Bloomfield. 2016. "Engaging the Private Sector to Strengthen NCD Prevention and Control." *The Lancet Global Health* 4 (12): e897–98. https://doi.org/10.1016/s2214-109x(16)30216-9.
7. Anderson, Gerard F. 1992. "The Courts and Health Policy: Strengths and Limitations." *Health Affairs* 11 (4): 95–110. https://doi.org/10.1377/hlthaff.11.4.95.
8. Andreyeva, Tatiana, Keith Marple, Samantha Marinello, Timothy E. Moore, and Lisa M. Powell. 2022. "Outcomes Following Taxation of Sugar-Sweetened Beverages." *JAMA Network Open* 5 (6): e2215276. https://doi.org/10.1001/jamanetworkopen.2022.15276.
9. Andreyeva, Tatiana, Keith Marple, Timothy E. Moore, and Lisa M. Powell. 2022. "Evaluation of Economic and Health Outcomes Associated with Food Taxes and Subsidies." *JAMA Network Open* 5 (6): e2214371. https://doi.org/10.1001/jamanetworkopen.2022.14371.
10. Barton, Hugh, and Marcus Grant. 2012. "Urban Planning for Healthy Cities." *Journal of Urban Health* 90 (S1): 129–41. https://doi.org/10.1007/s11524-011-9649-3.
11. Bee, Yong Mong, E. Shyong Tai, and Tien Y. Wong. 2022. "Singapore's 'War on Diabetes.'" *The Lancet Diabetes & Endocrinology* 10 (6): 391–92. https://doi.org/10.1016/S2213-8587(22)00133-4.
12. Bloom, David E., E.T. Cafiero, E. Jané-Llopis, S. Abrahams-Gessel, L.R., Bloom, S. Fathima, A.B. Feigl, et al. 2011. "The Global Economic Burden of Non-Communicable Diseases." Geneva, Switzerland: World Economic Forum. https://world-heart-federation.org/wp-content/uploads/2017/05/WEF_Harvard_HE_GlobalEconomicBurdenNonCommunicableDiseases_2011.pdf.
13. Bulc, Barbara, and Rohit Ramchandani. 2021. "Accelerating Global Health R&D: The Role of Product Development Partnerships." Geneva: Switzerland: Global Development/Waterloo, Canada: Antara Global Health Advisors. https://www.mmv.org/sites/default/files/uploads/docs/publications/Accelerating-global-health-RD_The-role-of-product-development-partnerships_BBulc_RRamchandani_March2021.pdf.
14. Carroll, Addy, Lisa Wood, and Sripen Tantivess. 2007. "Many Things to Many People: A Review of ThaiHealth." Bangkok, Thailand: Thai Health Promotion Foundation.
15. Casanova, Ann M. 2019. "Case Study: Clinicas Del Azucar: Bringing Disruptive Innovation to Chronic Disease Management in Mexico a Retail Approach to Diabetes Care." Washington, D.C.: International Finance Corporation. https://www.ifc.org/content/dam/ifc/doc/mgrt/201906-a-retail-approach-to-diabetes-care.pdf.
16. Chan, Juliana C. N., Lee-Ling Lim, Nicholas J. Wareham, Jonathan E. Shaw, Trevor J. Orchard, Ping Zhang, Eric S. H. Lau, et al. 2020. "The Lancet Commission on Diabetes: Using Data to Transform Diabetes Care and Patient Lives." *The Lancet* 396 (10267): 2019–82. https://doi.org/10.1016/S0140-6736(20)32374-6.
17. Chen, Simiao, Michael Kuhn, Klaus Prettner, and David E. Bloom. 2018. "The Macroeconomic Burden of Noncommunicable Diseases in the United States: Estimates and Projections." Edited by Muhammad Jami Husain. *PLOS ONE* 13 (11): e0206702. https://doi.org/10.1371/journal.pone.0206702.
18. Collins, Téa, Bente Mikkelsen, and Svetlana Axelrod. 2019. "Interact, Engage or Partner? Working with the Private Sector for the Prevention and Control of Noncommunicable Diseases." *Cardiovascular Diagnosis and Therapy* 9 (2): 158–64. https://doi.org/10.21037/cdt.2018.08.04.
19. Cox, Archibald. 1976. "The Role of the Supreme Court in American Government." *Harvard Law Review* 103: 100–141.
20. Cuadrado, Cristóbal, Alain Palacios, Tim Miller, and Branka Legetic. 2015. "Indicators for Monitoring the Socio-Economic Dimension of NCDs: A Pilot Study in Chile." *Working Paper*. Santiago: Ministry of Health, Chile, Pan-American Health Organization, and the Economic Commission for Latin America and the Caribbean . https://www.dcp-3.org/sites/default/files/resources/Indicators%20for%20Monitoring.pdf.
21. Dain, Katie. 2019. "A 'Whole of Society' Approach to Non-Com-

municable Diseases Must Include Civil Society Organisations." *The BMJ Opinion* (blog). December 6, 2019. https://blogs.bmj.com/bmj/2019/12/06/a-whole-of-society-approach-to-non-communicable-diseases-must-include-civil-society-organisations/.

22. DeVon, Holli A., Catherine J. Ryan, Amy L. Ochs, and Moshe Shapiro. 2008. "Symptoms across the Continuum of Acute Coronary Syndromes: Differences between Women and Men." *American Journal of Critical Care: An Official Publication, American Association of Critical-Care Nurses* 17 (1): 14–24; quiz 25. https://pubmed.ncbi.nlm.nih.gov/18158385/.
23. Ettman, Catherine K., Gregory H. Cohen, Salma M. Abdalla, Laura Sampson, Ludovic Trinquart, Brian C. Castrucci, Rachel H. Bork, et al. 2021. "Persistent Depressive Symptoms during COVID-19: A National, Population-Representative, Longitudinal Study of U.S. Adults." *The Lancet Regional Health - Americas* 5 (100091): 100091. https://doi.org/10.1016/j.lana.2021.100091.
24. Galambos, Louis, Jeffrey L. Sturchio, and Rachel C. Whitehead, eds. 2013. *Noncommunicable Diseases in the Developing World: Addressing Gaps in Global Policy and Research*. *Www.press.jhu.edu*. Baltimore: Johns Hopkins University Press. https://www.press.jhu.edu/books/title/11061/noncommunicable-diseases-developing-world.
25. Government of Samoa. 2019. "Samoa National Tobacco Control Policy and Plan of Action July 2019-June 2024." Ministry of Health, Government of Samoa. https://www.health.gov.ws/wp-content/uploads/2023/01/Samoa-National-Tobacco-Control-Policy-and-Plan-of-Action-Revised-11.11.2019.pdf.
26. ———. 2023. *Excise Tax Rate Amendment Act 2023, No. 5*. https://www.palemene.ws/PDFfiles/Excise%20Tax%20Rate%20Amendment%20Act%202023%20-%20Eng_English.pdf.
27. Hancock, Christine, Lise Kingo, and Olivier Raynaud. 2011. "The Private Sector, International Development and NCDs." *Globalization and Health* 7 (1): 23. https://doi.org/10.1186/1744-8603-7-23.
28. Institute of Health Metrics and Evaluation (IHME). 2019. Global Burden of Disease 2019. *Database*. https://vizhub.healthdata.org/gbd-results/
29. ———. 2020. "Disease Burden from Non-Communicable Diseases by Age." *Global Burden of Disease 2019*. Our World in Data. https://ourworldindata.org/grapher/disease-burden-from-ncds-by-age?time=earliest..2019&facet=none.
30. International Alliance for Responsible Drinking (IARD). 2019. "Focus on Public–Private Partnerships: Case Studies." https://www.iard.org/science-resources/detail/Focus-on-Public%E2%80%93Private-Partnerships-five-case-stu.
31. Juma, Pamela A., Clarisse Mapa-tassou, Shukri F. Mohamed, Beatrice L. Matanje Mwagomba, Catherine Ndinda, Mojisola Oluwasanu, Jean-Claude Mbanya, Misheck J. Nkhata, Gershim Asiki, and Catherine Kyobutungi. 2018. "Multi-Sectoral Action in Non-Communicable Disease Prevention Policy Development in Five African Countries." *BMC Public Health* 18 (S1). https://doi.org/10.1186/s12889-018-5826-6.
32. Kabayama, Mai , Kei Kamide, Kazue Sakakibara, and Kazuo Hayakawa. 2014. "The Role of Public Health Nurses in Japanese Long-Term Care Prevention Projects in the Community." *Journal of Nursing & Care* 03 (03). https://doi.org/10.4172/2167-1168.1000166.
33. Kagan, Robert A. 1991. "Adversarial Legalism and American Government." *Journal of Policy Analysis and Management* 10 (3): 369–406.
34. Kak, Mohini. 2019. *Disclosable Version of the ISR - Andhra Pradesh Health Systems Strengthening Project - P167581 - Sequence No : 02 (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/754591576131288997/Disclosable-Version-of-the-ISR-Andhra-Pradesh-Health-Systems-Strengthening-Project-P167581-Sequence-No-02
35. Kankeu, Hyacinthe Tchewonpi, Priyanka Saksena, Ke Xu, and David B Evans. 2013. "The Financial Burden from Non-Communicable Diseases in Low- and Middle-Income Countries: A Literature Review." *Health Research Policy and Systems* 11 (1). https://doi.org/10.1186/1478-4505-11-31.
36. Kassa, Melkamu Dugassa, and Jeanne Martin Grace. 2022. "Noncommunicable Diseases Prevention Policies and Their Implementation in Africa: A Systematic Review." *Public Health Reviews* 42 (February). https://doi.org/10.3389/phrs.2021.1604310.
37. Kerr, John, Costas Panagopoulos, and Sander van der Linden. 2021. "Political Polarization on COVID-19 Pandemic Response in the United States." *Personality and Individual Differences* 179 (179): 110892. https://doi.org/10.1016/j.paid.2021.110892.
38. Kwon, Sung Hee, Jun-Pyo Myong, Hyoung-Ah Kim, and Kyeong Yeon Kim. 2020. "Association between Morbidity of Non-Communicable Disease and Employment Status: A Comparison between Korea and the United States." *BMC Public Health* 20 (1). https://doi.org/10.1186/s12889-020-08883-3.
39. Laryea, Dennis O., and Thomas B. Cueni. 2019. "Including the Private Sector in Partnerships to Tackle Non-Communicable Diseases." *The BMJ Opinion* (blog). December 6, 2019. https://blogs.bmj.com/bmj/2019/12/06/including-the-private-sector-in-partnerships-to-tackle-non-communicable-diseases/.
40. Lencucha, Raphael, Jeffrey Drope, and Jenina Joy Chavez. 2014. "Whole-of-Government Approaches to NCDs: The Case of the Philippines Interagency Committee—Tobacco: Table 1." *Health Policy and Planning* 30 (7): 844–52. https://doi.org/10.1093/heapol/czu085.
41. Leppo, Kimmo, Eeva Ollila, Sebastián Peña, Matthias Wismar, and Sarah Cook. 2013. "Health in All Policies: Seizing Opportunities, Implementing Policies." Ministry of Social Affairs and Health, Finland. https://www.uab.edu/medicine/obesity/images/Health-in-All-Policies-final.pdf.
42. Mahat, Kishori, and Badri Thapa. 2019. "Multi-Sectoral Approach to Non-Communicable Diseases Control: Easier Said than Done." *Journal of Nepal Medical Association* 57 (220). https://doi.org/10.31729/jnma.4729.
43. Maldonado, Norman, Blanca Llorente, Luz Myriam Reynales-Shigematsu, Belen Saenz-de-Miera, Prabhat Jha, and Geordan Shannon. 2022. "Tobacco Taxes as the Unsung Hero: Impact of a Tax Increase on Advancing Sustainable Development in Colombia." *International Journal of Public Health* 67 (March). https://doi.org/10.3389/ijph.2022.1604353.
44. Merrick, Tom and colleagues. 2012. "What Can We Learn from 22 years and US$ 16 Billion of Lending for Health Through Non-Health Projects and Can We Do Better?" Presentation. Unpublished. World Bank.
45. Michael, Marmot, Jessica Allen, Peter Goldblatt, Eleanor Herd, and Joana Morrison. 2021. "Build Back Fairer: The COVID-19 Marmot Review. The Pandemic, Socioeconomic and Health Inequalities in England." Institute of Health Equity: London. https://www.instituteofhealthequity.org/resources-reports/build-back-fairer-the-covid-19-marmot-review.
46. Murray, Christopher J L, Aleksandr Y Aravkin, Peng Zheng, Cristiana Abbafati, Kaja M Abbas, Mohsen Abbasi-Kangevari, Foad Abd-Allah, et al. 2020. "Global Burden of 87 Risk Factors in 204 Countries and Territories, 1990–2019: A Systematic

Analysis for the Global Burden of Disease Study 2019." *The Lancet* 396 (10258): 1223–49. https://doi.org/10.1016/s0140-6736(20)30752-2.
47. NCD Alliance. 2020a. "Bridging the Gap on NCDs: From Global Promises to Local Progress." Geneva: Switzerland: NCD Alliance. https://ncdalliance.org/resources/bridging-the-gap-on-ncds-from-global-promises-to-local-progress-policy-brief.
48. ———. 2020b. "New NCD Countdown 2030 Report Shows Slow Progress towards UN SDG Target 3.4." *NCD Alliance* (blog). September 4, 2020. https://ncdalliance.org/news-events/news/new-ncd-countdown-2030-report-shows-slow-progress-towards-un-sdg-target-34.
49. Office of National Statistics (ONS). 2020. "Coronavirus (COVID-19) Related Deaths by Disability Status, England, and Wales, 2020." Government of the United Kingdom. www.ons.gov.uk.
50. Pan-American Health Organization (PAHO). 2011. "Non-Communicable Diseases and Gender." *Fact Sheet*. Washington, D.C.: Pan-American Health Organization/International Diabetes Foundation. https://www3.paho.org/hq/dmdocuments/2011/gdr-ncd-gender-factsheet-final.pdf.
51. Parry, Ian W. H., Sarah E West, and Ramanan Laxminarayan. 2009. "Fiscal and Externality Rationales for Alcohol Policies." *The B.E. Journal of Economic Analysis & Policy* 9 (1). https://doi.org/10.2202/1935-1682.2133.
52. Puska, Pekka, and Paresh Jaini. 2020. "The North Karelia Project: Prevention of Cardiovascular Disease in Finland through Population-Based Lifestyle Interventions." *American Journal of Lifestyle Medicine* 14 (5): 155982762091098. https://doi.org/10.1177/1559827620910981.
53. Sagapolutele, Fili. 2018. "Lolo Signs Three Admin Bills into Law — Cigarette Tax, Elderly/ Disabled Abuse Act, and Consumer Protection." *Samoa News*, October 24, 2018. https://www.samoanews.com/local-news/lolo-signs-three-admin-bills-law-cigarette-tax-elderly-disabled-abuse-act-and-consumer.
54. Shibuya, Kenji, Hideki Hashimoto, Naoki Ikegami, Akihiro Nishi, Tetsuya Tanimoto, Hiroaki Miyata, Keizo Takemi, and Michael R Reich. 2011. "Future of Japan's System of Good Health at Low Cost with Equity: Beyond Universal Coverage." *The Lancet* 378 (9798): 1265–73. https://doi.org/10.1016/s0140-6736(11)61098-2.
55. Steenkamp, Lizelle, Robin Terence Saggers, Rossella Bandini, Saverio Stranges, Yun-Hee Choi, Jane S. Thornton, Simon Hendrie, Deepak Patel, Shannon Rabinowitz, and Jon Patricios. 2022. "Small Steps, Strong Shield: Directly Measured, Moderate Physical Activity in 65 361 Adults Is Associated with Significant Protective Effects from Severe COVID-19 Outcomes." *British Journal of Sports Medicine* 56 (10): 568–76. https://doi.org/10.1136/bjsports-2021-105159.
56. Sturchio, Jeffrey L., and Akash Goel. 2012. "The Private-Sector Role in Public Health." Washington, D.C.: Center for Strategic and International Studies. https://www.csis.org/analysis/private-sector-role-public-health.
57. Sturchio, Jeffrey L., Ilona Kickbusch, and Louis Galambos, eds. 2019. *The Road to Universal Health Coverage*. Baltimore: Johns Hopkins University Press. https://www.press.jhu.edu/books/title/12246/road-universal-health-coverage.
58. Sturm, Roland, and Derek Yach. 2013. "Eating Better for Less. To Treat the Obesity Epidemic, Why Not Lower Prices on Healthier Food." *Modern Healthcare* 43 (21): 27. https://pubmed.ncbi.nlm.nih.gov/23947103/.
59. Su, X. Y., M. Y. Si, Z. K. Zhu, Y. Jiang, and Y. L. Liu. 2019. "[the Healthy Living Master Plan (HLMP): Singapore's Experience and Enlightenment]." *Zhonghua Yu Fang Yi Xue Za Zhi [Chinese Journal of Preventive Medicine]* 53 (12): 1198–1202. https://doi.org/10.3760/cma.j.issn.0253-9624.2019.12.002.
60. Thakur, Jarnail Singh, Ria Nangia, and Sukriti Singh. 2021. "Progress and Challenges in Achieving Noncommunicable Diseases Targets for the Sustainable Development Goals." *FASEB BioAdvances* 3 (8). https://doi.org/10.1096/fba.2020-00117.
61. The Lancet. 2020. "Non-Communicable Diseases—Level 1 Cause. Global Health Metrics. *The Lancet* 396 (10258): S42–43.
62. The National Academies of Medicine. 2022. *Global Roadmap for Healthy Longevity*. Washington, D.C.: The National Academies Press. https://doi.org/10.17226/26144.
63. Tong, Matai'a Lanuola Tusani T - Ah . 2023. "Bill on Tobacco Excise Scrutinised in House." *Samoa Observer*, July 4, 2023. https://www.samoaobserver.ws/category/samoa/104404.
64. Unwin, Nigel, T. Alafia Samuels, Trevor Hassell, Ross C. Brownson, and Cornelia Guell. 2016. "The Development of Public Policies to Address Non-Communicable Diseases in the Caribbean Country of Barbados: The Importance of Problem Framing and Policy Entrepreneurs." *International Journal of Health Policy and Management* 6 (2): 71–82. https://doi.org/10.15171/ijhpm.2016.74.
65. Williamson, Elizabeth J., Alex J. Walker, Krishnan Bhaskaran, Seb Bacon, Chris Bates, Caroline E. Morton, Helen J. Curtis, et al. 2020. "OpenSAFELY: Factors Associated with COVID-19 Death in 17 Million Patients." *Nature* 584 (July): 430–36. https://doi.org/10.1038/s41586-020-2521-4.
66. World Bank. 2015. Health Systems Strengthening and Support Project (P152799). IBRD Project Appraisal Document (August 28, 2015). Washington, D.C.: World Bank. https://projects.worldbank.org/en/projects-operations/project-detail/P152799.
67. ———. 2018a. Nicaragua: Integrated Public Provision of Health Care Services (P164452). IDA Restructuring Paper (March 15, 2018). Washington, D.C.: World Bank. https://documents1.worldbank.org/curated/en/551171574707407442/pdf/Disclosable-Restructuring-Paper-NI-INTEGRATED-PUBLIC-PROVISION-OF-HEALTH-CARE-SERVICES-P164452.pdf.
68. ———. 2018b. Anhui Aged Care System Demonstration Project (P154716). IBRD Project Appraisal Document (May 29, 2018). Washington, D.C.: World Bank. https://documents1.worldbank.org/curated/en/357051529638290655/pdf/Project-Appraisal-Document-PAD-disclosable-version-May-30-SECPO-comments-05312018.pdf.
69. ———. 2018c. Sri Lanka: Primary Health Care System Strengthening Project (P163721). Restructuring Paper (June 27, 2018). Washington, D.C.: World Bank. https://projects.worldbank.org/en/projects-operations/project-detail/P163721.
70. ———. 2018d. Health System Strengthening Project (P166783). IDA Project Appraisal Document (August 14, 2018). Washington, D.C.: World Bank. https://projects.worldbank.org/en/projects-operations/project-detail/P166783.
71. ———. 2018e. El Salvador: Addressing Non-Communicable Diseases Project (P164356). IBRD Restructuring Paper (September 13, 2018). Washington, D.C.: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/822611584483599152/disclosable-restructuring-and-or-additional-financing-paper-esv-addressing-non-communicable-diseases-p164356.
72. ——— 2019a. Tamil Nadu Health Systems Reform Program. IBRD Project Appraisal Document (February 22, 2019). Washington, D.C.: World Bank. https://projects.worldbank.org/en/projects-operations/project-detail/P166373.
73. ———. 2019b. Andhra Pradesh Health Systems Strengthen-

ing Project (P167581). IBRD Project Appraisal Document (April 9, 2019). Washington, D.C.: World Bank. https://projects.worldbank.org/en/projects-operations/project-detail/P167581.
74. ———. 2019c. Yemen Emergency Health and Nutrition Project (P167195). IDA Project Paper (April 16, 2019) Washington, D.C.: World Bank. https://projects.worldbank.org/en/projects-operations/project-detail/P167195.
75. ———. 2019d. Hashemite Kingdom of Jordan: Emergency Health Project Additional Financing (P170529). IBRD Project Paper (June 7, 2019) Washington, D.C.: World Bank. https://projects.worldbank.org/en/projects-operations/project-detail/P170529.
76. ———. 2019e. Samoa Health System Strengthening Program (P164382). IDA Project Appraisal Document (November 19, 2019). Washington, D.C.: World Bank. https://projects.worldbank.org/pt/projects-operations/project-detail/P164382.
77. ———. 2019f. Tajikistan Health Services Improvement Project. Second Additional Financing (P170358). IDA Project Paper (November 25, 2019). https://projects.worldbank.org/en/projects-operations/project-detail/P170358.
78. ———. 2020a. Growing Up Healthy Together: Comprehensive Early Childhood Development in El Salvador Project (P169677). IBRD Project Appraisal Document (February 27, 2020). Washington, D.C.: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/136621583358514932/el-salvador-growing-up-healthy-together-comprehensive-early-childhood-development-in-el-salvador-project.
79. ———. 2020b. "Europe and Central Asia Economic Update, Fall 2020: COVID-19 and Human Capital." Washington, D.C.: World Bank. http://hdl.handle.net/10986/34518.
80. ———. 2022. "World Development Report 2022: Finance for an Equitable Recovery." Washington, D.C.: World Bank. https://www.worldbank.org/en/publication/wdr2022.
81. World Health Organization (WHO). 2010. "Gender, Women, and the Tobacco Epidemic." Edited by Jonathan M. Samer and Soon-Young Yoon. Geneva, Switzerland: World Health Organization. https://iris.who.int/bitstream/handle/10665/44342/9789241599511_eng.pdf?sequence=1.
82. ———. 2020a. "The Impact of the COVID-19 Pandemic on Noncommunicable Disease Resources and Services: Results of a Rapid Assessment." Geneva, Switzerland: World Health Organization. https://www.who.int/publications/i/item/9789240010291.
83. ———. 2020b. "World Health Statistics 2020 Visual Summary." World Health Organization. 2020. https://www.who.int/data/gho/whs-2020-visual-summary.
84. ———. 2021. "Noncommunicable Diseases." *Fact Sheet*. Geneva: Switzerland: World Health Organization.
85. Wu, Fei, Hiroto Narimatsu, Xiaoqiang Li, Sho Nakamura, Ri Sho, Genming Zhao, Yoshinori Nakata, and Wanghong Xu. 2017. "Non-Communicable Diseases Control in China and Japan." *Globalization and Health* 13 (1). https://doi.org/10.1186/s12992-017-0315-8.
86. Yach, Derek. 2022. "Addressing the Impact of Multiple Chronic Conditions Can Improve Health and Reduce Morbidity." *ReSolve Global Health* (blog). July 4, 2022. https://www.re-solveglobalhealth.com/post/addressing-the-impact-of-multiple-chronic-conditions-can-improve-health-and-reduce-morbidity.
87. Yach, Derek, Zoë A. Feldman, Dondeena G. Bradley, and Mehmood Khan. 2010. "Can the Food Industry Help Tackle the Growing Global Burden of Undernutrition?" *American Journal of Public Health* 100 (6): 974–80. https://doi.org/10.2105/ajph.2009.174359.
88. Zuidberg, Mark R J, Amanda Shriwise, Lisanne M de Boer, and Anne S Johansen. 2020. "Assessing Progress under Health 2020 in the European Region of the World Health Organization." *European Journal of Public Health* 30 (6): 1072–77. https://doi.org/10.1093/eurpub/ckaa091.

Monitoring Indicators for Healthy Longevity

Chapter 17

Healthy Longevity Initiative: A Performance Dashboard for Decision-Making in Low- and Middle- Income Countries

Chapter 18

Assessing Human Capital, Non-communicable Diseases, and Healthy Longevity in Low- and Middle-Income Countries: Healthy Longevity Dashboard and the Case for Indian



17

Healthy Longevity Initiative

A performance dashboard for decision-making in low- and middle- income countries

Victoria Haldane [a], Gisela M. Garcia [b], Tahir Bockarie [c], Daphne Wu [d], Cristian A. Herrera [b,e], Maria Luisa Latorre Castro [f], Debapriya Chakraborty [d], Beverly Essue [a], Prabhat Jha [a,d], Jeremy Veillard [a,b]

[a] Institute of Health Policy, Management and Evaluation, University of Toronto
[b] Health, Nutrition, and Population, Latin America and the Caribbean, World Bank
[c] Warwick Medical School, University of Warwick
[d] Centre for Global Health Research, Unity Health Toronto, University of Toronto
[e] Department of Public Health, School of Medicine, Pontificia Universidad Católica de Chile
[f] Fundación Universitaria Juan N Corpas

INTRODUCTION

As the global population rapidly ages, there is a pressing need for approaches to promote health, well-being, and productivity across the life course (Beard and Bloom 2015; Bloom and Sousa-Poza 2013). The Healthy Longevity Initiative (HLI) sets an agenda that emphasizes how inaction towards healthy longevity will have profound and far-reaching impacts on human capital and productivity. The HLI takes a life course approach to considering the linkages between human capital, non-communicable diseases (NCDs), healthy longevity, economic, and well-being outcomes. Increasing prevalence of NCDs, particularly amongst older adults, threatens both lives and livelihoods (GBD 2019 Ageing Collaborators 2022). Given changing demographics, urbanization, and increased exposure to complex risk factors, older adults living in low- and middle-income countries (LMICs) bear a growing and disproportionate burden of morbidity and mortality from NCDs (WHO 2014, Mathers and Loncar 2006). Yet, NCDs remain low on the policy agenda in many LMICs despite the accelerating threat they pose not only to individual health and well-being, but to human capital, productivity, and future growth more broadly (Miranda et al. 2008; Chaker el al. 2015; Allen et al. 2020).

Advancing a healthy longevity agenda offers an opportunity to promote and monitor progress towards human capital accumulation and preservation, health, and well-being not only in younger age but for current generations both young and old (World Bank 2020). The concept of healthy longevity describes a process of ageing that promotes human capital across the life course and where NCDs, serious disability, and deaths are avoided in middle age, thereby compressing morbidity in older ages. This allows older adults to maintain functional abilities and mental health, as well as social connectedness and productivity, into their eldest ages. Healthy longevity extends working lives and creates a more productive workforce through several interrelated channels that promote active and productive ageing and avoidance of NCDs, underpinned by improvements in health and lifestyle (O'Keefe and Haldane 2024). From a national and global policy perspective, avoiding NCDs is crucial to healthy longevity given the multifactorial and interconnected ways these diseases impact inclusive growth, including impacts on savings, fiscal effects, as well as accumulation or depreciation of human capital (O'Keefe and Haldane 2024).

Building and operationalizing such an agenda, however, requires strategic action and focused investments, guided by local evidence, with progress monitored over time. Measuring the effectiveness of policies and investments and monitoring overall progress towards the goal of healthy longevity gives visibility to key issues, enables benchmarking, and offers important information to guide agenda setting, prioritization of resources and planning across levels of action from the global to the local (Baranek, Veillard, and Wright 2011; Hulme, Savoia, and Sen 2014; Holzer and Yang 2004). Countries need a multi-sectoral measurement approach based on information that enables them to determine their progress towards avoiding and adequate management of NCDs, as well as other complementary goals that promote human capital accumulation and preservation across the life course. The Human Capital Index (HCI) is one example of how a measurement approach can be effective to motivate national stakeholders to invest in people for greater inclusive economic growth (Corral et al. 2021; Stein and Sridhar 2019; World Bank 2020).

To advance a healthy longevity agenda globally, countries must bring together relevant and actionable data into a set of user-friendly resources that provide them with key information on health and human capital from across sectors to monitor performance, compare progress, guide investments and interventions, and drive strategy and planning. A common framework and harmonized benchmarking approach for countries to develop a healthy longevity dashboard is urgently needed.

Here, we offer such a common framework and harmonized approach to measurement of healthy longevity. We first contextualize and describe key considerations for a healthy longevity dashboard. We then present criteria for indicators to guide countries in making focused investments in NCDs and healthy longevity across the life course more broadly. Three country case studies are presented that illustrate a spectrum of dashboard possibilities considering differing data and information system contexts. Finally, we offer lessons learned through the dashboard creation process to assist others in creating national healthy longevity dashboards.

CONTEXTUALIZING DASHBOARDS FOR PERFORMANCE MONITORING AND STRATEGIC ACTION

Performance dashboards, hereafter 'dashboards,' are data visualization tools that bring together representations of indicators into a unified interface that allows stakeholders to monitor and assess performance and progress across selected dimensions (Helminski et al. 2022; Eckerson 2010). These dashboards are commonly used to monitor progress and show impact in the private sector, where they are an integral part of evidence-based business performance measurement (Pfeffer and Sutton 2006). Performance dashboards for business are linked to key performance indicators and organizational targets. An integral part of business intelligence, dashboards support agile program delivery linking current states to future growth as a part of 'learning systems' (Kaplan and Norton 1996). Increasingly, healthcare delivery organizations and health systems more broadly are adopting business intelligence and learning systems approaches to proactively measure, monitor, compare, and act based on metrics informed by ever evolving electronic medical record data and other health data sources (Veillard et al. 2010; Bonney 2013; OECD 2002).

Frameworks and indicators have widely been used to catalyze action around and monitor progress towards global goals. Notably, the Millennium Development Goals (MDGs) presented a set of targets grounded in a common vision to reduce global poverty. The MDGs saw the advent of a common framework for promoting global development guided by indicators to monitor progress (McArthur 2014). With a common goal and indicators to rally around, the MDGs spurred global advancements in education, economic growth, and poverty reduction, with some of the largest gains made in health, particularly in LMICs (Narh-Bana et al. 2022; McArthur and Rasmussen 2018). It's estimated that the accelerated development progress catalyzed by the MDGs saved an extra 20.9 to 30.3 million lives, approximately two-thirds of these in Africa (McArthur and Rasmussen 2018). From national initiatives to reduce child mortality, increase childhood education, and access to antiretrovirals, to global partnerships such as the Global Fund to Fight AIDS, Tuberculosis and Malaria, the MDGs spurred partnerships and initiatives that committed to measurement as the path towards greater health and well-being globally (McArthur 2013).

Building on this commitment to measurement, indicators are increasingly being aggregated into dashboards to readily and in near real time monitor progress towards goals that advance health and well-being (Annex 17.1). Dashboards leverage vital statistics, demographic, and census data, as well as outcomes data across a range of diseases. By doing so users are motivated to act, course correct, compare progress against others, and make strategic investments to address global health challenges.

For example, during the COVID-19 pandemic numerous dashboards have emerged that provide a picture of the epidemiological situation and response effectiveness across an array of indicators (e.g., number of deaths, cases, hospitalization, test positivity rates, amongst others) – (Ivankovic et al. 2021). Many COVID-19 dashboards quickly adapted to include information on COVID-19 vaccine roll out. These provided crucial information to inform local vaccination programs and prioritization strategies, as well as monitor global vaccine equity (UNDP 2022). Another example of a dashboard linked to more explicit goals to end a global health threat is the global tuberculosis program dashboard. Relying on data collected by national tuberculosis programs across a standard set of indicators, the dashboard presents a comprehensive country- and regional-level dashboard to monitor progress towards the End TB Strategy milestones (WHO 2004, 2022a). Similar dashboards to track progress towards global health goals are available for malaria, polio, HIV, as well as women's, children's and adolescent health (RBM Partnership to End Malaria 2022; WHO 2022b; AHEAD 2022; UNICEF 2022a, 2022b).

A COMMON FRAMEWORK FOR HEALTHY LONGEVITY MEASUREMENT

The healthy longevity dashboard is an ongoing effort to develop and refine a suite of indicators that bring together relevant data to measure and monitor country progress towards healthy longevity goals. Monitoring progress towards health and well-being in older age is not a novel concept. Many countries have already committed to making progress on indicators relevant to healthy longevity such as life expectancy, NCD risk reduction, adult health, and gender equality.

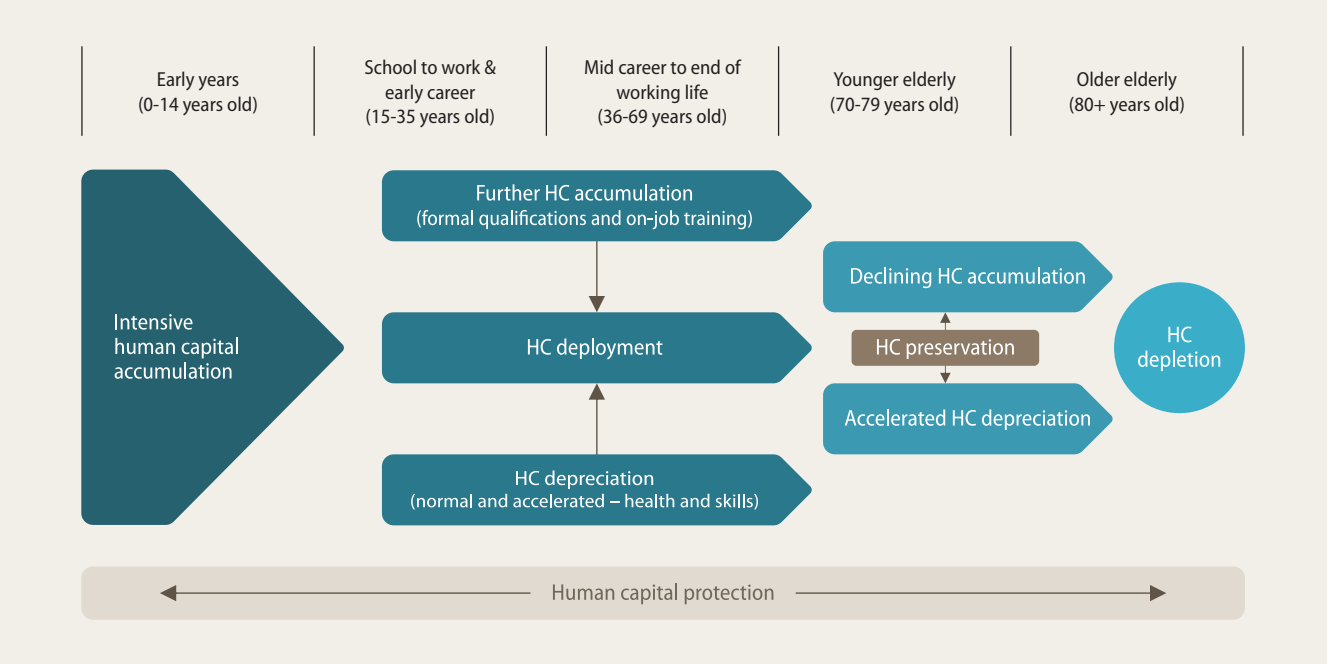
The common framework for a healthy longevity dashboard described here allows for framing a selected set of these indicators in a different way. It emphasizes their role in promoting health and human capital across the life course, while drawing attention to the multi-sectoral efforts needed to promote healthy longevity, inclusive growth, and well-being.

Importantly, there is no one-size-fits-all dashboard for healthy longevity. Rather we propose a common framework, grounded in a conceptual framework, and complemented by a minimum set of indicators that countries can leverage to define their own dashboard. Dashboards should be based on key indicators and meaningful disaggregations that are contextually relevant and supported by available data sources. These key indicators enable a harmonized benchmarking approach, so countries are well-placed to compare their progress against others with a similar level of development (e.g., similar World Bank classifications) or other comparable metrics (e.g., OECD countries).

The proposed common framework for a healthy longevity dashboard takes a life course approach, grounded in a conceptual framework, and offers a suite of potential indicators for monitoring interventions, progress towards goals, and relevant outcomes. The conceptual framework charts human capital across the life course. Dashboard creation and indicators selected are done on the basis of a solid conceptual grounding, which ensures that the life course approach proposed guides the choice and monitoring of key indicators. Proposed indicators map to the intensive accumulation of human capital during early years, onwards to the period of further human capital accumulation, deployment, and depreciation during advanced schooling and working life, as well as the declining human capital accumulation and accelerated human capital depreciation of older adults (Figure 17.1) – (O'Keefe and Haldane 2024). The framework offers inroads for healthy longevity interventions and policies that increase human capital accumulation, minimize human capital depreciation, and importantly, preserve human capital in older ages to ward off human capital depletion as long as possible. Linking indicators to life course considerations provides a holistic and comprehensive view of population health.

Given this, when developing a healthy longevity dashboard, three key actions and ten related domains must be prioritized, which map to the conceptual framework (Table 17.1). First, supporting enabling factors for human capital accumulation focusing on actions related to the capacity of future aging cohorts. Human capital accumulation is intensive during early life, during schooling and early career development. A life course approach, however, emphasize that human capital continues to be accumulated and must be protected during working life. Dashboards must consider indicators that

FIGURE 17.1 Healthy Longevity Initiative conceptual framework of human capital (HC) across the life course



Source: O'Keefe and Haldane 2024

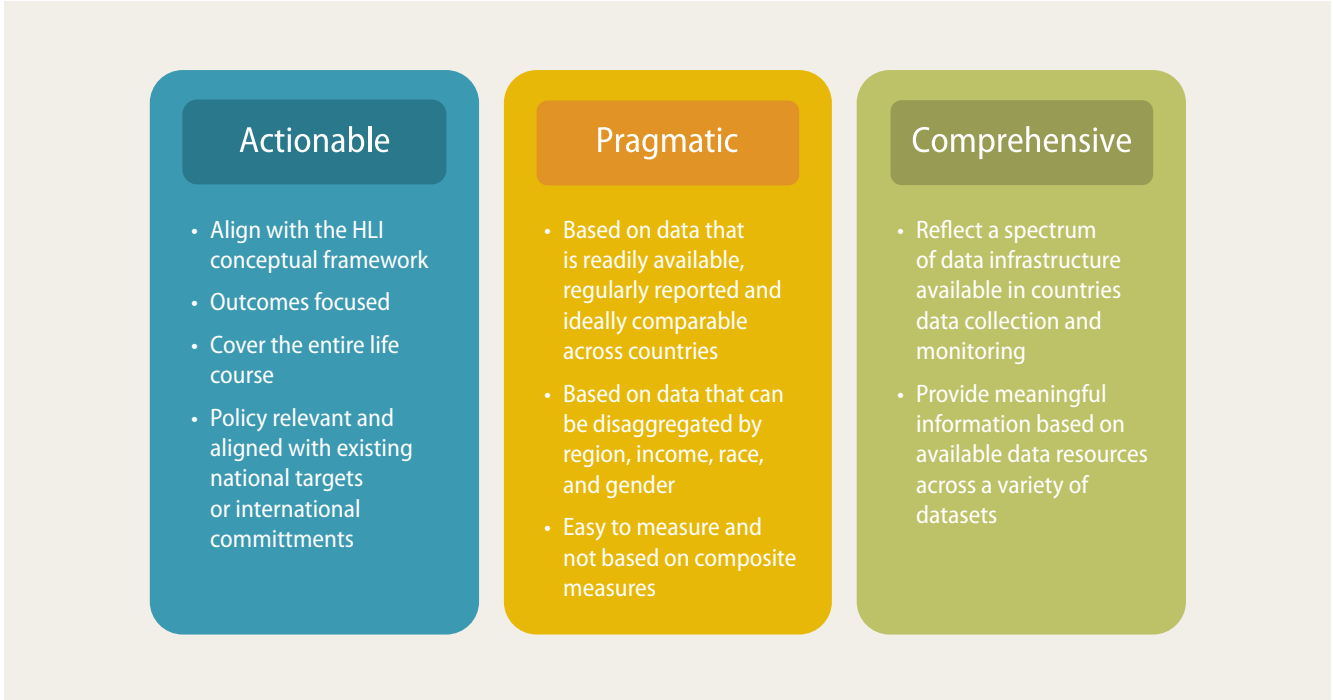
reflect this intensive human capital accumulation (e.g., including education outcomes, youth-focused indicators, gender norms), as well as indicators that reflect disease prevention to protect human capital later in life. Second, ensuring adequate prevention and control of NCDs, and reduced exposure to their risk factors, across the life course given their increasing prevalence, economic costs, and negative impacts on productivity, human capital depreciation, and deployment. The working life phase of the life course requires indicators that reflect the possibly divergent paths between human capital appreciation and depreciation shaped by NCD risk factors, prevention, and management. Third, creating supportive conditions for healthy and productive ageing focusing on actions to improve the well-being of vulnerable older adults. During older ages, human capital accumulation declines towards depletion but interventions and policies can support human capital preservation and maintain it as long as possible.

Indicators comprising a healthy longevity dashboard should be actionable, pragmatic, and comprehensive and represent a breadth of structure, process, and outcomes measures (Figure 17.2).

TABLE 17.1 Key actions and related domains when developing a healthy longevity dashboard

Life course stage	Intensive human capital accumulation	Human capital accumulation, deployment, and depreciation	Declining human capital accumulation, accelerated depreciation and depletion
Key action	1. Promoting enabling factors for human capital accumulation	2. Ensuring adequate prevention and control of NCDs across the life course	3. Creating supportive conditions for healthy and productive ageing
Supporting domains	• Disease prevention • Education outcomes • Youth focus • Gender norms	• NCD risk factors and behaviors • NCD management • Avoidable mortality	• Healthy population • Productive ageing • Well-being in old age

FIGURE 17.2 Criteria for selecting healthy longevity indicators



CASE STUDIES: SIERRA LEONE, INDIA, AND COLOMBIA

Considering the spectrum of data infrastructure and potential indicators available, we engaged with country stakeholders in the development of national healthy longevity dashboards in three different country contexts: Sierra Leone, India, and Colombia (Boxes 17.2-17.4). While the country cases have been developed with in-country teams, they are at this stage illustrative and would require more in-country participation to develop them further and build the ownership needed for them to be more than illustrative. Table 17.2 provides a summary of indicators across selected countries and forthcoming companion papers discuss each dashboard, and the engagement process through which it was created, in greater detail. Countries were chosen to represent different contexts not only across income level, but also in their epidemiological and demographic profile. These unique mortality constructs in each country point to differing NCD-related challenges and opportunities for policy action towards healthy longevity. Importantly, each country represents a different data infrastructure context from which information for indicators can be drawn. Each case study offers an example of the strengths of a progressive approach, whereby countries leverage available data resources to make purposeful and actionable dashboards. Sierra Leone illustrates how countries with nascent data infrastructure can bring together available indicators based on key investments in healthy longevity and NCDs in a meaningful way. India presents a case where data is more readily available, including from international sources, data is driven by national policy objectives, and can be used for benchmarking. Colombia offers an example of how countries can leverage more extensive datasets across multiple sectors, thereby offering an example of a more comprehensive set of indicators.

TABLE 17.2 Healthy longevity dashboard indicators for Sierra Leone, India, and Colombia.

Key action	Supporting domain	Indicators by country		
		Sierra Leone	India	Colombia
Promoting enabling factors for human capital accumulation	Disease prevention	• Life expectancy at birth • Percentage of one-year olds who received three doses of diphtheria, tetanus, toxoid, and pertussis (DTPS immunization)	• Percentage of one-year olds who received BCG vaccination; three doses of diphtheria, tetanus, toxoid, and pertussis (DTPS immunization); and two doses of measles (MCV2) immunization • Percentage of population who received at least two doses of COVID-19 vaccination • Percentage of mothers whose last birth was protected against neonatal tetanus	• Girls 14 years old vaccinated against Human Papillomavirus (HPV)
	Education outcomes	• Learning-Adjusted Years of Schooling • Literacy rate (adults, youth) • Elderly illiterate population, 65+ years (both sex, male, female)	• Learning-adjusted years of schooling at age 18 • Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months	• Learning Poverty • Learning-Adjusted Years of Schooling
	Youth focus	• Under-five mortality rate (per 1,000 live births) • Youth not in employment, education, or training • Youth and young adults (age 15-29 years) mortality rate (per 100,000 population) • School enrolment rate • Youth unemployment	• Under-five mortality rate (per 1,000 live births) • School age (age 5-14 years) and youth and young adults (age 15-29 years) mortality rate (per 100,000 population)	• Adolescent fertility Rate (15-19 years) • Youth not in employment, education, or training (NEET)
	Gender norms	• Women's participation in labor force (15-64 years) • Contributing family worker, female (%of female employment) • Ratio of female to male labor force participation rate • Percentage of ever-partnered women who experienced intimate partner violence in the past 12 months	• Percentage of ever-partnered women who experienced intimate partner violence in the past 12 months • Percentage of women's work time (paid and unpaid) spent on unpaid work • Ratio of female to male labor force participation rate • OECD Social Institution and Gender Index (SIGI)	• Gender gap in labour force participation (15-64 years) • Gender Gap in time spent on unpaid domestic work and care

Key action	Supporting domain	Indicators by country		
		Sierra Leone	India	Colombia
Ensuring adequate prevention and control of NCDs across the life course	NCD risk factors & behaviors	• Mortality from CVD, cancer, diabetes ages 30 -70 years • Occupational risk factors attributable DALYs per 100,000 capita • Occupational risk factors attributable DALYs • Prevalence of overweight among adults, BMI ≥ 25 (age-standardized estimate) (%) • Prevalence of insufficient physical activity among adults aged 18+ years (crude estimate) • Raised blood pressure (SBP>=140 OR DBP>=90) (age-standardized estimate) • Total NCD Deaths (in thousands)	• Stunting, wasting, and underweight prevalence among children under 5 years • Percentage of population aged 15+ years who use tobacco and/or smoke cigarettes • Tobacco cessation represented by the ratio of former to current smokers aged 45-59 years • Percentage of population aged 15+ years who practice harmful use of alcohol in the past 12 months • Percentage of population aged 20+ years with overweight or obesity • Percentage of population aged 18+ years with current depression • Percentage of population aged 20-79 years with type 2 diabetes	• Stunting prevalence among children under 5 years • Obesity in all ages • Daily smokers (50 + years) • Binge alcohol drinking aged 14+ years
	NCD management	**No data found**	• Percentage of population aged 30-79 years with hypertension that are currently taking antihypertensive medication	• % Population diagnosed with diabetes under treatment • % Population diagnosed with hypertension under treatment
	Avoidable mortality	• CVD and Diabetes mortality rate • NCD mortality rate • Age-standardized mortality rate by cause (per 100,000_-Cardiovascular • Life expectancy at age 60 (years) • Distribution of years of life lost by major cause group Age-standardized NCD mortality rate (per 100,000 population) • Probability (%) of dying between age 30 and exact age 70 from any of cardiovascular disease, cancer, diabetes, or chronic respiratory disease	• Life expectancy at birth • Adult (aged 30-69 years) mortality rate (per 100,000 population) • Life expectancy at age 60	• Premature Mortality due to NCD (30-69 years) • Life expectancy at age 60 • Avoidable mortality due to depression
Creating supportive conditions for healthy and productive ageing	Healthy population	• Deaths per 100000 population	• Mortality rate at older ages (aged 70 years and above) (per 100,000 population)	• Self-perception of overall health (60+)
	Productive ageing	• Labor force participation rate (50+)	• Labor force participation rate among population aged 15 years and over	• Labor Force Participation rate (50+) • % of pensionable age adults living in poverty
	Well-being in old age	**No data found**	• Population covered by at least one social protection cash benefit (excluding health) • Public expenditure on social protection (excluding health) and on pension, as % of GDP	• % of adults (60+) with limitations to perform activities of daily living (ADL) • Self-perception of happiness (60+)

BOX 17.1 Case study of a healthy longevity dashboard in Sierra Leone

NCD context

Sierra Leone is a small country on the west coast of Africa and has a population of 8 million people. It is ranked 182 out of 189 countries on the World Bank's Human Development Index (HDI), meaning that life expectancy, education, and per capital income indicators are very low compared to other countries on the HDI list. Recent data indicate that the average life expectancy is 54.3 years, while the average global life expectancy is 72.3 years. Communicable diseases still account for the majority of premature and avoidable deaths in this population, though this is changing. Indeed, a double burden of communicable and noncommunicable diseases is evident in the epidemiological profile. In 2019, 34.1% of deaths were caused by NCDs with cardiovascular and digestive diseases accounting for the majority (67%) of all NCD deaths.

Planning context and opportunities

Governance for health and the health sector is the responsibility of the Ministry of Health and Sanitation and guided by a National Health Sector Strategic Plan, as well as several supplementary sub-sector strategies. The health sector priorities align to the Sustainable Development Goals (SDGs), including SDG 3, which has provided a framework for prioritizing investments and interventions to reach the SDG targets by 2030. However, fragmentation of planning between sectors and implementation of initiatives, coupled with a lack of data have impacted the delivery of healthy longevity initiatives centered on human development and the reduction of NCDs. The ongoing development agenda, the changing disease burden, and strong commitment to accelerate health system recovery efforts from prior health emergencies (e.g., COVID-19 and Ebola) creates opportunities to leverage data in ways that can better support monitoring and planning for the current and emergent needs of the population.

Dashboard development

Sierra Leone is yet to make substantial investments in vital statistical and information systems. To guide the set of development measures which would provide reasonable baseline data on NCD mortality in relation to healthy longevity in Sierra Leone, we utilized data from the following: World Health Organization Global Health Observatory, Global Burden on Disease, IDF Diabetes Atlas, World Bank, International Labor Organization, Social Institute and Gender Index. Data from these international institutes was reviewed to allow for comparability of data across India and Colombia.

The research team carried out discrete work to use the Comprehensive Mortality Surveillance for Action (COMSA) data to aggregate NCD mortality by socio-demographic groups and disease groups across the four provinces of Sierra Leone. We used Tableau to develop the dashboard. Sierra Leone's dashboard is unique for four reasons. First, the dashboard is the first to present an interactive map visually to chart NCD mortality by region and across several sociodemographic indicators. Second, the dashboard has received positive feedback from Sierra Leoneans (in-county and aboard), including Sierra Leone's Ministry of Health and Sanitation (MoHS). Sierra Leone's MoHS have taken an interest in the dashboard being used as a tool for surveillance and to build on the dashboard to include other risk factor indicators. Third, the dashboard has received positive feedback from potential donor sponsors like the World Bank with the prospect of developing a country-wide healthy longevity initiative package centered on NCDs. Lastly, the dashboard has stimulated broader discussions with policymakers, academics, and bilateral donors.

Strengths of the approach proposed for Sierra Leone

- Indicators are regularly collected and are specific to each of the four provinces.
- Indicators collected thus far can be built upon to add other risk factor data to study associations of disease burden on socio-demographic indictors.

Limitations

- Lack of data on risk factors at the national or district/province level.
- Reliability of in-country census data.
- Employment indicators are hard to define; reliability of the labor force surveys to accurately capture the diverse structure of the labor market in SL and other LMICs is required moving forward.
- Data analytics in the health sector in Sierra Leone is still in its infancy.
- There is some promise that Sierra Leone will one day realize the power of data mining and integrate its routine demographic

BOX 17.1 Case study of a healthy longevity dashboard in Sierra Leone (continued)

and population health management surveys. However, a barrier to actualizing the power of data analytics is a lack of data analysts trained in specialized software such as Power BI, Tableau and R.
- To overcome this barrier, efforts to deliver training on this specialized software to individuals and organizations in Sierra Leone are needed.
- Still, international knowledge exchange and capacity building is required to create a sustainable change in how Sierra Leone uses data from an analytics perspective to inform policy and planning of health interventions.

Key enablers

- The Sierra Leone 2019-2023 NCD Policy and Strategy, including recently published literature on NCDs in Sierra Leone, provided a rough guide to our selection of indicators for the healthy longevity dashboard.
- Engagement with key departments/directorates within Sierra Leone's Ministry of Health and Sanitation; these include the Directorate of Non-communicable diseases and the Directorate of Planning and Policy.

Future directions and opportunities

- Investment in data infrastructure.
- Training on use of available data to support planning efforts, including intersectoral planning and investment, as required by the HLI framework.
- Public engagement / education on the importance and use of their data to support planning.
- Training for policy analysts to generate, update and use the dashboard.
- Discussions with policy makers on the comparators/benchmarks that are relevant in this context (e.g., all LMICs, low-income-countries).

BOX 17.2 Case study of a healthy longevity dashboard in India

NCD context

The population of India is rapidly ageing, and it is estimated that the number of people over the age of 60 in India will double by 2050, accounting for nearly 20% of the population. These growing numbers of older adults, however, also have a higher risk of developing NCDs and in turn, higher morbidity, and mortality. Based on the 2019 WHO Global Health Estimates, India has a premature mortality (death before age 70) rate of 422.20 per 100,000 population. Of the total deaths under age 70, NCDs account for about 59% in 2019, an increase of 136% from the 25% that NCDs accounted for in 2010.

Planning context and opportunities

India has a history of central planning, with decades of economic and development progress envisioned and charted through a series of Five-Year Plans. These have been created, executed, and monitored by the Planning Commission, and more recently the NITI Aayog, up until the most recent '12th Five-Year Plan.' Under the strategic vision of these plans, the Central government has shaped health policy and planning through the Council of Health and Family Welfare, including setting targets and developing schemes to further health and development goals. As the population rapidly ages, policy makers across sectors are faced with an urgent need for new social protection, health, and development programs that protect older adults from poverty, support their good health, and allow for further skill development across the life course.

Dashboard development

We conducted a review of data available from international institutions, including the World Health Organization Global Health Observatory, World Bank World Development Indicators, Organization for Economic Cooperation and Development (OECD) Statistics, ILOSTAT, and UNESCO Institute for Statistics. We only reviewed data from international institutions as this allows comparability of data across countries. From the global data review, we gathered a list of plausible indicators that pertain to the accumulation, deployment, and depletion of human capital and healthy longevity, with a focus on NCDs.

For each indicator in the dashboard, the country is assigned a score relative to all countries in the same income strata (based on the 2021 World Bank country classification). Thus, we aim to create a healthy longevity dashboard that can be used by LMICs where good quality health and economic data are usually sparse, to monitor their human capital and guide investments towards NCDs and human capital.

Strengths of the approach proposed for India

- International comparability of results and benchmarking
- Results can be reproduced easily over time

Limitations:

- Lack of data on adult education and health such as adult vaccination coverage and comparability across countries.
- Most health data are reported for child health but less so for adult health where majority of deaths and disabilities are accounted by NCDs.

Key enablers

- The India 2017 National Health Policy provided a guide to our selection of indicators for the healthy longevity dashboard

Future directions and opportunities

- Better data systems for periodic data collection, monitoring, and surveillance of the health of adults, particularly prevalence of various NCDs and access to NCD care and management
- Work with country governments on usability of the dashboard and provide necessary training to government personnel on how to use and tailor the dashboard to their needs as the needs change over time

BOX 17.3 Case study of a healthy longevity dashboard in Colombia

NCD context

Colombia is one of the countries in Latin America ageing at the fastest rate. The rapid ageing of the population requires the adaptation of a range of social and economic policies and sectoral transformation to respond to the needs of an ageing population. In Colombia, nearly eleven million people seek care for a chronic condition every year, of whom between 4.5 million and 6 million people have multiple NCDs. Mortality from the four main NCDS, diabetes, cardiovascular diseases, COPD, and cancer has increased in Colombia from 241.14 to 261.47 per 100,000 population between 2015 and 2020.

Planning context and opportunities

Colombia offers a rich tradition of central planning: by law, a national development plan must be developed by the national planning department and presented to Congress for discussion and vote after a new government is elected. The plan proposes a long-term perspective on development issues, is prioritized, costed, and presents targets for a range of sectoral and multi-sectoral development issues. In addition, the recently approved document Vision Colombia 2050[1] outlines the vision for the country acknowledging the challenges and opportunities of the rapid aging population Colombia is facing.

Dashboard development

Colombia has made substantial investments in core statistical and information systems over the last decades. The health and social sectors offer a wealth of quality information generated from vital statistics, census data, household surveys, clinical registries, electronic health records, and administrative datasets. The research team worked with leading academics and students to review potential data sources, map potential indicators to core domains of the HLI conceptual framework, select a parsimonious set of performance indicators (21 in total) meeting the criteria defined by the research team, define disaggregators and benchmarks or targets for each indicator (using to the extent possible existing national targets), and collect data at national and sub-national level. Further development of an online, automatically population electronic dashboard will offer key performance information to national policy makers, regional system planners and service delivery managers to understand progress towards better human capital outcomes for an ageing population and monitor the effectiveness of implementation of key interventions.

Strengths of the approach proposed for Colombia

- Indicators are available and are regularly collected (or can be calculated)
- Indicators are specific to each of the three core domains of the healthy longevity initiative

Limitations

- Disaggregation is not always possible: about half of the indicators can be disaggregated at the subnational level only
- One third of the indicators are self-reported, risk of bias and limitations
- Targets are not easy to define, only about a third of the indicators have a national target and international comparisons are not always possible

Key enablers

- Prior investments in strengthening information systems across government
- Culture of transparency and use of data to support decision-making
- Long-term planning culture in government through the National Planning Department, the National Development Plan, the Ten Years Health Plan, and the Vision 2050

Future directions and opportunities

- Need to keep on investing in better information data systems for monitoring and surveillance of the health of adults and older adults
- Work with government at multiple levels to ensure that electronic dashboard is built for use and meets needs of different users: national policy makers, system planners, managers

1 Gobierno de Colombia, Departamento Nacional de Planeación. Visión Colombia 2050: Discusión sobre el país del futuro [Colombia Vision 2050: Discussion on the Country's Future]. Bogotá, Colombia: Departamento Nacional de Planeación. 2022. https://colaboracion.dnp.gov.co/CDT/Prensa/Publicaciones/Documento_vision_colombia_2050.pdf.

DISCUSSION AND FUTURE DIRECTIONS

In creating a healthy longevity dashboard, countries bring together informational resources that allow them to monitor progress across a range of goals that contribute to health longevity and better understand the effectiveness of core HLI interventions to reach these goals. Based on our work developing a common framework for a healthy longevity dashboard, as well as the country-level case studies presented, we offer key areas for action to assist country stakeholders in producing, presenting, using, and institutionalizing a healthy longevity dashboard tailored to their unique demographic and epidemiological context and data infrastructure.

Producing dashboard data

Access to reliable and regularly reported data is key to developing a healthy longevity dashboard. Producing this data in countries, however, often proves challenging given the chronic underinvestment in data systems and IT infrastructure (Global Commission on Evidence to Address Societal Challenges 2022). The COVID-19 pandemic underscored the need for timely data to inform decision-making at all levels and spurred global and national investment in improvements to the coverage, quality, completeness, and capacity for data collection and sharing (de Bienassis et al. 2022). However, these efforts have emerged from longstanding informational inequity. Sparse and insufficient investment in data infrastructure have long undermined local efforts to produce, use, and routinely share high quality data in LMICs (Hoxha, Hung, and Grépin 2020; Kumar et al. 2018). Piecemeal approaches spurred by inconsistent donor and government funding, coupled with a lack of standardized data production and limited human resources have, in many places, led to a patchwork of systems and data sources with limited governance or quality assurance (Heeks 2022; Dehnavieh et al. 2019).

The approach proposed ensures that regardless of the data ecosystem and existing data infrastructure, a set of meaningful indicators can be brought together to guide monitoring and decision-making. Drawing on the concept of maturity models, which posit that people, organizations, processes, and systems evolve in complexity and capacity through a process of development over stages (Kolukisa et al. 2020; Vidal, Rocha, and Abreu 2019), Table 17.3 characterizes the data-related capabilities across three infrastructure maturity levels – emerging, established, and advanced. The infrastructure maturity stage reflects capabilities and capacities across key domains adapted from the Information Systems for Health Toolkit including IT infrastructure, namely data sources, quality and interoperability, information products, and data governance (PAHO 2019). In countries with an emerging data ecosystem, the minimum set of indicators offers a starting point for measuring progress on healthy longevity. As the data ecosystem develops and matures, other indicators can be added to scale up the dashboard while retaining the minimum set of common indicators (Table 17.4).

There are several key data sources that must be built up in countries to advance a minimum set of indicators towards a more fulsome dashboard: vital statistics, household surveys, administrative datasets, electronic health records, and outcomes measurement through patient-oriented surveys. Annex 17.2 offers key data sources on ageing. Working in partnership with local statistical offices and leveraging routine national data at the country level, however, should be favored over reliance on international surveys. Efforts to create and sustain dashboards are an important opportunity to promote robust and reliable statistical independence at a national level. Indeed, dashboard development and enhancing data production overall should be viewed as a part of local infrastructure building and equitable information systems strengthening. These capacity building efforts must be based on approaches that uphold privacy, ensure security, promote equitable and open sharing and dissemination, and consider data as a public good, both at the local and the global level (OECD 2022). For example, the District Health Information System 2 (DHIS2) is an open-source web-based platform, the world's largest health management information system, and is used by 73 LMICs for data warehousing, visualization and real-time analysis of live data (DHIS2 2022). The DHIS2 is not only a potential source of indicator data for countries with emerging infrastructure, but an important example of open data to monitor and evaluate health and well-being goals (Dehnavieh et al. 2019).

TABLE 17.3 Data ecosystem features by domain and information infrastructure maturity level.

Information ecosystem domain	Emerging infrastructure	Established infrastructure	Advanced infrastructure
IT infrastructure	• Basic IT tools are generally available (e.g., hardware, software, internet connectivity), but may be older or not performing well. • Paper-based data collection is common, with some digital data collection.	• Some advanced IT tools are available in well-resourced areas, but basic IT tools are widely available. • Majority of data are digitally collected from all key data sources, but some paper-based collection occurs.	• Advanced IT tools are ubiquitous (e.g., cloud systems) and innovative and are routinely evaluated and adopted. • Data sources are virtually all digitally collected.
Data sources	• Key data sources have been identified (e.g., vital statistics, household surveys, morbidity, mortality, and surveillance data). • Data may be routinely collected but challenges remain in ensuring data flow.	• Key data sources are well established and there is evidence of some data collection from multiple and unstructured sources, such as social media and others. • Data is routinely collected for the majority of key sources.	• Data from all key data sources, as well as data from multiple and unstructured sources is routinely collected. • There are established mechanisms to assess existing data sources that can improve them or integrate new ones.
Quality and interoperability	• Some use of data standards, however few formalized standards are routinely enforced. • There is limited or no interoperability between information systems.	• Standards have been adopted and some sectors have a defined and documented national information architecture. • There is evidence of interoperability between some information systems.	• Standards and national information architecture across sectors have been formally adopted and are periodically checked. • There is significant interoperability across systems and across sectors including integrated national data repositories from multiple data sources.
Information products	• Reports and other information products are published but these are infrequent and resource intensive to produce. • Data is not readily shared and requires permission from the highest levels.	• Reports and other information products are routinely produced and tailored to meet stakeholder needs. • Core datasets are readily available and shared.	• Stakeholders across sectors can effectively collaborate and engage with data to produce real-time information products. • All data is shared on principles of OpenData.
Data governance	• Limited strategy and mechanisms for data collection, use, sharing, and dissemination. • Limited privacy standards are developed.	• Data governance mechanisms have been established among some stakeholders. • There is evidence of continuous improvement processes to monitor and invest in data quality. • Privacy standards have been defined at least for key data sources and enforcement occurs.	• Formal and cross-sectoral data governance mechanisms have been established and are function effectively. • Continuous improvement processes are routine and drive innovation across systems. • Data is considered as a public good with strong privacy standards and enforcement.

Source: Adapted from PAHO Information Systems for Health (IS4H) Toolkit: https://www3.paho.org/ish/images/docs/about-IS4H-mm.pdf?ua=1

TABLE 17.4 Proposed healthy longevity indicators by information infrastructure maturity level

Key action	Supporting domain	Minimum Set of Indicators For countries Across Spectrum of Data Infrastructure		
		Limited Data Infrastructure	Moderate Data Infrastructure	Advanced Data Infrastructure
Promoting enabling factors for human capital accumulation	Disease prevention	• % of one year old with full immunization, by sex • Under-five mortality rate (per 1,000 live births)	• Percentage of population who received at least two doses of COVID-19 vaccine vaccination • Youth vaccinated against Human Papillomavirus (HPV), by sex	• % of population with full immunization according to national immunization plan for each age category
	Education outcomes	• Learning Poverty • Learning-Adjusted Years of Schooling	• Learning Poverty • Learning-adjusted Years of schooling	• Learning Poverty • Learning-Adjusted Years of Schooling
	Youth focus	• School enrolment rate • Youth unemployment • Adolescent fertility Rate (15-19 years)	• Adolescent fertility Rate (15-19 years) • Youth not in employment, education, or training (NEET)	• Adolescent fertility Rate (15-19 years) • Youth not in employment, education, or training (NEET)
	Gender norms	• Percentage of ever-partnered women who experienced intimate partner violence in the past 12 months	• Percentage of women's work time (paid and unpaid) spent on unpaid work	• Gender gap in labor force participation (15-64 years) • Gender Gap in time spent on unpaid domestic work and care
Ensuring adequate prevention and control of NCDs across the life course	NCD risk factors & behaviors	• Stunting, wasting, and underweight prevalence among children under 5 years • Prevalence of overweight among adults, BMI ≥ 25 (age-standardized estimate) (%)	• Stunting, wasting, and underweight prevalence among children under 5 years • Percentage of population aged 20+ years with overweight or obesity Percentage of population aged 15+ years who use tobacco and/or smoke cigarettes	• Stunting prevalence among children under 5 years • Obesity in all ages • Daily smokers (50 + years) • Binge alcohol drinking aged 14+ years
	NCD management	• Percentage of adult population with hypertension • Percentage of adult population with type 2 diabetes	• Percentage of population aged 15+ years with type 2 diabetes that are currently taking medication to lower blood glucose level • Percentage of population aged 30-79 years with hypertension that are currently taking antihypertensive medication	• % Population diagnosed with diabetes under treatment • % Population diagnosed with hypertension under treatment
	Avoidable mortality	• Life expectancy at birth • Life expectancy at age 60 (years) • Adult (aged 30-69 years) mortality rate (per 100,000 population)	• Life expectancy at birth • Life expectancy at age 60 • Mortality from CVD, cancer, diabetes ages 30 -70 years	• Premature Mortality due to NCD (30-69 years) • Life expectancy at age 60 • Avoidable mortality due to depression
Creating supportive conditions for healthy and productive ageing	Healthy population	• Deaths per 100,000 population	• Mortality rate at older ages (aged 70 years and above) (per 100,000 population)	• Self-perception of overall health (60+)
	Productive ageing	• Labor force participation rate among population (50+)	• Labor force participation rate among population (50+)	• Labor Force Participation rate (50+) • % of pensionable age adults living in poverty
	Well-being in old age	• Public expenditure on social protection (excluding health) and on pension, as % of GDP	• Population covered by at least one social protection cash benefit (excluding health)	• % of adults (60+) with limitations to perform activities of daily living (ADL) • Self-perception of happiness (60+)

Presenting and using data in the dashboard

Data visualization is an important strength of a dashboard-based measurement approach. A successful performance dashboard should be created from a robust and user-centered design philosophy grounded in accessibility, clarity, and meeting user needs (Kunjan, Doebbeling, and Toscos 2019; Ghazisaeidi et al. 2015). Users must be able to clearly see the status of indicators and navigate through increasing levels of detail depending on their unique informational needs. The dashboard, by meeting these needs, providing open access to information, and engaging with the political economy of measurement and goal setting, can then support better policymaking and program integration.

There are four key dashboard users – the public, policy makers, planners, and managers. The creation and content of a dashboard represents a tailored measurement approach to motivate action, prioritization, and support decision-making by users from the highest to most local levels of action (Kruglov, Strugar, and Succi 2021). Performance dashboards, however, also have important applications for broader planning, local priority setting and programming, and are an important avenue for public accountability (Veillard et al. 2016; Edwards and Thomas 2005). Performance dashboards, and the exercises necessary to create them, put important issues on the agenda of decision-makers at all levels of influence, and are an important inroad for the public to see, and advocate for, their data put to use towards goals that improve their health and happiness.

To realize the potential of performance dashboards, users must be able to engage with visual summaries to monitor progress, assess intervention effects, and think strategically about the healthy longevity commitments behind the indicators (Table 17.5). The public, including the media and civil society organizations, can use dashboards to participate in public policy making, monitor progress, and advocate for greater action towards goals set at the highest level that impact health, happiness, productivity, and the ability to age in place in communities. Policy makers will use the dashboard for performance improvement and to strengthen cross-sectoral cooperation. To do so, they require access to visualizations across a mix of outcomes and process indicators to monitor the impact of interventions and determine their effectiveness to drive strategic decision making and investment. Planners will require indicators describing outcomes, processes, and structures to determine whether adequate and appropriate infrastructure and resources are in place to achieve goals and deliver programs. Whereas managers of programs that aim to promote or enhance healthy longevity in communities require dashboards capable of visualizing granular details relevant to their context and programmatic goals for implementation and evaluation. These government stakeholders may come from diverse sectors including national planning departments, as well as ministries of finance,

TABLE 17.5 Key dashboard users, their purpose, and types of measures needed by users

User	Purpose	Types of measures needed
General public	• Transparency • Participation in public policy making	• Select outcome measures curated at their level of involvement and relevant to their context and programmatic goals • Key performance indicators
Policy maker	• Transparency • Strategic goal setting • Performance improvement • Cross-sectoral cooperation enhancement • Monitoring short term goals to achieve long term goals	• Mix of outcomes, outputs and process indicators • Indicators of relevance and efficacy of interventions • Monitoring indicators
Planner	• Transparency • Benchmarking and best practices • Performance improvement • Cooperation enhancement • Capacity building	• Outcomes, process, and structure indicators • Adequacy of infrastructure and resources to achieve goals • Indicators of effectiveness and efficacy
Manager	• Transparency • Performance improvement • Cooperation enhancement • Capacity building • Implementation	• Outcomes, process, and structure indicators • Ability to access and visualize granular details relevant to their context and programmatic goals

Source: Adapted from Veillard et al. 2016.

health, and ageing amongst others. It is important to recognize that dashboards must be built from the outset with flexibility in use to meet the needs of different users with different interests and needs.

Meeting these goals requires user journeys, information architecture, and visualizations that are fit for purpose and prioritize usability to meet unique user goals, while ensuring a cohesive architecture. Dashboard design should be accessible and engaging, with enough explanatory information to assure users of the quality, accuracy, and sources of the data underpinning the indicators. Functionalities should include user segmented journeys, maps to show regional variations, and the ability to display disaggregate data across several dimensions.

Institutionalizing the dashboard

Once assembled, a healthy longevity dashboard enables countries to establish contextually relevant, data-driven priorities to promote human capital and happiness across the life course and cannot be just a one-off exercise. Through the dashboard creation process, countries clarify their healthy longevity goals, commitments, and investments, while committing to ongoing goal monitoring. In doing so, the dashboard can be a tool for change at the highest levels, shifting the power dynamic between international funders and recipients and empowering countries to identify, monitor, and course correct investments and interventions based on their own data availability and evaluation processes (Global Commission on Evidence to Address Societal Challenges 2022).

Institutionalizing a dashboard is critical to ensure that the data informing the indicators is maintained and able to persist overtime. Learning from the evidence-to-policy literature, institutionalization of such efforts can occur through governance, in other words, through rule-making and steering-related functions, structures or platforms that increase visibility and protect it from ad hoc changes in politics and contexts (Kuchenmuller et al. 2022).[54] It can also be achieved through the use of standards and routinized processes, that is products and processes that policy-makers trust and use, serving as institutional memory and reducing reliance on individual people with knowledge and skills. Partnerships and collective action are another way to institutionalize dashboards, leveraging the extent to which stakeholders interact as a mechanism for continued engagement and involvement for the same cause. Leadership and commitment to the dashboard through strong leadership with the ability to ensure long-lasting adoption through allocation of resources, encouragement, support, and mentorship can also add to its sustainability. Dashboards can be institutionalized when supported with adequate resources, human, financial, material, and information resources, in a sustainable and stable way. Finally, organizational culture must align to ensure dashboards serve an ongoing purpose. That is the basic values, assumptions, artefacts, and beliefs that are considered valid and promoted, support dashboard inputs and ongoing use. All these institutionalizing levers can be used to ensure a healthy longevity dashboard is an enduring tool as part of a cohesive measurement approach. Institutionalizing a dashboard offers a useful approach to long-term planning towards healthy longevity. It is also important to note enduring obstacles such as lack of sustainable investments and low human resources capacity that often result in management information systems (of which dashboards are a subset) that are inadequately maintained or developed.

LIMITATIONS

There are several limitations to the dashboard creation approach we describe here.

First, when choosing indicators, we prioritized being selective and parsimonious to ensure that the dashboards included the most relevant indicators based on accessible and robust data. When considering population-level data, data quality varies, in particular at sub-national levels and for indicators where the denominator is unknown. Second, our framework and dashboards currently do not include indicators on an enabling environment, where societies and the built environment are built in such a way that people are able to live healthy lives, accumulate and protect human capital in their communities, eventually ageing in place. More work is needed to determine how best to measure and monitor this important aspect of healthy longevity (Wang et al. 2021; Lak et al. 2021; Kim et al. 2022).

Third, the dashboard is limited in its ability to track current multi-sectoral investments and government spending on healthy longevity. Future work should consider how to aggregate and monitor spending across the diverse interventions that preserve human capital and promote health longevity across the life course. Lastly, there may be risks to a healthy longevity dashboard that must be monitored. The pay for performance literature underscores that by focusing on a specific area, for example the key actions or domains we've highlighted, you risk losing focus on other unmeasured areas that need greater attention and investment (Kyeremanteng et al. 2019; Eijkenaar 2013). This risk highlights the need for broader and interconnected monitoring efforts within and across countries, as well as the importance of contextualizing a healthy longevity dashboard within larger planning and programmatic efforts.

CONCLUSION

As the global population ages and the burden of NCDs grows, ensuring healthy longevity will be increasingly important to policymakers, planners, managers, and the public, particularly in LMICs.

A healthy longevity dashboard is an important tool firstly, to indicate progress across a range of goals that offer insights as to whether a country is preparing for and adapting to an ageing population and higher burden of NCDs; and secondly, to offer information on effectiveness of core interventions to promote healthy longevity. In doing so, a healthy longevity dashboard can guide better systems planning and management and determine multisectoral interventions with a life course lens. Our case studies underscore that creating a healthy longevity dashboard is in reach across a spectrum of data infrastructure maturity levels and demographic contexts. A healthy longevity dashboard is ultimately more than a monitoring tool. It represents a commitment to the health, productivity, and happiness goals that underpin selected indicators and is an opportunity to use data for targeted interventions and to promote strategic approaches to investing in people across the life course.

REFERENCES

1. AHEAD. 2022. *Ending the HIV Epidemic in the U.S. America's HIV Epidemic Analysis Dashboard* (AHEAD). https://ahead.hiv.gov (accessed 14 October 2022).
2. Allen, Luke N, Brian D Nicholson, Beatrice Y T Yeung, and Francisco Goiana-da-Silva. 2020. "Implementation of Non-Communicable Disease Policies: A Geopolitical Analysis of 151 Countries." *The Lancet Global Health* 8 (1): e50–58.
3. Baranek, Patricia, Jeremy Veillard, and John Wright. 2011. "Benchmarking Health Care in Federal Systems: The Canadian Experience." In *Benchmarking in Federal Systems*, edited by Alan Fenna. Forum of Confederations.
4. Beard, John R, and David E Bloom. 2015. "Towards a Comprehensive Public Health Response to Population Ageing." *The Lancet* 385 (9968): 658–61.
5. Bienassis, Kate de, Rie Fujisawa, Tiago C.O. Hashiguchi, Niek Klazinga, and Jillian Oderkirk. 2022. "
6. Bloom, David E., and Alfonso Sousa-Poza. 2013. "Ageing and Productivity: Introduction." IZA Discussion Papers, No. 7205. Bonn, Germany: Institute of Labor Economics (IZA).
7. Bonney, Wilfred. 2013. "Applicability of Business Intelligence in Electronic Health Record." *Procedia - Social and Behavioral Sciences* 73 (February): 257–62.
8. Chaker, Layal, Abby Falla, Sven J. van der Lee, Taulant Muka, David Imo, Loes Jaspers, Veronica Colpani, et al. 2015. "The Global Impact of Non-Communicable Diseases on Macro-Economic Productivity: A Systematic Review." *European Journal of Epidemiology* 30 (5): 357–95.
9. Corral, Paul, Nicola Dehnen, Ritika D'Souza, Roberta Gatti, and Aaart Kray. 2021. "The World Bank Human Capital Index." In *Measuring Human Capital*, edited by Barbara Fraumeni. Academic Press.
10. Dehnavieh, Reza, AliAkbar Haghdoost, Ardeshir Khosravi, Fahime Hoseinabadi, Hamed Rahimi, Atousa Poursheikhali, Nahid Khajehpour, et al. 2018. "The District Health Information System (DHIS2): A Literature Review and Meta-Synthesis of Its Strengths and Operational Challenges Based on the Experiences of 11 Countries." *Health Information Management Journal* 48 (2): 62–75.
11. DHIS2. 2022. District Health Information System 2 (DHIS2). www.dhis2.org.
12. Eckerson, Wayne W. 2010. *Performance Dashboards: Measuring, Monitoring, and Managing Your Business*. 2nd ed. Hobo-

ken, N.J.: John Wiley.
13. Edwards, David, and John Clayton Thomas. 2005. "Developing a Municipal Performance-Measurement System: Reflections on the Atlanta Dashboard." *Public Administration Review* 65 (3): 369–76.
14. Eijkenaar, Frank. 2011. "Key Issues in the Design of Pay for Performance Programs." *The European Journal of Health Economics* 14 (1): 117–31.
15. GBD 2019 Ageing Collaborators. 2022. "Global, Regional, and National Burden of Diseases and Injuries for Adults 70 Years and Older: Systematic Analysis for the Global Burden of Disease 2019 Study." *BMJ*, March, e068208.
16. Ghazisaeidi, Marjan, Reza Safdari, Mashallah Torabi, Mahboobeh Mirzaee, Jebraeil Farzi, and Azadeh Goodini. 2015. "Development of Performance Dashboards in Healthcare Sector: Key Practical Issues." *Acta Informatica Medica* 23 (5): 317.
17. Global Commission on Evidence to Address Societal Challenges. 2022. "The Evidence Commission Report: A Wake-up Call and Path Forward for Decision-makers, Evidence Intermediaries, and Impact-oriented Evidence Producers." Hamilton: McMaster Health Forum.
18. Heeks, Richard. 2022. "Digital Inequality beyond the Digital Divide: Conceptualizing Adverse Digital Incorporation in the Global South." *Information Technology for Development* 28 (4): 1–17.
19. Helminski, Danielle, Jacob E Kurlander, Anjana Deep Renji, Jeremy B Sussman, Paul N Pfeiffer, Marisa L Conte, Oliver J Gadabu, et al. 2022. "Dashboards in Health Care Settings: Protocol for a Scoping Review." *JMIR Research Protocols* 11 (3): e34894.
20. Holzer, Marc, and Kaifeng Yang. 2004. "Performance Measurement and Improvement: An Assessment of the State of the Art." *International Review of Administrative Sciences* 70 (1): 15–31.
21. Hoxha, Klesta, Yuen W Hung, Bridget R Irwin, and Karen A Grépin. 2020. "Understanding the Challenges Associated with the Use of Data from Routine Health Information Systems in Low- and Middle-Income Countries: A Systematic Review." *Health Information Management Journal*, June, 183335832092872.
22. Hulme, David, Antonio Savoia, and Kunal Sen. 2014. "Governance as a Global Development Goal? Setting, Measuring and Monitoring the Post-2015 Development Agenda." ESID Working Paper No.32, University of Manchester.
23. Ivanković, Damir, Erica Barbazza, Véronique Bos, Óscar Brito Fernandes, Kendall Jamieson Gilmore, Tessa Jansen, Pinar Kara, et al. 2021. "Features Constituting Actionable COVID-19 Dashboards: Descriptive Assessment and Expert Appraisal of 158 Public Web-Based COVID-19 Dashboards." *Journal of Medical Internet Research* 23 (2): e25682.
24. Kaplan, Robert S., and David P. Norton. 2007. "Using the Balanced Scorecard as a Strategic Management System." Harvard Business Review. July 2007. https://hbr.org/2007/07/using-the-balanced-scorecard-as-a-strategic-management-system.
25. Kim, Kyeongmo, Tommy Buckley, Denise Burnette, Seon Kim, and Sunghwan Cho. 2021. "Measurement Indicators of Age-Friendly Communities: Findings from the AARP Age-Friendly Community Survey." Edited by Suzanne Meeks. *The Gerontologist* 62 (1).
26. Kolukısa Tarhan, Ayça, Vahid Garousi, Oktay Turetken, Mehmet Söylemez, and Sonia Garossi. 2020. "Maturity Assessment and Maturity Models in Health Care: A Multivocal Literature Review." *Digital Health* 6 (January): 205520762091477.
27. Kruglov, Artem, Dragos Strugar, and Giancarlo Succi. 2021. "Tailored Performance Dashboards—an Evaluation of the State of the Art." *Peer J Computer Science* 7 (October): e625.
28. Kuchenmüller, Tanja, Laura Boeira, Sandy Oliver, Kaelan Moat, Fadi El-Jardali, Jorge Barreto, and John Lavis. 2022. "Domains and Processes for Institutionalizing Evidence-Informed Health Policy-Making: A Critical Interpretive Synthesis." *Health Research Policy and Systems* 20 (1).
29. Kumar, Manish, David Gotz, Tara Nutley, and Jason B. Smith. 2017. "Research Gaps in Routine Health Information System Design Barriers to Data Quality and Use in Low- and Middle-Income Countries: A Literature Review." *The International Journal of Health Planning and Management* 33 (1): e1–9.
30. Kunjan, Kislaya, Bradley Doebbeling, and Tammy Toscos. 2018. "Dashboards to Support Operational Decision Making in Health Centers: A Case for Role-Specific Design." *International Journal of Human–Computer Interaction* 35 (9): 742–50.
31. Kyeremanteng, Kwadwo, Raphaëlle Robidoux, Gianni D'Egidio, Shannon M. Fernando, and David Neilipovitz. 2019. "An Analysis of Pay-For-Performance Schemes and Their Potential Impacts on Health Systems and Outcomes for Patients." *Critical Care Research and Practice* 2019 (1): 1–7.
32. Lak, Azadeh, Parichehr Rashidghalam, S. Nouroddin Amiri, Phyo K. Myint, and Hamid R. Baradaran. 2021. "An Ecological Approach to the Development of an Active Aging Measurement in Urban Areas (AAMU)." *BMC Public Health* 21 (1).
33. Mathers, Colin D, and Dejan Loncar. 2006. "Projections of Global Mortality and Burden of Disease from 2002 to 2030." Edited by Jon Samet. *PLoS Medicine* 3 (11): e442.
34. McArthur, John. 2013. "Own the Goals: What the Millennium Development Goals Have Accomplished." *Foreign Affairs* 92 (2).
35. McArthur, John W. 2014. "The Origins of the Millennium Development Goals." *The SAIS Review of International Affairs* 34 (2): 5–24.
36. McArthur, John W., and Krista Rasmussen. 2018. "Change of Pace: Accelerations and Advances during the Millennium Development Goal Era." *World Development* 105 (May): 132–43.
37. Means, Arianna Rubin, Christopher G. Kemp, Marie-Claire Gwayi-Chore, Sarah Gimbel, Caroline Soi, Kenneth Sherr, Bradley H. Wagenaar, Judith N. Wasserheit, and Bryan J. Weiner. 2020. "Evaluating and Optimizing the Consolidated Framework for Implementation Research (CFIR) for Use in Low- and Middle-Income Countries: A Systematic Review." *Implementation Science* 15 (1).
38. Miranda, J. J., S. Kinra, J. P. Casas, G. Davey Smith, and S. Ebra-

him. 2008. "Non-Communicable Diseases in Low- and Middle-Income Countries: Context, Determinants and Health Policy." *Tropical Medicine & International Health* 13 (10): 1225–34.
39. Narh-Bana, Solomon A., Mary Kawonga, Selase Adjoa Odopey, Frank Bonsu, Latifat Ibisomi, and Tobias F. Chirwa. 2022. "Factors Influencing the Implementation of TB Screening among PLHIV in Selected HIV Clinics in Ghana: A Qualitative Study." *BMC Health Services Research* 22 (1).
40. O'Keefe, Philip, and Victoria Haldane. 2024. "Towards a Framework for Impact Pathways between Non-communicable Diseases, Human Capital and Healthy Longevity, Economic and Wellbeing Outcomes," in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington D.C.: World Bank.
41. Organization for Economic Cooperation and Development (OECD). 2002. "Measuring Up: Improving Health System Performance in OECD Countries." Paris: OECD Publishing.
42. ———. Health Data Governance for the Digital Age: Implementing the OECD Recommendation on Health Data Governance. Paris: OECD Publishing.
43. Pan-American Health Organization (PAHO). 2019. "Information Systems for Health Toolkit IS4H Maturity Assessment Tool," IS4H-MM2.0. Geneva, Switzerland: World Health Organization.
44. Pfeffer, Jeffrey, and Robert I. Sutton. 2006. "Evidence-Based Management." Harvard Business Review. January 2006. https://hbr.org/2006/01/evidence-based-management.
45. RBM Partnership to End Malaria. 2022. *Global Malaria Dashboard*. Copenhagen, Denmark: United Nations Office for Project Services. https://dashboards.endmalaria.org/dashboard (accessed 14 October 2022).
46. Stein, Felix, and Devi Sridhar. 2019. "Back to the Future? Health and the World Bank's Human Capital Index." *BMJ*, November, l5706.
47. United Nations Children's Fund (UNICEF). 2022a. *Child Health and Well-Being Dashboard*. https://data.unicef.org/resources/child-health-and-well-being-dashboard/ (accessed 14 October 2022).
48. _____. 2022b. "The Countdown Country Profile: A Tool for Action." https://data.unicef.org/countdown-2030/ (accessed 14 October 2022).
49. United Nations Development Programme (UNDP). 2022. *Global Dashboard for Vaccine Equity*. https://data.undp.org/vaccine-equity/ (accessed 14 October 2022).
50. Veillard Jeremy, K Denny, B Tipper, N Klazinga. 2016. "Using Performance Measurement and Monitoring for Performance Improvement." In *Managing a Canadian Healthcare Strategy* edited by S Carson and K Nossal. Kingston: Queen's University Press.
51. Veillard, Jeremy, Tai Huynh, Sten Ardal, Sowmya Kadandale, Niek S. Klazinga, and Adalsteinn D. Brown. 2010. "Making Health System Performance Measurement Useful to Policy Makers: Aligning Strategies, Measurement and Local Health System Accountability in Ontario." *Healthcare Policy* 5 (3).
52. Vidal Carvalho, João, Álvaro Rocha, and António Abreu. 2017. "Maturity of Hospital Information Systems: Most Important Influencing Factors." *Health Informatics Journal* 25 (3): 617–31.
53. Wang, Chenghao, Diego Sierra Huertas, John W. Rowe, Ruth Finkelstein, Laura L. Carstensen, and Robert B. Jackson. 2021. "Rethinking the Urban Physical Environment for Century-Long Lives: From Age-Friendly to Longevity-Ready Cities." *Nature Aging* 1 (12): 1088–95.
54. World Bank. 2020. "The Human Capital Index 2020 Update: Human Capital in the Time of COVID-19." Washington, D.C: World Bank.
55. World Bank Group. 2020. "Human Capital Project: HCI Compass." Human Capital Project Washington, D.C.: World Bank Group.
56. World Health Organization (WHO). 2004. "Compendium of Indicators for Monitoring and Evaluating National Tuberculosis Programs." Geneva, Switzerland: World Health Organization.
57. ———. 2014. "Global Status Report on Noncommunicable Diseases 2014: Attaining the Nine Global Noncommunicable Diseases Targets, a Shared Responsibility." Geneva, Switzerland: World Health Organization.
58. ———. 2022a. *Summary of Tuberculosis Data*. Geneva, Switzerland: World Health Organization. https://worldhealthorg.shinyapps.io/TBrief/?_inputs_&sidebarCollapsed=true&entity_type=%22country%22&iso2=%22AF%22&sidebarItemExpanded=null (accessed 13 October 2022).
59. ———. 2022b. *Polio Transition Programme Monitoring and Evaluation Dashboard*. Geneva, Switzerland: World Health Organization. https://www.who.int/teams/polio-transition-programme/monitoring-and-evaluation-dashboard (accessed 14 October 2022).

ANNEX 17.1

EXAMPLES OF DASHBOARDS FOR GLOBAL GOALS

Below we offer an overview of select dashboards used to monitor progress and chart strategic action towards global goals across the health, environment, as well as the development sectors.

DASHBOARDS IN THE HEALTH SECTOR

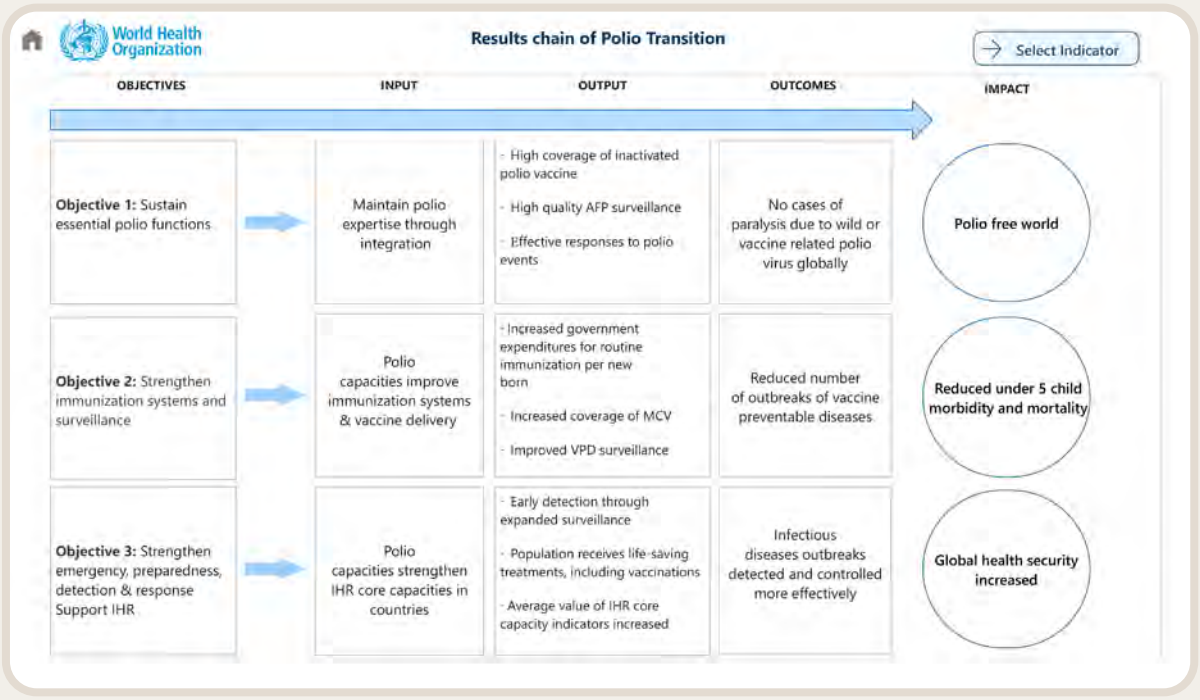
In the health sector, dashboards are descriptive and mainly used for tracking progress against global goals across vertical disease or stakeholder programming (such as tuberculosis, malaria, polio, maternal and child health) and are produced by international organizations (such as WHO) or consortia tasked with motivating progress towards established goals.

Polio transition programme monitoring and evaluation dashboard

Aims to be the central repository of output and process indicators to assess progress, identify areas for improvement, and document achievements. The dashboard aims to ensure a transparent and regular way of informing stakeholders on progress towards polio transition goals, as well as monitoring the quality of the polio immunization, surveillance, and outbreak response activities during the transition period, and detecting areas for improvement during the transition period so as to take corrective action when needed: https://www.who.int/teams/polio-transition-programme/monitoring-and-evaluation-dashboard.

The dashboard offers a results chain of the polio transition beginning with objects and following inputs, outputs, and outcomes to achieve impact in four areas – a polio free world, reduced under five child morbidity and mortality, and increased global health security. Indicators for further viewing can be accessed across objectives: 1) sustain a polio-free world after eradication; 2) strengthen immuniza-

FIGURE 17A.1a Polio transition program monitoring and evaluation dashboard



Source: https://www.who.int/teams/polio-transition-programme/monitoring-and-evaluation-dashboard

tion systems and surveillances; and 3) strengthen emergency, preparedness, detection and response capacity (through the International Health Regulations); as well as number of process indicators. Once an indicator is selected, visualizations can be accessed and sorted by region and year.

The dashboard identifies priority countries across WHO regions and is based on the components of the Strategic Action Plan on Polio Transition (WHA 171_9)[2].

FIGURE 17A.1b Polio transition program monitoring and evaluation dashboard



Source: https://www.who.int/teams/polio-transition-programme/monitoring-and-evaluation-dashboard

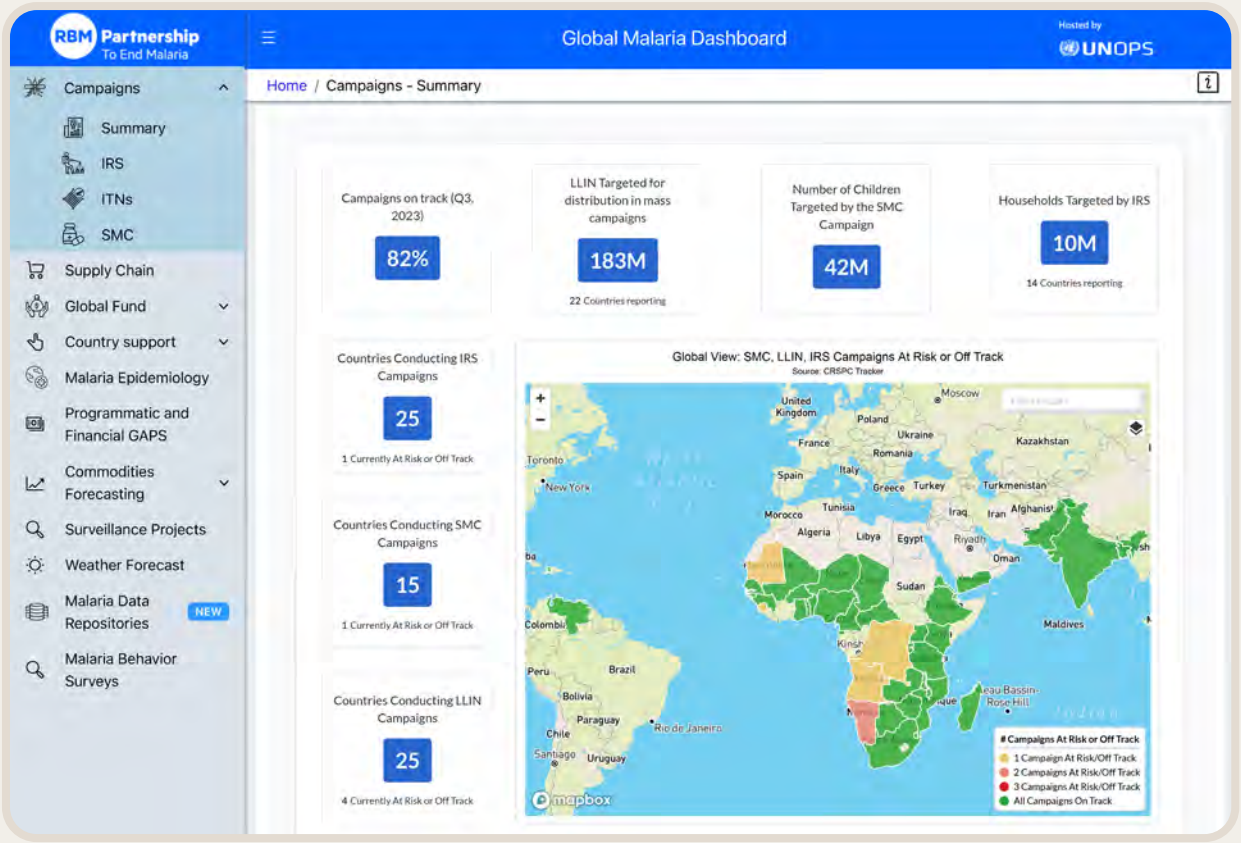
2 https://www.who.int/publications/i/item/A71-9

RBM partnership to end malaria global malaria dashboard

The dashboard offers a comprehensive overview of efforts towards goals to end malaria globally. Under the main dashboard are several sub-dashboards that track progress on end malaria strategies and goals globally. Dashboard available include information on campaigns, supply chain, global funding, country support, malaria epidemiology, programmatic and financial gaps, commodities forecasting, surveillance projects, and seasonal climate forecasts that offer probabilistic outlooks on temperature and precipitation given the sensitive of malaria-carrying mosquitos to environmental conditions.

The campaign dashboard provides a global overview on the number of planned campaigns by intervention and status by country. The dashboard includes indicators on distribution of insecticide-treated mosquito nets (ITN), indoor residual spraying (IRS), as well as preventive treatments for children (SMC) and pregnant women. Data is drawn from the End Malaria Country/Regional Support Partner Committee CRSPC country tracker platforms. The map visual includes a colour indicator that reports the number of campaigns at risk or off track within a country.

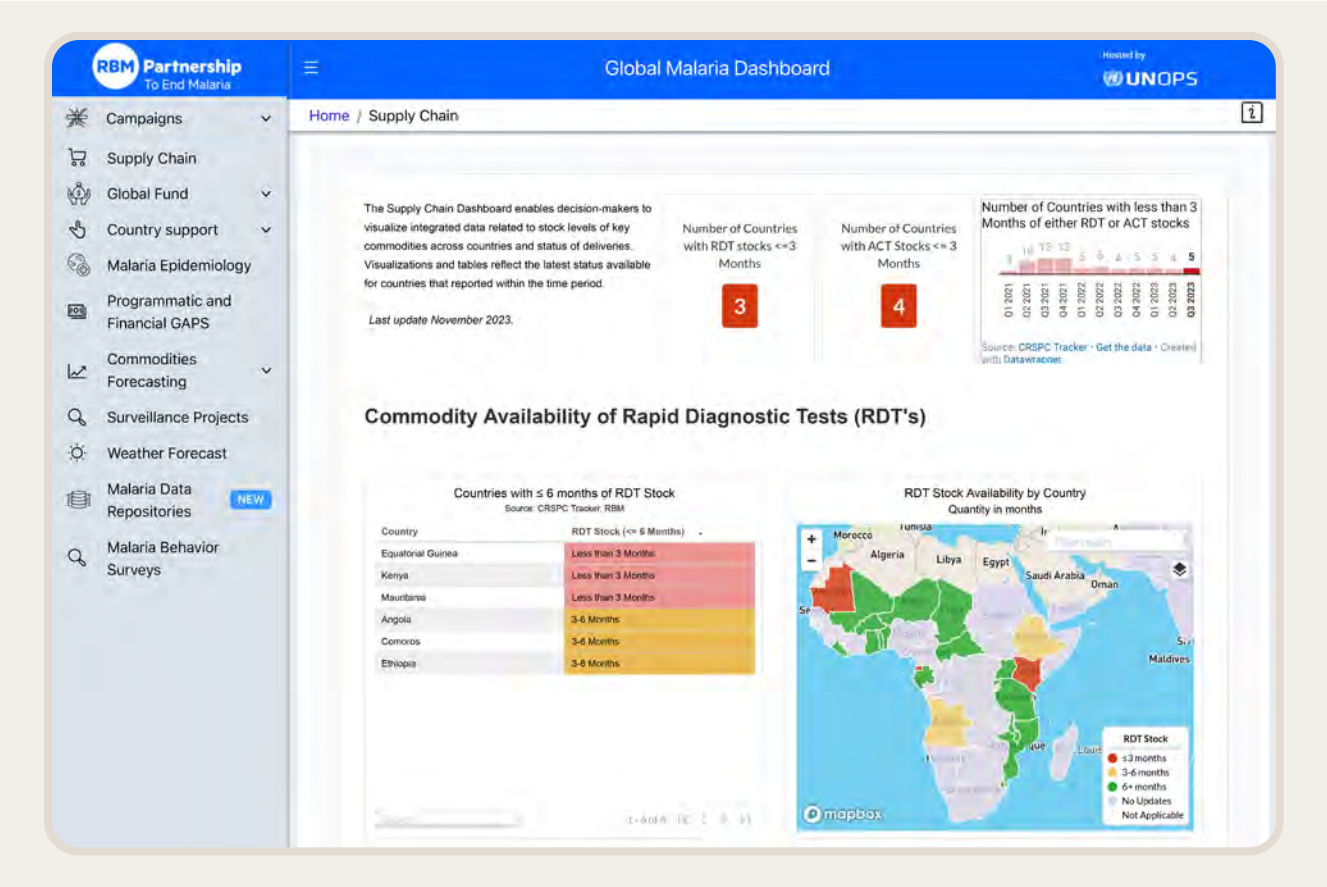
FIGURE 17A.2 Global Malaria Dashboard – Campaign Dashboard



Source: https://dashboards.endmalaria.org/dashboard

The Supply Chain Dashboard aims to enable decision-makers to visualize integrated data on stock levels of key commodities across countries, as well as the status of deliveries. It is offers information on targets for essential commodities set by the WHO including rapid diagnostic tests (RDTs) and treatment (Artemisinin-based combination therapy), as well as prevention tools. Data is drawn from the CRSPC tracker and triangulated with information from main donors including the Gates Foundation and PMI/USAID.

FIGURE 17A.3 Global Malaria Dashboard – Supply Chain Dashboard



Source: https://dashboards.endmalaria.org/dashboard

Countdown to 2030 for women's, children's and adolescents' health

Builds upon the successes of the Countdown to 2015 effort. It is a multi-stakeholder global movement that aims to accelerate the momentum to achieve the targets of the Sustainable Development Goals (SDGs) for ending preventable maternal, newborn, and child deaths; and catalyze efforts to achieve the vision of the Global Strategy for Women's, Children's and Adolescents' Health.

'The Countdown Country Profile: A Tool For Action' present the latest evidence to assess country progress in improving women's, children's, and adolescents' health: https://data.unicef.org/countdown-2030/

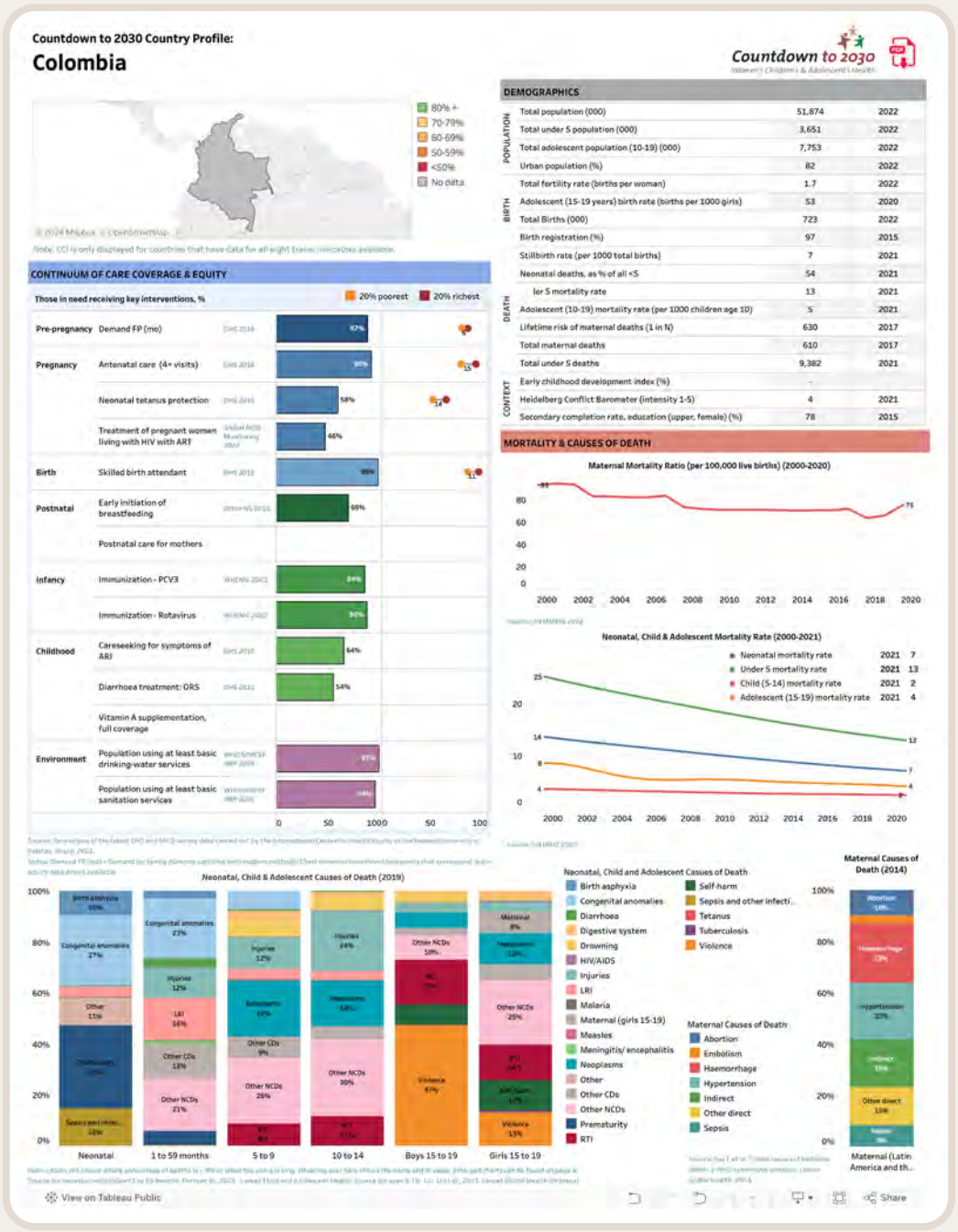
The tool draws on data on data from multiple global databases informed by national and international surveys and administrative sources. It presents this data using visualizations and tables displayed on a country-specific interactive dashboard across a range of indicators presented using progressive disclosure to reveal increasing complexity and detail including (organized by page):

- Demographic information (population, birth, death, and context domains); continuum of care coverage and equity (pre-pregnancy, pregnancy, birth, postnatal, infancy, childhood, and environment domains); mortality and causes of death (maternal, neonatal, child and adolescent mortality including causes of death).
- Nutrition, breastfeeding practices, child nutritional status, maternal and newborn health, child and adolescent health, environment, equity indicators.
- Policies systems and financing indicators; service delivery indicators.

The tool offers ways to use the evidence presented for action highlighting that all actors can leverage the dashboard to improve accountability for women's, children's, and adolescents' health. More specifically, civil society organizations and advocates are advised that the tool can be used to highlight areas where

progress has been lacking. Accountability is emphasized and the dashboard offered as a tool to help users hold country government and partners accountable for fulfilling their commitments to the 2030 agenda. To country governments and policy makers, the dashboard is presented as a planning tool, particularly for use in annual review cycles. It is also framed as a catalyst for discussions around priority investments, and for strategic policy and programmatic prioritization. The dashboard is also offered to academic partners and research institutions as a database for comparative analyses to reveal trends across countries and regions.

FIGURE 17A.4 Page 1 of The Countdown Country Profile: A Tool For Action for Colombia



Source: https://data.unicef.org/countdown-2030/country/Colombia/1/

Child health and well-being dashboard

The dashboard was designed through a consultative process with the Children in All Policies 2030 (CAP2030) Data and Learning Working Group, through which consensus was reached on basic dashboard parameters through a three-step process.[3] The dashboard is an additional accountability mechanism to assess progress on the UN Convention on the Rights of the Child (CRC). The user-friendly dashboard helps countries to regularly monitor their progress on child health and wellbeing and make evidence-based decisions about priority areas for action and resource allocation.

The Child Health and Well-being Dashboard aims to make data available to improve child and adolescent well-being and health: https://data.unicef.org/resources/child-health-and-well-being-dashboard/

The tool draws on data from the UNICEF data warehouse comprised of data sets from national and international surveys, as well as administrative data. It presents the data using a stoplight visualization with green signifying good progress or that the CRC target has been met, yellow indicates that moderate progress has been made or the target is on track, and red giving a warning that the target needs attention or acceleration to meet goals. Countries can be sorted by SDG, WHO, or UNICEF regions, as well as by income. Data can be filtered by age, domain, and country with options to view the numbers instead of the stoplight visualization, as well as colour-blind friendly formatting.

The dashboard presents indicators across four domains – survival, protection, development, and participation. Thirty-seven indicators are visualized, four indicators per age bracket are offered across six age brackets ranging from birth to 19 years, as well as context and policy indicators.

The dashboard highlights that the data and visualizations allow policymakers, governments, and organisations to easily monitor and compare a selection of indicators by region, country, age group, domain and income.

FIGURE 17A.5 Section of the Child Health and Well-being Dashboard



Source: https://data.unicef.org/resources/child-health-and-well-being-dashboard/

3 Requejo J, Diaz T, Park L, Strong K, Lopez G, Borrazzo J, Costello A, Dalglish SL, Doherty T, Felici C, Gram L. Child health and wellbeing dashboards: accountability for children's rights. The Lancet. 2022 May 14;399(10338):1847-9.

DASHBOARDS IN THE ENVIRONMENT SECTOR

In the environment sector dashboards are both descriptive and predictive. Dashboards, such as the Climate Action Tracker (CAT), are extensively used to call for action towards climate goals and emphasize the effects of insufficient action towards meeting climate goals set in the Paris Agreement.

FIGURE 17A.6 **Climate Action Tracker dashboard for Canada**



Source: https://climateactiontracker.org/countries/canada/

The climate action tracker (CAT)

An independent scientific analysis that monitors government climate action and measures it against the Paris Agreement aim of "holding warming well below 2°C and pursuing efforts to limit warming to 1.5°C." Created in 2009 by Climate Analytics and the NewClimate Institute, the CAT quantifies and evaluates climate change mitigation targets, policies, and action. The dashboard aggregates country action to the global level and using the MAGICC climate model determines likely temperature increases during the 21st century. The CAT also offers sectoral analysis to illustrate required pathways for meeting global temperature goals.

The CAT offers a colour coded scale to rank a country's performance against global emissions goals, while also offering visualizations of historical emissions and future pathways depending on policies and actions that lead to different temperature ranges derived from global least-cost models. The dashboard also offers a descriptive synthesis of the data presented and outlines policy developments that could impact country-level ratings.

DASHBOARDS IN THE DEVELOPMENT SECTOR

The Sustainable Development Goals (SDGs) are key overarching global development goals emerging from prior collective goal-setting efforts including the Millennium Development Goals. The SDGs have several associated dashboards to monitor progress towards their multiple, cross-cutting, and ambitious aims. To realize these goals, it has been emphasized that decision-makers need ongoing access to data that is accurate, timely, sufficiently disaggregated, relevant, accessible, and user friendly.

FIGURE 17A.7 Section of the Open SDG Data Hub Country Profile: India



Source: https://unstats.un.org/sdgs/dataportal/countryprofiles/IND

The open SDG data hub

To ensure this level of data availability and quality, the Open SDG Data Hub makes SDG-related data available for exploration and analysis: https://unstats.un.org/sdgs/dataportal.

The goal of the datahub is to enable data providers, managers, and users to discover, understand, and communicate patterns and interrelationships from the SDG data and statistics. Data is organized into SDG indicators organized by goal. The database also offers SDG analytics and country profiles that allow users to track country progress towards the 17 SDGs.

To fully implement and monitor progress on the Sustainable Development Goals, decision makers everywhere need data and statistics that are accurate, timely, sufficiently disaggregated, relevant, accessible and easy to use. The Open SDG Data Hub promotes the exploration, analysis, and use of authoritative SDG data sources for evidence-based decision-making and advocacy. Its goal is to enable data providers, managers and users to discover, understand, and communicate patterns and interrelationships in the wealth of SDG data and statistics that are now available.

ANNEX 17.2

TABLE 17A.1 Available Data to Better Understand Population Ageing

Type	Example
Internationally administrated surveys	• WHO Surveys on Ageing and Health • Longitudinal Social Protection Survey • World Value Survey
Regionally administrated surveys	• Survey of Health, Ageing and Retirement in Europe • Household Finance Consumer Survey
Nationally administrated surveys	• Health and Retirement Study (US) • Longitudinal Study of Ageing (UK, Brazil, China, India, Ireland, Japan, Mexico, and the Republic of Korea) • Luxembourg Wealth Study
Administrative data from health and social systems	• Vital Statistics data • Clinical registries • Electronic health records

18

Assessing Human Capital, Non-communicable Diseases, and Healthy Longevity in Low- and Middle-Income Countries

Healthy longevity dashboard and the case for India

Daphne C. Wu [a], Jeremy Veillard [b], Victoria Haldane [c], Seemeen Saadat [d], Prabhat Jha [a]

[a] Centre for Global Health Research, Unity Health Toronto, University of Toronto, Canada
[b] Health, Nutrition, and Population, Latin America and Caribbean, World Bank
[c] Institute of Health Policy, Management and Evaluation, University of Toronto
[d] Health, Nutrition, and Population Global Practice, World Bank

INTRODUCTION

The global population is rapidly aging. By 2050, one in six people will be over the age of 65 (United Nations, Department of Economic and Social Affairs, Population Division 2022). An aging population comes with a complex set of risks to health, well-being, and productivity. Non-communicable diseases (NCDs) are one such risk that increasingly threatens the lives and livelihoods of older adults. Indeed, 74% of all deaths people annually are due to NCDs (WHO 2022a). Low- and middle-income countries (LMICs) bear a disproportionate and growing burden of NCD-related morbidity and mortality, with 77 percent of all NCD deaths occurring in LMICs (WHO 2022a). Yet, in many LMICs, healthy aging and NCDs are a nascent area of policy action.

Coordinated efforts are needed globally to emphasize the importance of healthy longevity on both health and well-being. The concept of healthy longevity describes a process of ageing that promotes human capital across the life course and where NCDs, serious disability, and deaths are avoided in middle age, thereby compressing morbidity into the older ages. The World Bank Healthy Longevity Initiative (HLI) sets an agenda that promotes human capital accumulation and preservation across the life course, while also considering the linkages between these, NCDs, healthy longevity, economic, and well-being outcomes (World Bank 2024). To realize such an agenda, strategic action, and focused investments, guided by local evidence, are required with progress monitored over time.

The HLI offers a common framework and harmonized benchmarking approach to measuring and monitoring healthy longevity, while also recognizing that differing data and information system contexts across countries will inform the mix of indicators and their presentation in performance dashboards (hereafter 'dashboards'). Dashboards bring together representations of indicators into a unified interface that uses data visualization tools to enable performance monitoring across selected performance dimensions. Here, we describe one such healthy longevity dashboard proposed for use by countries with moderate data infrastructure maturity.

METHODS

Selecting indicators

Rationale for selecting HLI indicators

The healthy longevity dashboard is an ongoing effort to develop and refine a suite of indicators that bring together relevant data to measure and monitor country progress towards healthy longevity. As part of these efforts, a common framework for healthy longevity and harmonized approach has been proposed under HLI (World Bank 2024, O'Keefe and Haldane 2024). Under this approach, indicators were selected that map to the overarching HLI conceptual framework and that can be distilled across three key actions and ten related domains to be prioritized when developing a healthy longevity dashboard (Table 18.1). This approach allows us to identify indicators that map to data infrastructure maturity in a given country, while ensuring comparable and consistent conceptual underpinnings. What indicators are used to carry out these actions and represent these domains is informed in part by country context as well as by the data infrastructure maturity of the country developing the dashboard. As such, indicators must be selected that not only correspond to different stages of the life course but that are also are actionable, pragmatic, and comprehensive and represent a breadth of structure, process, and outcomes measures.

Indicators of context

First, we selected contextual indicators. These indicators were selected to provide crucial information on basic social, demographic, and economic characteristics of a country that enables policymakers and other dashboard users to correctly interpret the setting from which other performance-related indicators are drawn.

TABLE 18.1 Key actions and related domains when developing a healthy longevity dashboard

Life course stage	Intensive human capital accumulation	Human capital accumulation, deployment, and depreciation	Declining human capital accumulation, accelerated depreciation and depletion
Key action	1. Promoting enabling factors for human capital accumulation	2. Ensuring adequate prevention and control of NCDs across the life course	3. Creating supportive conditions for healthy and productive ageing
Supporting domains	• Disease prevention • Education outcomes • Youth focus • Gender norms	• NCD risk factors and behaviors • NCD management • Reducing avoidable mortality	• Healthy population • Productive ageing • Well-being in old age

The indicators of context are as follows:

i. Gross domestic product (GDP) per capita and World Bank income category based on the 2021 World Bank country classification: low income, lower-middle income, upper-middle income, or high income;

ii. GINI index;

iii. Poverty gap at $3.65 a day (2017 PPP), defined as the mean shortfall in income or consumption from the poverty line of $3.65 a day, expressed as a percentage of the poverty line (World Bank 2022);

iv. Percentage of population aged 60 years and older;

v. Percentage of population of working age defined as ages 15 to 64;

vi. Labour force participation rate, defined as the proportion of the population ages 15 and older that is economically active;

vii. Ratio of female to male labor force participation rate;

viii. Mean years of schooling among population aged 25 years and over;

ix. Percentage of total deaths due to NCDs;

x. UHC coverage index, defined as the average coverage of essential services based on interventions in reproductive, maternal, newborn and child health, infectious diseases, NCDs and service capacity and access, among the general and the most disadvantaged population (WHO 2022b).

HLI indicators

We then used the conceptual framework to identify healthy longevity indicators that draw from available data that are contextually relevant, readily available and would inform policymakers and others on key elements for monitoring and progress. To identify such indicators, we conducted a review of data available from international institutions, including the World Health Organization (WHO) Global Health Observatory (WHO 2022c), World Bank World Development Indicators (World Bank 2022), Organization for Economic Co-operation and Development (OECD) Statistics (Organization for Economic Co-operation and Development (OECD) 2022), ILOSTAT (International Labour Organization (ILO) 2022), and UNESCO Institute for Statistics (UNESCO Institute for Statistics 2022). We only reviewed data from international institutions as this allows comparability of data across countries which is an important objective of the dashboard. We did not include data from the Institute for Health Metrics and Evaluation's Global Burden of Diseases, Injuries, and Risk Factors Study (GBD), as most estimates in the GBD are generated from complex models using inputs from country surveys, vital statistics, and other data sources, where available (Vos and others 2020). For LMICs where data collection and availability is sparse, the input sources used in the GBD model are ambiguous and the estimates generated are thus debatable. As such, we excluded data from the GBD.

From the global data review, we gathered a list of plausible indicators that can be classified into 10 broad domains pertaining to the accumulation, deployment, and depletion of human capital and healthy longevity, with a focus on NCDs. These domains are: (i) life expectancy, (ii) mortality at different life stages (under five years, school age (age

FIGURE 18.1 **Criteria and process of indicator selection**



5-14 years), youths and young adults (age 15-29 years), adults aged 30-69 years, and older ages (aged 70 years and above)), (iii) child health, (iv) adult immunizations, (v) risk factors, (vi) access to care for NCDs and NCD management, (vii) education, (viii) gender equality, (ix) labor force, and (x) social protection. We did not have a domain on morbidity as the only cross-country sources of morbidity data are the WHO and the GBD, and WHO estimates are drawn primarily from the GBD.

The list of plausible indicators was further streamlined using the following criteria:

a. The indicator must be outcome-focused,

b. The indicator must be available for most countries, particularly for LMICs where data are usually sparse,

c. The indicator must align with national or international goals,

d. The indicator must be easy to measure and not based on composite indicators,

e. The indicator must be based on data that are reported on a regular basis at the country level and comparable across countries, and

f. The indicator must have data that are based on country surveys and not generated chiefly from epidemiological or econometric models.

The steps used to select the indicators are presented in Figure 18.1.

The list of selected indicators along with the domains are presented in Table 18.2. Where sex and income disaggregated data are available, they were included. This list of indicators may, however, differ by country, depending on data availability for the country.

TABLE 18.2 Indicator domains and indicators in the HLI dashboard for setting with moderate data infrastructure, and data sources for the India HLI dashboard

Domains	Indicators
Life expectancy	• Life expectancy at birth • Life expectancy at age 60 • Healthy life expectancy at birth • Healthy life expectancy at age 60
Mortality at different life stages	• Under-five mortality rate • School age (age 5-14 years) mortality rate • Mortality rate among youths and young adults (age 15-29 years) • Adult (aged 30-69 years) mortality rate • Mortality rate at older ages (aged 70 years and above)
Child health	**Childhood vaccinations** • BCG immunization coverage among one-year olds • Diphtheria tetanus toxoid and pertussis (DTP3) immunization coverage among one-year-olds • Polio (Pol3) immunization among one-year-olds • Measles-containing-vaccine second-dose (MCV2) immunization coverage by the nationally recommended age **Healthy growth** • Stunting prevalence among children under 5 years • Wasting prevalence among children under 5 years • Underweight prevalence among children under 5 years
Adult immunizations	• Tetanus vaccination coverage for pregnant women • COVID-19 vaccination (two doses) coverage for all ages
Access to care for NCDs and NCD management	• Prevalence of treatment (taking medicine) for hypertension among population aged 30-79 with hypertension
NCD risk factors	**Tobacco use** • Tobacco use prevalence among population aged 15 years and over • Cigarette smoking prevalence among population aged 15 years and over • Tobacco use prevalence among youths aged 15-24 years • Tobacco cessation, represented by the ratio of former to current smokers aged 45-59 years **Harmful alcohol use** • 12-month prevalence of harmful alcohol use among population aged 15+ years **Obesity** • Obesity prevalence among population aged 20 years and over **Type 2 diabetes** • Prevalence of type 2 diabetes among population aged 20-79 **Hypertension** • Prevalence of hypertension among population aged 30-79 years **Mental health** • Prevalence of current depression among population aged 18 years and over
Education	• Learning-adjusted years of school at age 18
Gender equality	• Percentage of ever-partnered women aged 15-49 years who experienced physical and/or sexual violence by current or former partner in the previous 12 months • Percentage of women's (aged 15-64) work time (paid and unpaid) spent on unpaid work • Ratio of female to male labor force participation rate • OECD Social Institution and Gender Index (SIGI)*
Labour force	• Labour force participation rate among population aged 15 years and over
Social protection	• Population covered by at least one social protection cash benefit (excluding health)† • Public expenditure on social protection (excluding health), as % of GDP • Public expenditure on pension, as % of GDP

* The OECD Development Centre's Social Institutions and Gender Index (SIGI) is a cross-country measure of discrimination against women that takes into account country laws, social norms, and practices around women's rights and access to resources (including discrimination in the family, restricted physical integrity, restriction access to productive and financial resources, and restricted civil liberties for women) (OECD 2019). Although this index is not based on data reported periodically by countries, it serves an important information source on "Whether or not legal frameworks are in place to promote, enforce and monitor gender equality and women's empowerment" (SDG Indicators 5.1.1).

† Proportion of the total population receiving at least one contributory or non-contributory cash benefit, or actively contributing to at least one social security scheme.

Performance score

To assess the performance of a country relative to other countries with respect to an indicator, we normalized the data across countries to calculate the score based on two approaches: percentile rank approach and z-score approach. Details of the two approaches are described below. In both approaches, the study country is compared with other countries that fall under the same income strata as the study country, based on the 2021 World Bank country classification (World Bank 2021), and have a population of more than seven million (or 0.1 percent of the world population) in 2021, based on the United Nations' World Population Prospects 2022 (United Nations, Department of Economic and Social Affairs, Population Division 2022). A score of 100 percent indicates best performance, 50 percent indicates average performance, and 0 percent indicates worst performance relative to the other countries.

Percentile rank approach

In the percentile rank approach, the score for an indicator is represented by its percentile rank. The percentile rank is calculated using the standard formula:

$$\text{Percentile rank}=(M+(0.5*R))/Y$$

where 'M' is the number of values below the value for the study country, 'R' is the number of values equals to the value for the study country, and 'Y' is the total number of values.

For indicators where a higher value indicates better performance, such as life expectancy and employment rate, the percentile rank is directly interpreted as the score, whereas for indicators where a lower value indicates better performance, such as mortality and morbidity rate, the score is further calculated as 1 – percentile rank. We use 'P' to denote the score calculated based on this approach.

Z-score approach

While the percentile rank approach provides the performance of a country relative to all other countries, it does not take into account the distribution of the indicator across countries. To take into account the indicator distribution, including the mean and standard deviation, a score is computed based on the z-score. This approach assumes that the indicator values are normally distributed and a z-score for a country is calculated using the standard formula:

$$z=((x - \mu))/\sigma$$

where 'x' is the value for the study country, μ is the mean value across all countries, and 'σ' is the standard deviation.

Based on the z-score, we then used the z-table to obtain the percentage of countries that are performing below the study country. This percentage is used as the score for indicators where higher the value, better the performance, such as life expectancy. For indicators where lower the value, better the performance, such as mortality rate, the score is further calculated as one minus calculated percentage. The score calculated using this approach is denoted by 'Z'.

Based on the scores calculated from the two approaches, we assigned the study country into one of four quartiles: <25%, 25 - <50%, 50% - <75%, and ≥75%.

Performance dashboard results for india

Drawing on these indicators and scoring approach, we present the HLI dashboard for India as an example of settings with moderate data infrastructure. India is a lower-middle income country, according to the 2021 World Bank country classification (World Bank 2021), with a population of about 1.39 billion in 2021 (United Nations Department of Economic and Social Affairs Population Division 2022). Thus, on the dashboard, India is ranked relative to 33 lower-middle income countries. The list of 33 countries is provided in Appendix Table A18.1. Appendix Table A18.2 presents the data sources for each indicator included in the India dashboard. For each indicator, we used most recently available data between 2015 and 2019. We did not use data older than 2015 as they may not reflect the current scenario in the country. We did not use data after 2019, as they may not be comparable to those before the COVID-19 pandemic.

Alignment with national and international goals

In 2015, all Member States of the United Nations (UN) adopted the Sustainable Development Goals (SDGs). The SDGs comprise of an ambitious set of 17 goals and 169 targets addressing the global challenges of poverty, inequality, climate change, environmental degradation, peace, and justice (United Nations General Assembly 2015). The HLI indicators broadly ad-

dress a number of areas in the SDGs, including Goal 2 on zero hunger, goal 3 on good health and well-being, goal 4 on quality education, goal 5 on gender equality, and goal 8 on decent work and economic growth (United Nations General Assembly 2015).

The HLI indicators chosen for this dashboard are also relevant to the current 2017 Indian National Health Policy, including universal health coverage, life expectancy, child mortality, mortality from major NCDs (cardiovascular diseases, cancer, diabetes, and chronic respiratory diseases), child immunizations, access to medications among those with NCDs, tobacco use, stunting, and gender-based violence (Ministry of Health and Family Welfare, Government of India 2017). Given this, the HLI dashboard could serve as a guide to achieving many of the policy objectives.

RESULTS

Context

Table 18.3 presents contextual information on economic, social, and health indicators for India and compares them, where applicable, with the average for all lower-middle countries and the world, using most recently available data between 2015 and 2019. In 2019, the GDP per capita for India sits just below the average for all lower-middle income countries at US$2,047 or Int$6,887 (US$2,386 or Int$7,566 for lower-middle income countries). It has an adequately equal income distribution with a GINI index of 35.7, and an estimated poverty gap measured at US$3.65 per day (2017 PPP) of 12 percent, making it comparable to that for lower-middle income countries (11 percent), but higher than the global average of 8 percent.

In terms of demography, India has a slightly higher proportion of population aged 60 and over than the average for lower-middle income countries but lower than for the world (10.2 percent in India vs 9.1 percent in lower-middle income countries vs 13.5 percent globally). It also has a higher proportion of working age population; however, the labor force participation rate is much lower. The ratio of female to male labor force participation rate and mean years of schooling in India are also lower than that in lower-middle income countries and globally. Finally, in terms of health profile and service coverage, India has a higher proportion of deaths that are attributable to NCDs and higher UHC coverage compared to the average of lower-middle income countries but lower than the global average.

TABLE 18.3 Indicators of context– India, lower-middle income countries and world in 2019

Indicators of context	India	Lower-middle income countries	World
GDP per capita, in US$ (Int$)	2,047.2 (6,887.5) lower-middle income	2,386.5 (7,566.2)	11,320.9 (17,607.6)
GINI index	35.7	-	-
Poverty gap at $3.65 a day (2017 PPP), as % of the poverty line	12	11	8
Percentage of population aged 60 years and older (%)	10.2	9.1	13.5
Percentage of population of working age (%)	66.9	64.9	64.2
Labour force participation rate (%)	49.3	54.4	60.2†
Ratio of female to male labor force participation rate	28.9	43.6	65.8†
Mean years of schooling among population aged 25 years and over	6.7	7.3	8.9
Percentage of deaths due to NCDs	65.9	62.6	73.6
UHC service coverage index*	61	58	67

*UHC (universal health coverage) service coverage index is defined as the average coverage of essential services based on interventions in reproductive, maternal, newborn and child health, infectious diseases, NCDs and service capacity and access, among the general and the most disadvantaged population (WHO 2022b).
†Modelled ILO estimate.
- N/A

Health indicators (Domains 1-6)

Table 18.4 presents the data and scores based on percentile rank approach (P) and z-score approach (Z) for the HLI health indicators for India. For a majority of the health indicators, P and Z are closely correlated. For most indicators, India falls in the categories of 25 - < 50% (orange) and 50 - < 75% (yellow) among lower-middle income countries. India fares better on obesity than most other lower-middle income countries but lags substantially on the healthy growth indicators (stunting, wasting, and underweight). On the other hand, where gender disaggregated data are available, we find that males score higher than females except in harmful alcohol use and prevalence of hypertension. In other words, males in India fare better than females when compared to their counterparts in other lower-middle income countries. Scores are not available for mental health (current depression) due to lack of comparable data from other countries.

TABLE 18.4 HLI health indicators (domains 1-6) and scores based on percentile rank approach (P) and z-score approach (Z) for India

Domain	Indicators	Both sexes			Males			Females		
		Value	P (out of 100)	Z (out of 100)	Value	P (out of 100)	Z (out of 100)	Value	P (out of 100)	Z (out of 100)
Life expectancy	Life expectancy at birth (years)	-	-	-	69.5	66	68	72.2	47	55
	Life expectancy at age 60 (years)	-	-	-	18.1	84	74	19.5	66	51
	Healthy life expectancy at birth (years)	-	-	-	60.3	53	57	60.4	41	38
	Healthy life expectancy at age 60 (years)	-	-	-	13.0	69	54	13.5	16	23
Mortality at different life stages	Under five years (per 1,000 live births)	33	47	60	-	-	-	-	-	-
	School age (5-14 years, per 100,000 population)	55	47	66	-	-	-	-	-	-
	Youths and young adults (15-29 years, 100,000 population)	-	-	-	127	63	69	113	38	37
	Adults aged 30-69 years (per 100,000 population)	-	-	-	813	59	59	595	47	51
	Older ages (70 years and above, per 100,000 population)	-	-	-	7,512	81	77	6,830	56	60
Child health	*Childhood immunizations*									
	BCG immunization coverage among one-year olds (%)	85	25	41	-	-	-	-	-	-
	DTP3 immunization coverage among one-year-olds (%)	85	50	59	-	-	-	-	-	-
	Polio (Pol3) immunization coverage among one-year-olds (%)	85	56	61	-	-	-	-	-	-
	MCV2 immunization coverage by nationally recommended age (%)	81	68	62	-	-	-	-	-	-
	Healthy growth									
	Stunting prevalence among children under 5 years	34.7	8	17	-	-	-	-	-	-
	Wasting prevalence among children under 5 years	17.3	0	0	-	-	-	-	-	-
	Underweight prevalence among children under 5 years	33.4	0	0	-	-	-	-	-	-

Domain	Indicators	Both sexes			Males			Females		
		Value	P (out of 100)	Z (out of 100)	Value	P (out of 100)	Z (out of 100)	Value	P (out of 100)	Z (out of 100)
Adult immunizations	Tetanus vaccination coverage for pregnant women (%)	90	24	48	-	-	-	-	-	-
	COVID-19 vaccination (two doses) coverage for all ages (%)	67	81	83	-	-	-	-	-	-
Access to care for NCDs and NCD management	Prevalence of treatment (taking medicine) for hypertension among population aged 30-79 with hypertension (%)	-	-	-	17	69	66	25	56	55
Risk factors	Tobacco use prevalence among population aged 15 years and over (%)	-	-	-	23	59	66	3	44	63
	Cigarette smoking prevalence among population aged 15 years and over (%)	-	-	-	10	90	85	1	59	66
	Tobacco use prevalence among youths aged 15-24 years (%)	-	-	-	12	63	73	2	50	64
	Ratio of former to current smokers aged 45-59 years	-	-	-	0.27	16	27	0.33	22	35
	12-month prevalence of harmful alcohol use among population aged 18 years and over (%)	-	-	-	2	56	70	0.1	81	83
	Obesity prevalence among population aged 20 years and over (%)	-	-	-	3	94	82	5	91	88
	Prevalence of type 2 diabetes among population aged 20-79 years (%)	10	25	40	-	-	-	-	-	-
	Prevalence of hypertension among population aged 30-79 years (%)	-	-	-	25	41	48	24	78	74
	Prevalence of current depression among population aged 18 years and over (%)	-	-	-	2.4			3.0		

Score of <25% | Score of 25-<50% | Score of 50-<75% | Score of ≥75% | Not available | Not analyzed/not applicable

Social and economic indicators (Domains 7-10)

Table 18.5 shows the P and Z scores for the HLI social and economic indicators for India. For many of these indicators, India falls in the 50 - < 75% category. However, India performs worse than 50 percent of other lower-middle income countries on intimate partner violence. Furthermore, it performs worse than 75 percent of other lower-middle income countries in female labor force participation rate and the ratio of female to male labor force participation.

TABLE 18.5 HLI social and economic indicators (domains 7-10) and scores based on percentile rank approach (P) and z-score approach (Z) for India

Domain	Indicators	Both sexes			Males			Females		
		Value	P (out of 100)	Z (out of 100)	Value	P (out of 100)	Z (out of 100)	Value	P (out of 100)	Z (out of 100)
Education	Learning adjusted years of school by age 18 (out of 14)	-	-	-	7.1	76	58	57	72	57
Gender equality	Percentage of ever-partnered women aged 15-49 years who experienced physical and/or sexual violence by current for former partner in the previous 12 months (%)	-	-	-	-	-	-	18	30	28
	Percentage of women's (aged 15-64) work time (paid and unpaid) spent on unpaid work (%)	-	-	-	-	-	-	65	56	59
	Ratio of female to male labor force participation rate	-	-	-	-	-	-	35	16	12
	SIGI index	-	-	-	-	-	-	34	67	72
Labour force	Labour force participation rate among population aged 15 years and over	-	-	-	76	80	61	26	16	24
Social protection	Population covered by at least one social protection cash benefit (excluding health)*	24	52	51	-	-	-	-	-	-
	Public expenditure on social protection (excluding health), as % of GDP	1.4			-	-	-	-	-	-

Score of <25% | Score of 25-<50% | Score of 50-<75% | Score of ≥75% | Not available | Not analyzed/not applicable

* Proportion of the total population receiving at least one contributory or non-contributory cash benefit, or actively contributing to at least one social security scheme.

DISCUSSION

The performance measurement literature identifies four pathways to improvement through public reporting (Berwick, James and Coye 2003; Hibbard, Stockard and Tusler 2003; Hibbard 2008): the change pathway (providers of services use comparative information to improve performance); the selection pathway (health system users apply comparative information to change care consumption from poor to good performers); pay-for-performance (providers who achieve standards or targets receive financial rewards); and reputational damage (providers who perform poorly suffer damage to their public reputation from regular public reports). These four pathways are consistent with the public sector literature on performance management, which classifies performance improvement pathways depending on their internal or external source of control and on the supportive or punitive actions derived from the controls (Boland and Fowler 2000; Veillard et al. 2005).

The use of global performance dashboards as a monitoring tool has been increasing in recent years owing to their ease of use and effectiveness in communicating information about complex systems. Globally, performance dashboards have been developed and used by governments and multilateral organizations to monitor status and progress in global development or for specific sectors such as health,

education, or other fields. Numerous dashboards exist in global health, such as the SDG Dashboard (Sachs and others 2023), the UNICEF Child health and well-being dashboard (UNICEF 2022), the ILO World Social Protection Data Dashboards (ILO 2020), and the World Bank Human Capital Index, all performance dashboards serving specific purposes. However, to the best of our knowledge, no performance dashboards have been developed with a focus on health longevity, which is defined by the WHO as "the process of developing and maintaining the functional ability that enables wellbeing in older age" (WHO 2020). Here, we present an HLI dashboard that LMICs can use to monitor their status related to human capital, NCDs, and healthy longevity. The dashboard presented in this paper follows the change pathway, providing opportunities for government to identify priorities for action derived from international comparisons with peer countries.

In addition to focusing on healthy longevity, the novelty of the HLI dashboard lies in its focus on international comparisons. In the HLI dashboard, for each country and indicator, two scores are assigned to indicate the country's performance relative to all other countries in the same income strata. These scores are calculated based on the percentile rank approach and the z-score approach, respectively. The first, percentile rank approach, has been previously used in the SDG Index to compare performance across all countries (Schmidt-Traub and others 2017). The second z-score approach of scoring adds an additional dimension to understanding the cross-country data by accounting for the distribution of the indicator across countries. This z-score approach of scoring has not been used by any previous global health performance dashboard, to the best of our knowledge. The dashboard is an Excel-based tool which does not require intensive technology or capacity training. Hence, it can be readily adopted by LMICs. Due to its focus on LMICs, some of the indicators, such as children underweight, may not be relevant to many high-income settings.

The current HLI dashboard relies on data readily available in the public domain. As such, LMICs can replicate the dashboard for their countries without the need for additional data collection. However, relying only on readily available data restricts the range of indicators included in the dashboard. Due to this, there are, for example currently no indicators available internationally on important performance dimensions relevant to human capital and healthy longevity, such as adult immunizations (e.g., human papillomavirus immunization among adolescent girls, flu immunization at all ages, and herpes zoster at older ages), ongoing education among adults, adult population that are free of NCDs, and public expenditure on long term care and on pensions. Although performance for these indicators is expected to be very low in LMICs, collection of such data and regular surveillance is essential to monitor the status of human capital and healthy longevity.

Further, not all the indicators selected in the performance dashboard can be calculated at national level, limiting the understanding of variation in performance at a sub-national level. This limits the use of data at sub-national level, in the highly decentralized politico-administrative context of India. Complementing the indicators selected with additional or substitutive indicators that can be calculated at sub-national level and be made useful to decision-makers able to act on findings will be an important next step in tailoring this performance dashboard to the needs of policymakers in India.

Finally, improving the usability of the dashboard for decision-making requires understanding in greater detail the nature of actions by government and other actors (including the private sector) required to improve performance. This is of particular importance for indicators requiring multi-sectoral interventions to drive better performance, such as nutrition indicators for example.

CONCLUSION

This performance dashboard offers a compelling, simple, and intuitive approach to measure performance on healthy longevity, a critical challenge to many middle-income and high-income countries, and an emerging challenge for many low-income countries.

The dashboard uses existing data and is grounded in performance measurement systems implemented at scale in most countries. It should not however preclude countries from investing in building up their essential data infrastructure to produce performance information of sufficient granularity to enable relevant decision-making at the appropriate governance level, with information of high quality

and of relevant timeliness and granularity. In addition, further research is required in understanding the drivers of healthy longevity, improving its measurement, and producing performance dashboards of use to policymakers. Engaging with the general public on indicators selection and general design of the performance dashboard will be a condition for usefulness of the approach and strengthening accountability for better results (Veillard et al. 2015).

REFERENCES

1. Berwick, Donald M., Brent James, and Molly Joel Coye. 2003. "Connections between Quality Measurement and Improvement." *Medical Care* 41 (Supplement): I–30I–38.
2. Boland, Tony, and Alan Fowler. 2000. "A Systems Perspective of Performance Management in Public Sector Organisations." *International Journal of Public Sector Management* 13 (5): 417–46.
3. Hibbard, Judith H., Jean Stockard, and Martin Tusler. 2003. "Does publicizing hospital performance stimulate quality improvement efforts?". *Health Affairs* 22 (2): 84–94.
4. Hibbard, Judith H. 2008. "What can we say about the impact of public reporting? Inconsistent execution yields variable results." *Annals of Internal Medicine 148* (2): 160–61.
5. International Labour Organization (ILO). 2020. *World Social Protection Data Dashboards*. https://www.social-protection.org/gimi/WSPDB.action?id=19. [Accessed October 13, 2022].
6. International Labour Organization (ILO). 2022. *ILOSTAT - The leading source of labour statistics.* https://ilostat.ilo.org/. [Accessed September 28, 2022].
7. Ministry of Health and Family Welfare, Government of India. 2017. "National Health Policy 2017." https://www.nhp.gov.in/nhpfiles/national_health_policy_2017.pdf. [Accessed September 28, 2022].
8. O'Keefe, Philip, and Victoria Haldane. 2024. "Towards a framework for impact pathways between non-communicable diseases, human capital and healthy longevity, economic and wellbeing outcomes," in *Unlocking the Power of Healthy Longevity: Compendium of Research for the Healthy Longevity Initiative*. Washington D.C.: World Bank.
9. Organization for Economic Co-operation and Development (OECD). 2019. "SIGI 2019 Global Report: Transforming Challenges into Opportunities, Social Institutions and Gender Index." Paris: OECD Publishing. https://doi.org/10.1787/bc56d212-en.
10. _____. 2022. *OECD Statistics.* https://stats.oecd.org/. [Accessed September 28, 2022].
11. Sachs, Jeffrey D., Guillaume Lafortune, Grayson Fuller, and Eamon Drumm. 2023. "Implementing the SDG Stimulus." *Sustainable Development Report 2023*. Paris: SDSN, Dublin: Dublin University Press. https://doi.org/10.25546/102924.
12. Schmidt-Traub, Guido, Christian Kroll, Katerina Teksoz, David Durand-Delacre, and Jeffrey D. Sachs. 2017. "National Baselines for the Sustainable Development Goals Assessed in the SDG Index and Dashboards." *Nature Geoscience* 10 (8): 547–55.
13. UNESCO Institute for Statistics. 2022. *UIS Statistics*. http://data.uis.unesco.org/. [Accessed September 28, 2022].
14. United Nations, Department of Economic and Social Affairs, Population Division. *World Population Prospects, Online Edition, 2022*. [Accessed September 28, 2022].
15. UN General Assembly. 2015. "Transforming our world : the 2030 Agenda for Sustainable Development, 21 October 2015, A/RES/70/1." https://www.refworld.org/docid/57b6e3e44.html. [Accessed October 4, 2022].
16. UNICEF. 2022. *Child health and well-being dashboard*. https://data.unicef.org/resources/child-health-and-well-being-dashboard/. [Accessed October 20, 2022].
17. Veillard, Jeremy, François Champagne, Niek S. Klazinga, Vahé Kazandjian, Onyebuchi A. Arah, and Ann.-Lise Guisset. 2005. "A Performance Assessment Framework for Hospitals: The WHO Regional Office for Europe PATH Project." *International Journal for Quality in Health Care* 17 (6): 487–96.
18. Vos, Theo, Stephen S. Lim, Cristiana Abbafati, Kaja M. Abbas, Mohammad Abbasi, Mitra Abbasifard, Mohsen Abbasi-Kangevari, et al. 2020. "Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990–2019: A Systematic Analysis for the Global Burden of Disease Study 2019." *The Lancet* 396 (10258): 1204–22.
19. World Bank. 2021. *World Bank Country and Lending Groups.* https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups. [Accessed September 28, 2022].
20. _____. 2022. *World Development Indicators.* Washington, D. C.: World Bank. https://data.worldbank.org/indicator. [Accessed September 28, 2022].
21. _____.2024. Unlocking the Power of Healthy Longevity: Demographic Change, Noncommunicable Diseases, and Human Capital. Washington, DC: World Bank.
22. World Health Organization (WHO). 2020. *Healthy ageing and functional ability*. https://www.who.int/news-room/questions-and-answers/item/healthy-ageing-and-functional-ability [Accessed August 2, 2022].
23. _____. 2022a. *Noncommunicable diseases*. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases. [Accessed August 16, 2023].
24. _____. 2022b. *UHC service coverage index (3.8.1)*. https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4834. [Accessed October 13, 2022].
25. _____. 2022c. *Global Health Observatory*. Geneva, Switzerland: World Health Organization. https://www.who.int/data/gho/data/indicators/indicators-index. [Accessed September 28, 2022].

ANNEX 18.1

TABLE 18A.1 List of 33 lower-middle income countries with population of more than 7 million in 2020

Algeria	Ghana	Myanmar	Tunisia
Angola	Haiti	Nepal	Ukraine
Bangladesh	Honduras	Nigeria	Tanzania
Benin	India	Pakistan	Uzbekistan
Bolivia	Indonesia	Papua New Guinea	Viet Nam
Cambodia	Iran	Philippines	Zimbabwe
Cameroon	Kenya	Senegal	
Côte d'Ivoire	Lao People's Democratic Republic	Sri Lanka	
Egypt	Morocco	Tajikistan	

TABLE 18A.2 Indicator data sources for the HLI India dashboard

Indicators	Data sources
GDP per capita GINI index Poverty gap at $3.65 a day (2017 PPP), as % of the poverty line	World Bank 2022.
Percentage of population aged 60 years and older Percentage of population of working age	United Nations Department of Economic and Social Affairs Population Division 2022.
Labour force participation rate Ratio of female to male labour force participation rate	World Bank 2022.
Mean years of schooling	Global Data Lab 2013-2023; Smits and Permanyer 2019.
Percentage of total deaths due to NCDs	WHO 2020.
UHC service coverage index	WHO 2022a.
Life expectancy at birth Life expectancy at age 60 Healthy life expectancy at birth Healthy life expectancy at age 60	WHO 2022b.
Under-five mortality rate (per 1,000 live births) School age (age 5-14 years) mortality rate (per 100,000 population) Mortality rate among youths and young adults (age 15-29 years) (per 100,000 population) Adult (aged 30-69 years) mortality rate (per 100,000 population) Mortality rate at older ages (aged 70 years and above) (per 100,000 population)	WHO 2020.
Percentage of one-year olds who received three doses of diphtheria tetanus toxoid and pertussis (DTP3) immunization. Percentage of one-year olds who received three doses of polio (Pol3) immunization. Percentage of one-year olds who received two doses of measles (MCV2) immunization	WHO 2022b.
Stunting prevalence among children under 5 years Wasting prevalence among children under 5 years Underweight prevalence among children under 5 years	WHO 2022b.
Percentage of mothers whose last birth was protected against neonatal tetanus	WHO 2022b.
Percentage of population that received at least two doses of COVID-19 vaccination	Mathieu and others 2022

Indicators	Data sources
Percentage of population aged 15+ years who currently use tobacco Youth tobacco use (percentage of population aged 15-24 years who use tobacco) Ratio of former to current smokers aged 45-59 years	Institute for Health Metrics and Evaluation (IHME) 2022.*
Percentage of population aged 15+ years who smoke cigarettes Percentage of population aged 15+ years who practice harmful use of alcohol in the past 12 months Percentage of population aged 20+ years who have overweight or obesity	WHO 2022b.
Percentage of population aged 20-79 years who have type 2 diabetes	International Diabetes Federation 2021.
Percentage of population aged 30-79 years who have hypertension	WHO 2022b.
Percentage of population aged 18 years and older who currently have depressive disorders	Gururaj and others 2016.
Percentage of population aged 30-79 years with hypertension that are currently taking antihypertensive medication	WHO 2022b.
Learning-adjusted years of schooling at age 18	World Bank 2021.
Prevalence of intimate partner violence among ever-partnered women in the past 12 months	WHO 2019.
Percentage of women's work time (paid and unpaid) spent on unpaid work	ILO 2018.
Ratio of female to male labor force participation rate	World Bank 2022.
Social Institution and Gender Index (SIGI)	OECD 2019.
Labor force participation rate among population aged 15 years and over	World Bank 2022.
Population covered by at least one social protection cash benefit (excluding health) †	ILO 2020.
Public expenditure on social protection (excluding health), as % of GDP	ILO 2020.

* We included estimates of tobacco use from the GBD because they were generated from nationally representative surveys on tobacco use.
†Proportion of the total population receiving at least one contributory or non-contributory cash benefit, or actively contributing to at least one social security scheme.

ANNEX 18.1 REFERENCES

1. Global Data Lab. Subnational HDI. The Netherlands: Global Data Lab, Institute for Management Research, Radboud University; 2013-2023. https://globaldatalab.org/shdi/download/. [Accessed April 4, 2023].
2. Gururaj, G., M. Varghese, V. Benegal, G. N. Rao, K. Pathak, L. K. Singh, et al. 2016. "National Mental Health Survey of India, 2015-16: Prevalence, patterns and outcomes." Bengaluru, National Institute of Mental Health and Neurosciences, NIMHANS Publication No. 129.
3. Institute for Health Metrics and Evaluation (IHME). 2022. "The Global Burden of Disease Study 2019 (GBD 2019) Results." Seattle, Washington: IHME, University of Washington, 2022. https://vizhub.healthdata.org/gbd-results/. [Accessed October 13, 2022].
4. International Diabetes Federation. 2022. Diabetes estimates (20-79 y): Age-adjusted comparative prevalence of diabetes, %. https://diabetesatlas.org/data/en/indicators/2/. [Accessed October 13, 2022].
5. International Labour Organization (ILO). 2018. "Care work and care jobs for the future of decent work". Geneva, Switzerland: International Labour Organization.
6. _____. 2020. *World Social Protection Data Dashboards*. https://www.social-protection.org/gimi/WSPDB.action?id=19. [Accessed October 13, 2022].
7. Mathieu, Edouard, Hannah Ritchie, Esteban Ortiz-Ospina, Max Roser, Joe Hasell, Cameron Appel, Charlie Giattino, and Lucas Rodés-Guirao. 2021. "A global database of COVID-19 vaccinations." *Nature Human Behaviour* 5 (7): 947–53.
8. Organization for Economic Cooperation and Development (OECD). 2019. "SIGI 2019 Global Report: Transforming Challenges into Opportunities, Social Institutions and Gender Index." Paris: OECD Publishing. https://doi.org/10.1787/bc56d212-en.
9. Smits, Jeroen, and Iñaki Permanyer. 2019. "The Subnational Human Development Database." *Scientific Data* 6 (1): 190038.
10. United Nations, Department of Economic and Social Affairs, Population Division. *World Population Prospects, Online Edition, 2022*. [Accessed September 28, 2022].

11. World Bank. 2022. *World Development Indicators*. Washington, D. C.: World Bank. https://data.worldbank.org/indicator. [Accessed September 28, 2022].
12. _____. 2021. "The Human Capital Index 2020 Update: Human Capital in the Time of COVID-19." Washington, D.C.: World Bank; 2021.
13. World Health Organization (WHO). 2020. *Global Health Estimates 2020: Deaths by Cause, Age, Sex, by Country and by region, 2000-2019*. Geneva, Switzerland: World Health Organization. https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys. [Accessed October 13, 2022].
14. _____. 2022a. UHC service coverage index (3.8.1) https://www.who.int/data/gho/indicator-metadata-registry/imr-details/4834. [Accessed October 13, 2022].
15. _____. 2022b. *Global Health Observatory*. Geneva, Switzerland: World Health Organization. https://www.who.int/data/gho/data/indicators/indicators-index. [Accessed September 28, 2022].

Appendix 1: Acknowledgments by Chapter

Chapter 1 summarizes findings from the pre-cursor to the Healthy Longevity Initiative - the *Non-Communicable Diseases and Human Capital Research Initiative,* led by the World Bank Human Capital Project, in collaboration with partners, in 2019. The initiative was coordinated by Sir George Alleyne (Director Emeritus, Pan American Health Organization (PAHO)), Timothy Evans (McGill University), Prabhat Jha (University of Toronto), and Jeremy Veillard (World Bank). This chapter was drafted by the initiative coordinators and Alexander Irwin (Independent Global Health Writer and Researcher). It is based on the proceedings of *the Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop*, hosted in Toronto by the University of Toronto Dalla Lana School of Public Health on July 9-10, 2019, and sponsored by the Access Accelerated Trust Fund.

The team is thankful to the workshop participants for their contributions to the workshop and the discourse on healthy longevity. Authors whose work was presented at the workshop included Dean T. Jamison (University of California at San Francisco (UCSF)); David Watkins (University of Washington); Prabhat Jha, Ryan Hum, Daphne Wu (University of Toronto); Aayush Khadka and Stéphane Verguet (Department of Global Health and Population, Harvard T.H. Chan School of Public Health); Sanam Roder-DeWan (Harvard University); Jean-Louise Arcand, Seoni Han, and Daniele Rinaldo (The Graduate Institute, Geneva); Jeremy Addison Lauer (World Health Organization (WHO)); Ojaswi Pandey and Aakash Mohpal (World Bank). The team is also grateful for the contributions of Daniel Sellen (University of Toronto); Francisca Akala, Daniel Dulitzky, and Miriam Schneidman (World Bank); Sarbani Chakraborty (Access Accelerated); Adriana Blanco (PAHO); Pedro Conceicao (UNDP); Vivek Goel and Erica Di Ruggiero (University of Toronto); Sue Horton (University of Waterloo); Alexey Kulikov (World Health Organization); Rachel Nugent (Research Triangle Institute (RTI) International) at the workshop.

The team is especially grateful to Adriana Blanco (PAHO), Erica Di Ruggiero (University of Toronto), Daniel Dulitzky (World Bank), Sue Horton (University of Waterloo), Dean Jamison (UCSF), and Rachel Nugent (RTI), who served as co-chairs or formal respondents during workshop sessions. Valuable comments and suggestions were received on earlier drafts of this report from the following colleagues: Francisca Akala, Adriana Blanco, Erica Di Ruggierro, Dean Jamison, Aakash Mohpal, Rachel Nugent, Miriam Schneidman, and Stéphane Verguet. The authors would particularly like to thank the University of Toronto colleagues who provided administrative, logistical, and technical support during the July 9-10, 2019, Toronto workshop, especially Desirée Bernard and Yvonne Edwards.

Chapter 2 summarizes the literature on the impacts of health and longevity on growth, using macroeconomic, growth accounting, and microeconomic approaches and presents a framework for channels through which NCDs interact with these outcomes. The chapter is authored by Phillip O'Keefe (University of New South Wales) and Victoria Haldane (University of Toronto).

The team is grateful to Sue Horton (University of Waterloo) and Michele Gragnolati (World Bank) for their peer review. The chapter also benefited from feedback from Sir George Alleyne (PAHO), Paul Isenman (World Bank/OECD (retired)), Prabhat Jha (University of Toronto), Beverley Essue (University of Toronto), Stephane Verguet (Harvard T.H. Chan School of Public Health), Linda Fried (Columbia University Mailman School of Public Health), Gabriel Demombynes (World Bank), John Giles (World Bank), Elena Glinskaya (World Bank), Norbert Schady (World Bank), Michael Weber (World Bank), Jeremy Veillard (World Bank), Gisela Garcia (World Bank), Sameera Altuwaijri (World Bank), Seemeen Saadat (World Bank), and John Piggott (University of New South Wales).

Chapter 3 estimates the avoidable mortality from non-communicable diseases by world regions between 2000 and 2050. It was authored by Angela Y. Chang (University of Southern Denmark), Gretchen A. Stevens (Independent Researcher), Diego S. Cardoso (Purdue University), Bochen Cao (WHO), and Dean T. Jamison (UCSF). Peer reviewers include Usha Ram (International Institute of Population Sciences) and Mukesh Chawla (World Bank). The authors have dedicated the chapter to Professor James W. Vaupel (1945-2022) who inspired them and many others with his intellect, vision, and passion for great research.

Chapter 4 provides estimates of avoidable mortality by cause of death for 2000 to 2050. It was written by Stéphane Verguet (Harvard T.H. Chan School of Public Health), Sarah Bolongaita (Harvard T.H. Chan School of Public Health), Angela Y. Chang (University of Southern Denmark), Diego S. Cardoso (Purdue University), and Gretchen A. Stevens (Independent Researcher). The team received valuable feedback from Usha Ram (International Institute of Population Sciences), Dean T. Jamison (UCSF), Prabhat Jha (University of Toronto), Beverley Essue (University of Toronto), and participants at the Health Systems Research Symposium (Bogota, November 2022) on an earlier version of the chapter.

Chapter 5 presents data on the rates of mortality decline globally between 2000 and 2019. It was drafted by Daphne C. Wu (University of Toronto), Debapriya Chakraborty (University of Toronto), Ryan Hum (University of Toronto), Prabhat Jha (University of Toronto), and Dean T. Jamison (USCF).

Chapter 6 focuses on the role of behavioral science in addressing non-communicable diseases. The chapter was developed by Ana Maria Rojas (World Bank), Ana Maria Munoz Boudet (World Bank), Ellen Moscoe (World Bank), Julian Jamison (University of Exeter), and Carlos Riumallo Herl (Erasmus University). The authors are grateful to Damien De Walque (World Bank) and Akshar Saxena (Nanyang Technological University) for their peer review; and to Sir George Alleyne (PAHO) and Paul Isenman (World Bank/OECD), for their valuable feedback.

Chapter 7 reviews the evidence on role fiscal instruments in changing behaviors for better health outcomes. It was authored by Guillermo Paraje (Escuela de Negocios, Universidad Adolfo Ibáñez), Prabhat Jha (University of Toronto), William Savedoff (Social Insight), and Alan Fuchs (World Bank). The chapter benefited from peer review feedback, which was provided by Cornelis Peter Van Walbeek (University of Cape Town) and Patrick Petit (International Monetary Fund (IMF)). Valuable inputs were also received from Jeremy Veillard (World Bank), Kate Mandeville (World Bank), Ceren Ozer (World Bank), Danielle Bloom (World Bank), Hana Ross (University of Cape Town), Owen Smith (World Bank), and Paul Isenman (World Bank/OECD). The authors are also thankful to Daniel Araya for his valuable research assistance.

Chapter 8 examines the burden of key non-communicable diseases for older adults ages 45 years and above by sex and reviews evidence on main challenges for these populations in access to adequate healthcare. The chapter was written by Seemeen Saadat (World Bank), Meriem Boujadja (World Bank), and Sameera Altuwaijri (World Bank). The chapter benefited from peer review inputs from Tanima Ahmed (World Bank), Amparo Gordillo-Tobar (World Bank), and Faiza Benhadid (Independent Expert on Gender and Human Rights). Earlier feedback from Gisela Garcia (World Bank) was also helpful in shaping the chapter.

Chapter 9 explores the relationship between caring for older parents and parents-in-law and the labor supply of women and men aged 40 to 59 years in Colombia, Indonesia, and Poland, as well as that of an individual's parents' disability status and labor supply in Egypt. It was authored by Roberta Gatti (World Bank), Daniel Halim (World Bank), Allen Hardiman (University of Illinois), and Shuqiao Sun (World Bank). The chapter benefitted from peer review feedback from Tanima Ahmed (World Bank) and discussions with seminar participants at the Healthy Longevity Initiative Workshops.

Chapter 10 discusses key challenges in health care and long-term care as populations age. Developed initially as a background paper for the World Bank's Independent Evaluation Group's (IEG) review on aging, it was drafted by Natalia Aranco Araújo (World Bank) and Gisela M. Garcia (World Bank). The authors are very grateful to Ian Forde (World Bank) and Cristian Hererra (World Bank) who provided valuable peer review inputs.

Chapter 11 focuses on the demand and supply of long-term care in low- and middle-income countries. The chapter was developed by Elena Glinskaya (World Bank), Xiaohui Hou (World Bank), Zhanlian Feng (RTI International), Marco Angrisani (University of Southern California), Guadalupe Suarez (Research Triangle Institute), Jigyasa Sharma (World Bank), Drystan Phillips (University of Southern California) , Jenny Wilkens (University of Southern California), Jinkook Lee (University of Southern California), Yeeun Lee Yoo (University of Southern California), Samuel Lau (University of Southern California), Hae Yeun Park (University of Southern California), and Yizhou Chen (University of Southern California). The chapter benefited from peer review feedback from Indu Bhushan (Partnership for Impact) and Feng Zhao (World Bank).

Chapter 12 presents a review of the evidence on the associations between labour market outcomes and major risk factors for non-communicable diseases. It was written by Debapriya Chakraborty (University of Toronto), Daphne Wu (University of Toronto), and Prabhat Jha (University of Toronto). The authors are thankful to Beverly Essue (University of Toronto) for her valuable advice on the chapter and to David Lightfoot (Unity Health) for his support with literature searches.

Chapter 13 identifies labor market and related policies that foster productive longevity i.e., extending productive working lives and increasing labor force participation and productivity among mature workers in L/MICs. It is authored by Sara Johansson de Silva (World Bank) and Indhira Santos (World Bank). Victoria Strokova (World Bank) peer reviewed the chapter and Gustavo Demarco (World Bank), Elena Glinskaya (World Bank), and Victoria Levin (World Bank) provided very helpful comments and suggestions on an early version.

Chapter 14 discusses adequacy of pensions and other non-contributory models for ensuring access to healthcare for older and aging adults, particularly in low- and middle-income countries. The chapter is authored by Gustavo Demarco (World Bank), Johannes Koettl (World Bank), Miglena Abels (World Bank) and Andrea Petrelli (World Bank). The authors are thankful to Claudia Rodriguez Alas (World Bank)and Ana Sofia Martinez Cordova (World Bank) for their support on the household survey data analysis; to Danilo Aristizabal (World Bank), who prepared the calculations for the household survey analysis, and to Patrick Hoang-Vu Eozenou (World Bank) and Marc-Francois Smitz (World Bank) for their guidance and access to micro-data from the HEFPI database. Christoph Kurowski (World Bank), Gonzalo Reyes (World Bank), and Paul Isenman (World Bank/OECD) provided very useful comments.

Chapter 15 focuses on prioritizing interventions for addressing NCDs and health system investments. The chapter is authored by David Watkins (University of Washington), Sali Ahmed (University of Washington), and Sarah Pickersgill (University of Washington). The chapter is based on earlier work by the authors as part of the larger Disease Control Priorities Project, 3rd edition (DCP3), which has been extensively reviewed separately.

Chapter 16 discusses whole of government and whole of society approaches for addressing NCDs bringing in experiences from across the world. The chapter is authored by Ramesh Govindaraj (World Bank) and Sundararajan Srinavasa Gopalan (Independent Researcher and former World Bank staff member). The authors are grateful for the contribution of Nora Wu (World Bank), who provided excellent research support and was responsible for the analysis of the World Bank's portfolio of NCD projects, and the valuable inputs provided by Charles Dalton (IFC) on examples of public-private collaboration on NCDs. The chapter benefited from the feedback from many internal and external reviewers, including Sir George Alleyne (PAHO), Prabhat Jha (University of Toronto), Sameera Maziad Altuwaijri (World Bank), Jeremy Veillard (World Bank), Derek Yach (Independent Global Health Consultant), Jeff Sturchio (Rabin Martin), Patrick Osewe (Asian Development Bank), Shambhu Acharya (World Health Organization), VR Muraleedharan (Indian Institute of Technology Madras), and Seemeen Saadat (World Bank), who provided incisive comments. The authors would also like to thank the Human Capital Project of the World Bank, and the Healthy Longevity Initiative, for the financial support and encouragement provided for undertaking this study.

Chapter 17 discusses the importance of data monitoring and presents a common framework and harmonized benchmarking approach to measuring healthy longevity. The chapter was authored by Victoria Haldane (University of Toronto), Gisela M.

Garcia (World Bank), Tahir Bockarie (University of Warwick), Daphne Wu (University of Toronto), Cristian A Herrera (World Bank), Maria Luisa Latorre Castro (Fundación Universitaria Juan N Corpas), Debapriya Chakraborty (University of Toronto), Beverly Essue (University of Toronto), Prabhat Jha (University of Toronto), and Jeremy Veillard (World Bank).

Chapter 18 details the data monitoring dashboard for healthy longevity in India. The chapter was conceived by Daphne Wu (University of Toronto), and Prabhat Jha (University of Toronto), with inputs from Jeremy Veillard (World Bank) Victoria Haldane (University of Toronto), and Seemeen Saadat (World Bank).

All chapters benefited from feedback from members of the core HLI team at various stages and from participants at the Healthy Longevity Initiative Technical Workshop held in Mexico City in May 2022 hosted by *Escuela de Salud Pública De México*, World Bank, and University of Toronto, and the Healthy Longevity Initiative's Author Workshop held in October 2022 at the World Bank in Washington D.C. A special thanks to Sir George Alleyne and Paul Isenman for their thorough review of all chapters.

The findings, interpretations, and conclusions expressed in this paper are solely those of the authors and do not necessarily reflect the views of the Board of Executive Directors of the World Bank or the governments they represent.

Appendix 2: Workshops and Consultations

1. NCDs and Human Capital Workshop

December 6–7, 2018, in Washington D.C. Sponsored by the World Bank.

Chair: George Alleyne and Tim Evans
Participants: Jean-Louis Arcand, Kathryn Gilman Andrews, Zelalem Debebe, Michele Gragnolati, Dean Jamison, Prabhat Jha, Aart Kraay, Jeremy Lauer, Aakash Mohpal, Rachel Nugent, Dena Ringold, Sanam Roder-DeWan, Rosa Sandoval, Miriam Schneidman, Jeremy Veillard, and Stéphane Verguet

2. Non-Communicable Diseases and Human Capital Analytic Work and Key Messaging Workshop

July 9–10, 2019, at the Dalla Lana School of Public Health at University of Toronto. Sponsored by the Access Accelerated, the University of Toronto, and the World Bank.

Co-Chairs: George Alleyne, Daniel Dulitzky, Timothy Evans, and Rachel Nugent
Participants: Francisca Akala, Jean-Louis Arcand, Adriana Blanco, Sarbani Chakraborty, Pedro Conceicao, Erica Di Ruggiero, Vivek Goel, Sue Horton, Alexander Irwin, Dean Jamison, Prabhat Jha, Alexey Kulikov, Jeremy Lauer, Aakash Mohpal, Miriam Schneidman, Daniel Sellen, Jeremy Veillard, Stéphane Verguet, and Daphne Wu

3. Healthy Longevity Initiative Technical Workshop I

May 18–20, 2022, in Mexico City. Sponsored by Instituto Nacional de Salud Pública and the World Bank.

Co-Chairs: George Alleyne, Sameera Altuwaijri, Michele Gragnolati, and Prabhat Jha
Participants: Tonatiuh Barrientos, Luis Benveniste, Diego Cardoso, Debapriya Chakraborty, Angela Chang, Beverly Essue, Gisela Garcia, Elena Glinskaya, Ramesh Govindaraj, Daniel Halim, Nedim Jaganjac, Dean Jamison, Julian Jamison, Venus Jaraba, Blanca Llorente Anaas, Hugo López Gatell, Claudia Macias, Norman Maldonado, Laura Vivian Mendoza Ardila, Ellen Moscoe, Ana Maria Munoz Boudet, Phillip O´Keefe, Truman Packard, Guillermo Paraje, María Luisa Latorre Castro, Eduardo Lazcano Ponce, Luz Myriam Reynales, Seemeen Saadat, Belen Saenz de Miera Juarez, William Savedoff, Gretchen Stevens, Florence Theodore, Angela Vega Landaeta, Jeremy Veillard, Stéphane Verguet, David Watkins, Daphne Wu, and Feng Zhao

4. HLI Dashboards Workshop

September 20–22, 2022 in Bogotá, Colombia. Sponsored by the World Bank.

Co-Chairs: Gisela Garcia and Jeremy Veillard
Participants: Sameera Altuwaijri, Debapriya Chakraborty, Beverley Essue, Victoria Haldane, Cristian A. Herrera, Prabhat Jha, Maria Luisa Latorre Castro, Seemeen Saadat, Gretchen Stevens, Angela Vega, and Daphne Wu

5. Healthy Longevity Initiative Technical Workshop II

October 26–28, 2022, in Washington D.C. Sponsored by the World Bank.

Chair: Sameera Altuwaijri
Participants: George Alleyne, Meriem Boujadja, Angela Chang, Debapriya Chakraborty, Gisela Garcia, Elena Glinskaya, Sundararajan Srinivasa Gopalan, Ramesh Govindaraj, Victoria Haldane, Daniel Halim, Anselm Hennis, Alexander Irwin, Paul Isenman, Prabhat Jha, Toni Joe Lebbos, Ellen Moscoe, Ana Maria Munoz Boudet, Philip O'Keefe, Guillermo Paraje, Seemeen Saadat, Gretchen Stevens, Jeremy Veillard, Stéphane Verguet, and David Watkins

6. HLI Analytic Meeting

February 8–9, 2023, in Washington D.C. Sponsored by the World Bank.

Chair: Sameera Altuwaijri
Participants: Rythia Afkar, George Alleyne, Debapriya Chakraborty, Daisy Demirag, Gisela Garcia, Anselm Hennis, Alexander Irwin, Paul Isenman, Prabhat Jha, Bente Mikkelsen, Seemeen Saadat, Iffath Sharif, and Michael Weber

7. Economic Value of Avoidable Mortality

March 16–17, 2023, in Toronto. Sponsored by the World Bank and University of Toronto

Co-Chairs: Dean Jamison and Prabhat Jha
Participants: George Alleyne, Sarah Bolongaita, Debapriya Chakraborty, Angela Chang, Ryan Hum, Alexander Irwin, Paul Isenman, Gretchen Stevens, Stéphane Verguet, and Daphne Wu

The Healthy Longevity Initiative

Demographic change, aging populations, and the rising burden of non-communicable diseases (NCDs) pose formidable challenges worldwide. The drastic shifts in global demographics underway include an increased population of adults, higher mortality and hospitalizations, and heightened caregiving burdens, particularly impacting women.

The World Bank's Healthy Longevity Initiative (HLI) has undertaken comprehensive analyses to offer solutions, turning demographic challenges into opportunities. Key HLI recommendations focus on life course investments to improve health, reduce poverty, address gender inequity, enhance productivity, and increase overall wellbeing. A holistic, country-led approach is crucial, emphasizing the interdependence of responses to demographic shifts, pandemic threats, and climate change.

Governments worldwide can prioritize life course HLI investments to control NCDs, delivering tangible benefits that grow dramatically and swiftly over time. Cost-effective measures, such as expanding low-cost treatments for common vascular diseases and cancers, can have a profound impact on households and societies. Fiscal interventions such as higher excise taxes on tobacco yield remarkably quick benefits. The HLI proposals involve increasing healthcare personnel, including essential nurses and doctors, along with upgrading primary care facilities, which yield substantial returns on investment. The HLI builds upon the remarkable achievements in reducing childhood, maternal and infectious disease mortality. The HLI emphasis on research and development, coupled with global public goods, provides a means to "bend the cost curve" for NCDs.

At its core, the report underscores the imperative for country-driven initiatives to invest in Healthy Longevity. This presents a viable route to alleviate poverty and elevate well-being, utilizing the strength of the entire life course. The life-course approach can increase the impact of human capital, enabling progress and prosperity for all societies.



WORLD BANK GROUP