

VOLUME **8**

DISEASE CONTROL PRIORITIES • THIRD EDITION

# Child and Adolescent Health and Development



# **DISEASE CONTROL PRIORITIES • THIRD EDITION**

## **Series Editors**

Dean T. Jamison  
Rachel Nugent  
Hellen Gelband  
Susan Horton  
Prabhat Jha  
Ramanan Laxminarayan  
Charles N. Mock

## **Volumes in the Series**

Essential Surgery  
Reproductive, Maternal, Newborn, and Child Health  
Cancer  
Mental, Neurological, and Substance Use Disorders  
Cardiovascular, Respiratory, and Related Disorders  
Major Infectious Diseases  
Injury Prevention and Environmental Health  
**Child and Adolescent Health and Development**  
Disease Control Priorities: Improving Health and Reducing Poverty



## DISEASE CONTROL PRIORITIES

Budgets constrain choices. Policy analysis helps decision makers achieve the greatest value from limited available resources. In 1993, the World Bank published *Disease Control Priorities in Developing Countries (DCP1)*, an attempt to systematically assess the cost-effectiveness (value for money) of interventions that would address the major sources of disease burden in low- and middle-income countries. The World Bank's 1993 *World Development Report* on health drew heavily on *DCP1*'s findings to conclude that specific interventions against noncommunicable diseases were cost-effective, even in environments in which substantial burdens of infection and undernutrition persisted.

*DCP2*, published in 2006, updated and extended *DCP1* in several aspects, including explicit consideration of the implications for health systems of expanded intervention coverage. One way that health systems expand intervention coverage is through selected platforms that deliver interventions that require similar logistics but deliver interventions from different packages of conceptually related interventions, for example, against cardiovascular disease. Platforms often provide a more natural unit for investment than do individual interventions. Analysis of the costs of packages and platforms—and of the health improvements they can generate in given epidemiological environments—can help to guide health system investments and development.

*DCP3* differs importantly from *DCP1* and *DCP2* by extending and consolidating the concepts of platforms and packages and by offering explicit consideration of the financial risk protection objective of health systems. In populations lacking access to health insurance or prepaid care, medical expenses that are high relative to income can be impoverishing. Where incomes are low, seemingly inexpensive medical procedures can have catastrophic financial effects. *DCP3* offers an approach to explicitly include financial protection as well as the distribution across income groups of financial and health outcomes resulting from policies (for example, public finance) to increase intervention uptake. The task in all of the *DCP* volumes has been to combine the available science about interventions implemented in very specific locales and under very specific conditions with informed judgment to reach reasonable conclusions about the impact of intervention mixes in diverse environments. *DCP3*'s broad aim is to delineate essential intervention packages and their related delivery platforms to assist decision makers in allocating often tightly constrained budgets so that health system objectives are maximally achieved.

*DCP3*'s nine volumes are being published in 2015, 2016, 2017, and 2018 in an environment in which serious discussion continues about quantifying the sustainable development goal (SDG) for health. *DCP3*'s analyses are well-placed to assist in choosing the means to attain the health SDG and assessing the related costs. Only when these volumes, and the analytic efforts on which they are based, are completed will we be able to explore SDG-related and other broad policy conclusions and generalizations. The final *DCP3* volume will report those conclusions. Each individual volume will provide valuable, specific policy analyses on the full range of interventions, packages, and policies relevant to its health topic.

More than 500 individuals and multiple institutions have contributed to *DCP3*. We convey our acknowledgments elsewhere in this volume. Here we express our particular

gratitude to the Bill & Melinda Gates Foundation for its sustained financial support, to the InterAcademy Medical Panel (and its U.S. affiliate, the National Academies of Science, Engineering, and Medicine), and to the External and Corporate Relations Publishing and Knowledge division of the World Bank. Each played a critical role in this effort.

*Dean T. Jamison*

*Rachel Nugent*

*Hellen Gelband*

*Susan Horton*

*Prabhat Jha*

*Ramanan Laxminarayan*

*Charles N. Mock*

VOLUME **8**

DISEASE CONTROL PRIORITIES • THIRD EDITION

# Child and Adolescent Health and Development

EDITORS

Donald A. P. Bundy  
Nilanthi de Silva  
Susan Horton  
Dean T. Jamison  
George C. Patton

© 2017 International Bank for Reconstruction and Development / The World Bank  
1818 H Street NW, Washington, DC 20433  
Telephone: 202-473-1000; Internet: www.worldbank.org

Some rights reserved  
1 2 3 4 20 19 18 17

This work is a product of the staff of The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent. The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map 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.

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

## Rights and Permissions



This work is available under the Creative Commons Attribution 3.0 IGO license (CC BY 3.0 IGO) <http://creativecommons.org/licenses/by/3.0/igo>. Under the Creative Commons Attribution license, you are free to copy, distribute, transmit, and adapt this work, including for commercial purposes, under the following conditions:

**Attribution**—Please cite the work as follows: Bundy, D. A. P., N. de Silva, S. Horton, D. T. Jamison, and G. C. Patton, editors. 2017. *Child and Adolescent Health and Development. Disease Control Priorities* (third edition), Volume 8. Washington, DC: World Bank. doi:10.1596/978-1-4648-0423-6 License: Creative Commons Attribution CC BY 3.0 IGO

**Translations**—If you create a translation of this work, please add the following disclaimer along with the attribution: *This translation was not created by The World Bank and should not be considered an official World Bank translation. The World Bank shall not be liable for any content or error in this translation.*

**Adaptations**—If you create an adaptation of this work, please add the following disclaimer along with the attribution: *This is an adaptation of an original work by The World Bank. Views and opinions expressed in the adaptation are the sole responsibility of the author or authors of the adaptation and are not endorsed by The World Bank.*

**Third-party content**—The World Bank does not necessarily own each component of the content contained within the work. The World Bank therefore does not warrant that the use of any third-party-owned individual component or part contained in the work will not infringe on the rights of those third parties. The risk of claims resulting from such infringement rests solely with you. If you wish to reuse a component of the work, it is your responsibility to determine whether permission is needed for that reuse and to obtain permission from the copyright owner. Examples of components can include, but are not limited to, tables, figures, or images.

All queries on rights and licenses should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: [pubrights@worldbank.org](mailto:pubrights@worldbank.org).

### Softcover:

ISBN: 978-1-4648-0423-6  
ISBN (electronic): 978-1-4648-0439-7  
DOI: 10.1596/978-1-4648-0423-6

### Hardcover:

ISBN: 978-1-4648-0517-2  
DOI: 10.1596/978-1-4648-0517-2

Cover photo: © John Hogg/World Bank. Used with the permission of John Hogg/World Bank. Further permission required for reuse.

© Cover and interior design: Debra Naylor, Naylor Design, Washington, DC

### Chapter opener photos:

**Chapter 1:** © Greatstock/Alamy Stock Photo. Used with permission. Further permission required for reuse; **chapter 2:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 3:** © Greatstock/Alamy Stock Photo. Used with permission. Further permission required for reuse; **chapter 4:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 5:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 6:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 7:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 8:** © Simone D. McCourtie/World Bank. Further permission required for reuse; **chapter 9:** © Scott Wallace/World Bank. Further permission required for reuse; **chapter 10:** © Greatstock/Alamy Stock Photo. Used with permission. Further permission required for reuse; **chapter 11:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 12:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 13:** © Simone D. McCourtie/World Bank. Further permission required for reuse; **chapter 14:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 15:** © Greatstock/Alamy Stock Photo. Used with permission. Further permission required for reuse; **chapter 16:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 17:** © Simone D. McCourtie/World Bank. Further permission required for reuse; **chapter 18:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 19:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 20:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 21:** © Scott Wallace/World Bank. Further permission required for reuse; **chapter 22:** © Simone D. McCourtie/World Bank. Further permission required for reuse; **chapter 23:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 24:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 25:** © Simone D. McCourtie/World Bank. Further permission required for reuse; **chapter 26:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 27:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 28:** © Scott Wallace/World Bank. Further permission required for reuse; **chapter 29:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse; **chapter 30:** © Frank Spangler/Worldview Images. Used with the permission of Worldview Images. Further permission required for reuse.

Library of Congress Cataloging-in-Publication Data has been requested.

# Contents

Foreword	xiii
Preface	xv
Abbreviations	xvii

## **1. Child and Adolescent Health and Development: Realizing Neglected Potential 1**

*Donald A. P. Bundy, Nilanthy de Silva, Susan Horton, George C. Patton, Linda Schultz, and Dean T. Jamison*

### PART 1 ESTIMATES OF MORTALITY AND MORBIDITY IN CHILDREN (AGES 5–19 YEARS)

## **2. Mortality at Ages 5 to 19: Levels and Trends, 1990–2010 25**

*Kenneth Hill, Linnea Zimmerman, and Dean T. Jamison*

## **3. Global Nutrition Outcomes at Ages 5 to 19 37**

*Rae Galloway*

## **4. Global Variation in Education Outcomes at Ages 5 to 19 47**

*Kin Bing Wu*

## **5. Global Measures of Health Risks and Disease Burden in Adolescents 57**

*George C. Patton, Peter Azzopardi, Elissa Kennedy, Carolyn Coffey, and Ali Mokdad*

### PART 2 IMPACT OF INTERVENTIONS DURING THE LIFE COURSE (AGES 5–19 YEARS)

## **6. Impact of Interventions on Health and Development during Childhood and Adolescence: A Conceptual Framework 73**

*Donald A. P. Bundy and Susan Horton*

## **7. Evidence of Impact of Interventions on Growth and Development during Early and Middle Childhood 79**

*Harold Alderman, Jere R. Behrman, Paul Glewwe, Lia Fernald, and Susan Walker*

- 8. Evidence of Impact of Interventions on Health and Development during Middle Childhood and School Age 99**  
*Kristie L. Watkins, Donald A. P. Bundy, Dean T. Jamison, Günther Fink, and Andreas Georgiadis*
- 9. Puberty, Developmental Processes, and Health Interventions 107**  
*Russell M. Viner, Nicholas B. Allen, and George C. Patton*
- 10. Brain Development: The Effect of Interventions on Children and Adolescents 119**  
*Elena L. Grigorenko*

### PART 3 CONDITIONS AND INTERVENTIONS

- 11. Nutrition in Middle Childhood and Adolescence 133**  
*Zohra Lassi, Anoosh Moin, and Zulfiqar Bhutta*
- 12. School Feeding Programs in Middle Childhood and Adolescence 147**  
*Lesley Drake, Meena Fernandes, Elisabetta Aurino, Josephine Kiamba, Boitshepo Giyose, Carmen Burbano, Harold Alderman, Lu Mai, Arlene Mitchell, and Aulo Gelli*
- 13. Mass Deworming Programs in Middle Childhood and Adolescence 165**  
*Donald A. P. Bundy, Laura J. Appleby, Mark Bradley, Kevin Croke, T. Deirdre Hollingsworth, Rachel Pullan, Hugo C. Turner, and Nilanthi de Silva*
- 14. Malaria in Middle Childhood and Adolescence 183**  
*Simon J. Brooker, Sian Clarke, Deepika Fernando, Caroline W. Gitonga, Joaniter Nankabirwa, David Schellenberg, and Brian Greenwood*
- 15. School-Based Delivery of Vaccines to 5- to 19-Year Olds 199**  
*D. Scott LaMontagne, Tania Cernuschi, Ahmadu Yakubu, Paul Bloem, Deborah Watson-Jones, and Jane J. Kim*
- 16. Promoting Oral Health through Programs in Middle Childhood and Adolescence 211**  
*Habib Benzian, Renu Garg, Bella Monse, Nicole Stauf, and Benoit Varenne*
- 17. Disability in Middle Childhood and Adolescence 221**  
*Natasha Graham, Linda Schultz, Sophie Mitra, and Daniel Mont*
- 18. Health and Disease in Adolescence 239**  
*Nicola Reavley, George C. Patton, Susan M. Sawyer, Elissa Kennedy, and Peter Azzopardi*

### PART 4 PACKAGES AND PLATFORMS TO PROMOTE CHILD AND ADOLESCENT DEVELOPMENT

- 19. Platforms to Reach Children in Early Childhood 253**  
*Maureen M. Black, Amber Gove, and Katherine A. Merseth*

**20. The School as a Platform for Addressing Health in Middle Childhood and Adolescence 269**

*Donald A. P. Bundy, Linda Schultz, Bachir Sarr, Louise Banham, Peter Colenso, and Lesley Drake*

**21. Platforms for Delivering Adolescent Health Actions 287**

*Susan M. Sawyer, Nicola Reavley, Chris Bonell, and George C. Patton*

**22. Getting to Education Outcomes: Reviewing Evidence from Health and Education Interventions 307**

*Daniel Plaut, Milan Thomas, Tara Hill, Jordan Worthington, Meena Fernandes, and Nicholas Burnett*

**23. Cash Transfers and Child and Adolescent Development 325**

*Damien de Walque, Lia Fernald, Paul Gertler, Melissa Hidrobo*

**PART 5 THE ECONOMICS OF CHILD DEVELOPMENT**

**24. Identifying an Essential Package for Early Child Development: Economic Analysis 343**

*Susan Horton and Maureen M. Black*

**25. Identifying an Essential Package for School-Age Child Health: Economic Analysis 355**

*Meena Fernandes and Elisabetta Aurino*

**26. Identifying an Essential Package for Adolescent Health: Economic Analysis 369**

*Susan Horton, Elia De la Cruz Toledo, Jacqueline Mahon, John Santelli, and Jane Waldfogel*

**27. The Human Capital and Productivity Benefits of Early Childhood Nutritional Interventions 385**

*Arindam Nandi, Jere R. Behrman, Sonia Bhalotra, Anil B. Deolalikar, and Ramanan Laxminarayan*

**28. Postponing Adolescent Parity in Developing Countries through Education: An Extended Cost-Effectiveness Analysis 403**

*Stéphane Verquet, Arindam Nandi, Véronique Filippi, and Donald A. P. Bundy*

**29. Economics of Mass Deworming Programs 413**

*Amrita Ahuja, Sarah Baird, Joan Hamory Hicks, Michael Kremer, and Edward Miguel*

**30. The Effects of Education Quantity and Quality on Child and Adult Mortality:  
Their Magnitude and Their Value 423**

*Elina Pradhan, Elina M. Suzuki, Sebastián Martínez, Marco Schäferhoff, and  
Dean T. Jamison*

<i>DCP3 Series Acknowledgments</i>	441
<i>Volume and Series Editors</i>	443
<i>Contributors</i>	447
<i>Advisory Committee to the Editors</i>	451
<i>Reviewers</i>	453
<i>Policy Forum Participants</i>	455
<i>Africa Regional Roundtable Participants</i>	457
<i>Index</i>	459

## Foreword

### HEALTH AND EDUCATION DURING THE 8,000 DAYS OF CHILD AND ADOLESCENT DEVELOPMENT: TWO SIDES OF THE SAME COIN

Today, there is comfort to be found in returning to the inspired words of others. Until H. G. Wells' time machine is made, words are our emotional anchor to the past and, one hopes, our window to a brighter future. Speaking before the 18th General Assembly of the United Nations in 1963, it was President John F. Kennedy who noted that the “effort to improve the conditions of man, however, is not a task for the few.” Development is a shared, cross-cutting mission I know well. For the breakthroughs we witness—from Borlaug's wheat to a vaccine for polio—are the products of cooperation, a clean break from siloed thinking, and a courage to work at the sharp edges of disciplines.

Working as a lecturer for five years in the 1970s and early 1980s, I came to see—in a way I never had as a student—that education unlocks talent and unleashes potential. And as Chancellor, Prime Minister, and most importantly a parent, education has remained a centerpiece in my life because of the hope it delivers. For when we ask ourselves what breaks the weak, it is not the Mediterranean wave that submerges the life vest, nor the food convoy that does not make it to the besieged Syrian town. Rather, it is the absence of hope, the soul-crushing certainty that there is nothing ahead to plan or prepare for—not even a place in school.

Two years ago, the International Commission on Financing Global Education Opportunity, composed of two dozen global leaders and convened by the Prime Minister of Norway and the Presidents of Chile, Indonesia, and Malawi, as well as the Director-General

of UNESCO, set out to make a new investment case for global education. What resulted was a credible yet ambitious plan capable of ensuring that the Sustainable Development Goal of an inclusive and quality education for all is met by the 2030 deadline. While we continue to work today to ensure our messages become action—from increased domestic spending on schooling to an International Finance Facility for Education—we sought to produce an authoritative, technically strong report that would spend more time being open on desks than collecting dust on a shelf.

The *Disease Control Priorities (DCP)* series established in 1993 shares this philosophy and acts as a key resource for Ministers of Health and Finance, guiding them toward informed decisions about investing in health. The third edition of *DCP* rightly recognizes that good health is but one facet of human development and that health and education outcomes are forever intertwined. The Commission report makes clear that more education equates with better health outcomes. And approaching this reality from the other direction, this year's volume of *DCP* shows that children who are in good health and appropriately nourished are more likely to participate in school and to learn while there. The Commission report raises the concept of progressive universalism or giving greatest priority to those children most at risk of being excluded from learning. Here, too, the alignment with *DCP* is clear as health strides are most apparent when directed to the poorest and sickest children, as well as girls.

It is fitting that one of the Commission's background papers appears as a chapter in this volume. The Commission showed that education spending, particularly for adolescent girls, is a moral imperative and an economic necessity. Indeed, girls are the least likely to

go to primary school, the least likely to enter or complete secondary school, highly unlikely to matriculate to college, and the most likely to be married at a young age, to be forced into domestic service or trafficked. And with uneducated girls bearing five children against two children for educated girls, the vicious cycle of illiterate girls, high birth rates, low national incomes per head, and migration in search of opportunity will only worsen so long as we fail to deliver that most fundamental right to an education.

Here is a projection to remember. If current education funding trends hold, by 2030, 800 million children—half a generation—will lack the basic secondary skills necessary to thrive in an unknowable future. In calling for more and better results-based education spending, the Commission estimated that current total annual education expenditure is US\$1.3 trillion across low- and middle-income countries, an anemic sum that must steadily rise to US\$3 trillion by 2030. A rising tide must lift all ships, and so as education spending at the domestic and international levels sees an uptick, the same must be witnessed for health. The numbers may seem large, but the reality is that this relatively inexpensive effort would do more than unlock better health and education outcomes; it would bring us closer to achieving all 17

Sustainable Development Goals and unlocking the next stage of global growth.

A key message of this volume is that human development is a slow process; it takes two decades—8,000 days—for a human to develop physically and mentally. We also know a proper education requires time. So the world needs to invest widely, deeply, and effectively—across education, health, and all development sectors—during childhood and adolescence. And while individuals may have 8,000 days to develop, we must mobilize our resources today to secure their tomorrow. Let us not forget that the current generation of young people will transition to adulthood in 2030, and it will be their contribution that will determine whether the world achieves the Sustainable Development Goals.

We have, to again draw on Kennedy's words, "the capacity to control [our] environment, to end thirst and hunger, to conquer poverty and disease, to banish illiteracy and massive human misery." We have this capacity, but only when we work together. Both the Commission report and this latest *Disease Control Priorities* volume seek to elevate cross-sector initiatives on the global agenda. In human development, health and education are two sides of the same coin: only when we speak as one will this call be heard.

**Gordon Brown**

*United Nations Special Envoy for Global Education  
Chair of the International Commission on  
Financing Global Education Opportunity  
Prime Minister of the United Kingdom, 2007–2010  
Chancellor of the Exchequer, 1997–2007*

## Preface

More children born today will survive to adulthood than at any time in human history. This is true both in terms of the proportion of live births and of absolute numbers. The current cohort of children who have survived to age 5 years will transition to adulthood around 2030 and will be the Sustainable Development Goals (SDGs) generation. The health, nutrition, and education of these young people as they develop from ages 5 to 19 years will have lifelong consequences for the adults they become and for their role in the development of the next generation. Will the world have prepared them well for this task?

Our analyses in this volume show that although the education of this age group is the primary focus of public sector investment, their health is a much lower priority. Indeed, middle childhood and adolescence has historically received the least attention of any age group.

Health and development in middle childhood and adolescence is a new focus of the *Disease Control Priorities* series, which was first published in conjunction with the World Bank's *World Development Report 1993: Investing in Health*, and which has become a key reference for health policy makers in low- and middle-income countries (box 1.1). The earlier editions touched on human development; this third edition is the first to give a specific focus beyond health to issues of human development, including the special role of the education sector, and the first to give prominence to health in this age group. This volume complements volume 2, *Reproductive, Maternal, Newborn, and Child Health*, which focuses on health in the under-five age group.

This volume presents its analyses and conclusions in 30 chapters grouped into five parts:

- **Part 1. Estimates of Mortality and Morbidity in Children (Ages 5 to 19 Years)** explores mortality and morbidity in this age group, with a focus on low- and lower-middle-income countries. A new analysis of

mortality is presented, with surprising conclusions, and morbidity is examined with respect to three selected issues: nutrition, education, and health in adolescence.

- **Part 2. Impact of Interventions during the Life Course (Ages 5–19 Years)** reviews development issues at different stages in the life course and presents a conceptual framework for health and development from birth, through middle childhood and adolescence, to young adulthood.
- **Part 3. Conditions and Interventions** describes the evolving age distribution of disease and how new understanding of interventions and epidemiology has transformed the ways in which health systems can contribute to health and development objectives.
- **Part 4. Packages and Platforms to Promote Child and Adolescent Development** explores how novel approaches to policy that deliver health and development interventions to children and adolescents are slowly being implemented in low-income countries. In many cases, the focus is on vertical programs as part of underdeveloped primary health care systems, with a particular emphasis on school-based delivery. Current health systems often fail children and adolescents, especially in the low-income countries and communities that most need them.
- **Part 5. The Economics of Child Development** assembles economic data and seeks to prioritize interventions within three age classes: early childhood, school-age, and adolescence. Each age group is considered in a separate chapter, and each chapter prioritizes interventions on the basis of cost-effectiveness, extended cost-effectiveness, benefit-costs, and returns on investment. Part 5 also includes age-specific economic analysis of important areas of development, including the role of education in delaying

pregnancy and marriage, as well as public financing for mass deworming as an example of school-based intervention.

We would like to acknowledge the many thoughtful people who contributed to the content and conclusions of this volume. The 110 authors from 19 countries contributed most directly to the preparation of the 30 chapters presented here; the volume simply could never have happened without their substantial investment of time and effort in crafting and writing the chapters. We, and they, thank the more than 60 independent reviewers, selected and commissioned by the National Academy of Science, Engineering, and Medicine, who provided peer reviews of all of the chapters (see the section entitled “Reviewers” at the end of the volume for a detailed listing of these individuals).

As a further check on the policy implications of the conclusions, we sought input from those more directly involved in health policy making. A policy consultation was held in Geneva under the leadership of the Regional Director of the World Health Organization (WHO) Eastern Mediterranean Regional Office, with representation from 10 countries.<sup>1</sup> The African Union hosted a regional consultation of Ministry of Health representatives from five countries in Sub-Saharan Africa.<sup>2</sup> We also presented the main conclusions at a variety of fora, seeking feedback from practitioners—including the annual meeting of the European Society for Paediatric Infectious Diseases, in Brighton, United Kingdom; and the Bill & Melinda Gates Foundation, in Seattle, Washington, United States. We are grateful for the many thoughtful responses that we received.

We would also like to recognize our debt to all those who contributed to The *Lancet* Commission on Adolescent Health and Wellbeing. This volume was written in parallel with the report of the Commission and shares some common editors and authors. We support the conclusions of the Commission’s report, published in May 2016 (Patton and others); we extend them in this volume to include further economic analysis, as well as an exploration of the health and development needs of children in middle childhood, an age group that may be even more neglected than adolescents in public health policy and planning.

The main conclusion of this volume is that human development is a process that extends over the first two decades of life; for individuals to achieve their full potential, there is a need for age- and condition-specific interventions throughout this 20-year period. The current focus on the “first 1,000 days” represents a failure to recognize the critical importance of subsequent development during middle childhood and adolescence. Although intervention during the first 1,000 days is indeed the essential foundation for subsequent

development, it cannot serve as a substitute for continuing intervention during three key phases:

- The middle childhood phase of growth and consolidation (ages 5–9 years), when infection and malnutrition remain key constraints on development, and mortality rates are much higher than previously realized
- The adolescent growth spurt (ages 10–14 years), when the increase in muscle, bone, and organ mass approaches rates not seen since age 2 years, and there are commensurate demands for good diet and health
- The adolescent phase of growth and consolidation (ages 15–19 years), when major restructuring of the brain is associated with behavioral and social experimentation that has lifelong consequence.

We note the asymmetry between the public investment in formal education versus health during the age range of 5–19 years, and the lack of recognition that the developmental returns from education are themselves dependent on concurrent good health and diet. We argue that current policy on health and development has substantially neglected and underserved children in this age range, and that there is too little research on how to respond to the needs of middle childhood and adolescence. We propose packages of interventions for these crucial later phases of development that are in the same range of cost-effectiveness as interventions in the early years of life but of substantially lower cost. We also call for significantly increased investment in research into the health and development needs during middle childhood and adolescence.

#### **Volume Editors**

Donald A. P. Bundy  
Nilanthy de Silva  
Susan Horton  
Dean T. Jamison  
George C. Patton

#### **Volume Coordinator**

Linda Schultz

## **NOTES**

1. Participants are listed at the end of this volume.
2. Participants are listed at the end of this volume, as well as online: <http://www.dcp-3.org/CAHDEthiopia>.

## **REFERENCE**

Patton, G. C., S. M. Sawyer, J. S. Santelli, D. A. Ross, R. Afifi, and others. 2016. “Our Future: A *Lancet* Commission on Adolescent Health and Wellbeing.” *The Lancet* 387 (10036): 2423–78.

## Abbreviations

AIDS	acquired immune deficiency syndrome
AQ	amodiaquine
AS	artesunate
BCR	benefit-cost ratio
BMI	body mass index
CCT	conditional cash transfer
CHERG	Child Health Epidemiology Reference Group
CME	Child Mortality Estimation
CT	cash transfer
DALY	disability-adjusted life year
<i>DCP1</i>	<i>Disease Control Priorities in Developing Countries</i> , first edition
<i>DCP2</i>	<i>Disease Control Priorities in Developing Countries</i> , second edition
<i>DCP3</i>	<i>Disease Control Priorities</i> , third edition
DHS	Demographic and Health Surveys
DMFT	decayed, missing, and filled teeth
DOHaD	Developmental Origins of Health and Disease
DP	dihydroartemisinin-piperaquine
ECD	early child development
ECE	early childhood education
EFA	Education for All
EGRA	Early Grade Reading Assessment
ESP	education sector plan
FA	fractional anisotropy
FRESH	Focusing Resources on Effective School Health
FRP	financial risk protection
GBD	Global Burden of Disease
GDP	gross domestic product
GHE	Global Health Estimates
GIZ	German Development Cooperation
GNI	gross national income
GYTS	Global Youth Tobacco Survey

HAZ	height-for-age z-scores
Hb	hemoglobin
HBSC	Health Behaviour in School-Aged Children
HEADSS	home, education, activities/employment, drugs, suicidality, sex
HICs	high-income countries
HIV	human immunodeficiency virus
HIV/AIDS	human immunodeficiency virus/acquired immune deficiency syndrome
HLM	hierarchical linear model
HPV	human papillomavirus
HSV-2	herpes simplex virus-2
ICF	International Classification of Functioning, Disability and Health
IEA	International Association for the Evaluation of Educational Achievement
IEC	information, education, and communication
IHME	Institute for Health Metrics and Evaluation
INCAP	Institute of Nutrition for Central America and Panama
IPCs	intermittent parasite clearance in schools
IPT	intermittent preventive treatment
IQ	intelligence quotient
IRS	indoor residual spraying
IST	intermittent screening and treatment
ITN	insecticide-treated bednet
KMC	kangaroo mother care
LBW	low birth weight
LICs	low-income countries
LMICs	low- and middle-income countries
MDA	mass drug administration
MDGs	Millennium Development Goals
m-health	mobile health
MICs	middle-income countries
MICS	Multiple Indicator Cluster Survey
NCDs	noncommunicable diseases
NTD	neglected tropical diseases
OECD	Organisation for Economic Co-operation and Development
OOP	out of pocket
OTL	opportunity to learn
PDV	present discounted value
PIAAC	Programme for the International Assessment of Adult Competencies
PIRLS	Progress in International Reading Literacy Study
PISA	Programme for International Student Assessment
PFC	prefrontal cortex
PRIMR	Primary Mathematics and Reading
PT	planum temporale
QALY	quality-adjusted life year
RCT	randomized controlled trial
RDT	rapid diagnostic test
RMNCH	reproductive, maternal, newborn, and child health
RoR	rate of return
RSC	Rockefeller Sanitary Commission
RTI	road traffic injury

SABER	Systems Approach for Better Education Results
SSBs	sugar-sweetened beverages
SBM	school-based management
SDGs	Sustainable Development Goals
SES	socioeconomic status
SHN	school health and nutrition
SMC	seasonal malaria chemoprevention
SP	sulphadoxine-pyrimethamine
SR	self-regulation
STHs	soil-transmitted helminths
STI	sexually transmitted infection
TFR	total fertility rate
TIMSS	Trends in International Mathematics and Science Study
TT	tetanus toxoid
U5MR	under-5 mortality rate
UCT	unconditional cash transfer
UMICs	upper-middle-income countries
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
VLY	value of a life year
VSL	value of a statistical life
VWFA	visual word form area
WASH	water, sanitation, and hygiene
WAZ	weight-for-age
WG	Washington Group
WHO	World Health Organization
WHZ	weight-for-height
WPP	World Population Prospects
WRA	women of reproductive age
YLD	years lost to disability
YOURS	Youth for Road Safety

