Chapter 2

Mortality at Ages 5 to 19: Levels and Trends, 1990–2010

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INTRODUCTION

During the past 15 years, the attention of the international community, as reflected in the Millennium Declaration and its associated Development Goals (UN 2000), has focused on the health of children under age five years and of adults. Adolescents and children older than age five years have been relatively neglected. However, publication of the report of a *Lancet* Commission on Adolescent Health and Wellbeing (Patton and others 2016), as well as the essays in this volume, suggest the beginning of serious concern for this neglected age group.

Mortality rates provide the most significant single indicator of health, but two publications (UN 2014; Wang and others 2012) have arrived at different estimates of numbers of deaths in the age 5–19 years range. Both the UN and Wang studies use models to generate mortality estimates. This chapter reviews and expands on a third set of estimates of mortality rates and numbers of deaths in those ages 5–19 years in low- and middle-income countries (LMICs) for 1990 and 2010 (Hill, Zimmerman, and Jamison 2015). The purpose of the Hill, Zimmerman, and Jamison (2015) study was to generate empirical estimates of mortality rates to check against the modeled numbers from UN (2014) and Wang and others (2012). It compares and contrasts the empirical estimates with those from the two previous modeling exercises. More specifically, the chapter summarizes the findings in Hill, Zimmerman, and Jamison (2015) on gender-specific mortality risks and numbers of deaths by World Bank geographical region for ages 5–9 years and 10–14 years for 1990 and 2010, and on the rates of change in these risks and numbers during the two decades. It then extends these findings to ages 15–19 years. The chapter concludes by reporting the World Health Organization's (WHO) estimates of percentage of deaths by broad cause of death category. We do not discuss risk factors or potential interventions. Definitions of age groupings and age-specific terminology used in this volume can be found in chapter 1 (Bundy and others 2017).

The age range of 5–19 years encompasses the inflection point of human mortality risks, with infectious disease mortality declining from the high risks of early childhood before noncommunicable disease risks start their exponential increase in adulthood. Despite being a healthy age range relative to all others, the number of deaths exceeded an estimated 2 million in 2010. This age range is also crucial for human development. In most societies, it covers the large majority of educational attainment; in many societies, it also covers the start of family formation (Sawyer and others 2012; UNICEF 2012). This chapter attempts to ground this volume's discussion of these larger issues with a reminder that the mortality reduction agenda remains unfinished and substantial.

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MORTALITY AT AGES 5 TO 19 YEARS

Methods and Data

The methodology used by Hill, Zimmerman, and Jamison (2015) to develop the new estimates is fully described in their paper and summarized here. The empirical basis for their estimates is the full birth histories collected by Demographic and Health Surveys (DHS) (Rutstein and Rojas 2006) in more than 70 LMICs. These full birth histories—which consist of information on dates of birth, survival status, and age at death if relevant for all live births of a representative sample of women of reproductive age—are the primary source of information on mortality under age five years in LMICs, given that most of these countries lack accurate civil registration systems (UN 2014). Because the birth histories collect data on all births, and deaths to those births at all ages, they provide information, albeit increasingly selected by age of mother, about the mortality of older children and adolescents. The method used to estimate mortality risks for ages five years and older is the same as that used for mortality under age five years (Hill 2013). The numbers of deaths are much smaller above age 5 years, and particularly above age 10 years, than below, however, and estimates have been calculated for the 10 calendar years before each survey.

Although the coverage of the DHS program has been wide, not all countries have conducted such surveys; China is the most notable exception. Given the importance of China for global estimates, we adopted a different estimation strategy for that country, using census data from 1990 and 2010, adjusted for coverage. Because the DHS program does not cover all LMICs, and because individual countries are represented in the dataset for some years and not others, we adopted a model-based estimation method. We used the empirical survey-specific dataset to estimate relationships between risks of dying at ages 5–9, 10–14, and 15–19 years to the under-5 mortality rate (U5MR), and then applied those relationships to regional estimates of U5MR in 1990 and 2010, as produced by the Interagency Group on Mortality Estimation (UN 2014).

The empirical dataset is derived from 213 surveys covering 77 countries; the earliest survey is from 1986, and the latest is from 2011. Before turning to modeled estimates, it is of interest to examine the empirical observations themselves. Table 2.1 reports the mean mortality risks for both genders for ages 0–4, 5–9, 10–14, and 15–19 years, as calculated for the 10 calendar years before each survey. Across all observations, which are weighted toward Sub-Saharan Africa because of the geographic distribution of the DHS, the median U5MR is 85.6 per 1,000 live births; the risk of dying for ages 5–9 years is 15.8 per 1,000 survivors to age 5 years; the risk of dying for ages 10–14 years is 9.3 per 1,000 survivors to age 10; and the risk of dying for ages 15–19 years is 11.7 per

Table 2.1 Median Conditional Probabilities of Dying per 1,000 at Ages 0–4, 5–9, 10–14, and 15–19 Years, Estimated from DHS by World Bank Region

	World Bank Low- and Middle-Income Country Regions						
	All	East Asia and Pacific, excluding China	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	South Asia	Sub-Saharan Africa
Number of DHS analyzed	213	17	14	40	17	17	108
Age range (years)							
0–4	80 (50, 113)	42 (39, 72)	39 (19, 49)	53 (35, 74)	44 (34, 75)	69 (53, 81)	110 (85, 138)
5–9	13 (6.6, 23)	9.4 (7.0, 13)	3.2 (1.6, 3.7)	5.6 (3.4, 8.1)	4.3 (3.2, 8.5)	12 (8.5, 18)	23 (15, 30)
10–14	7.5 (4.2, 13)	5.8 (4.5, 6.4)	2.4 (1.8, 3.3)	4.3 (2.9, 5.8)	4.0 (2.5, 5.8)	5.7 (5.2, 7.7)	13 (9.0, 16.2)
15–19	10 (7.1, 15)	8.1 (6.3, 9.5)	5.1 (2.6, 7.3)	8.5 (5.6, 10)	5.6 (4.3, 7.4)	9.0 (7.1, 11)	14 (11, 20)

Note: Numbers in parentheses are the 25th and 75th percentiles. DHS = Demographic and Health Surveys.

1,000 survivors to age 15. The risks are highest in Sub-Saharan Africa in all age ranges; in this region, these risks are also higher relative to the U5MR.

Results: Mortality Risks

Across all regions, the lowest risk is in ages 10–14 years. The increase in risk from 10–14 to 15–19 years is substantially larger in two regions, Latin America and the Caribbean, and Europe and Central Asia. To bring out the relationships between risks in different age groups, figure 2.1 plots the risk of dying, for both genders combined, at ages 10–14 against 5–9 years, and 15–19 against 10–14 years. The risk at 10–14 years is lower than that at 5–9 years in almost all cases; risk at 15–19 years is generally higher than at 10–14 years, although there are numerous exceptions. The risk at 15–19 years relative to that at 10–14 years seems to increase at lower mortality levels and thus presumably at higher levels of economic development.

Figure 2.2 shows empirical relationships by gender for all three age ranges. Patterns are less clear than in figure 2.1, but further analysis through paired *t*-tests of the basic observations indicates that male mortality risks are higher than female risks in each age range, by about 12 percent for ages 5–9 years, 8 percent for 10–14 years, and 6 percent for 15–19 years; the first two differences are significant at 1 percent or higher, but the third misses significance at the 10 percent level. Once again, there is some indication that the pattern changes at low levels of mortality toward larger male disadvantages.

To obtain estimates for regions that include some countries that have not conducted surveys or have not conducted them consistently, we estimated models by regressing survey-specific mortality risks for ages 5–9, 10–14, and 15–19 years on the U5MR, and then estimated regional risks for 1990 and 2010 using regional estimates of U5MR. The models relating mortality at ages 5–9 and 10–14 years are statistically much stronger than the model for mortality at ages 15–19 years. This occurs partly because of smaller numbers of recorded deaths at ages 15–19 years, but also partly because the relationship itself seems to be more variable across countries, so the estimates for ages 15–19 years are substantially more uncertain.

Given its size and importance in any regional or global estimates, we adopted a different approach for China. Following the work of Banister and Hill (2004), we used information on population and deaths by age from the Chinese population censuses of 1990 (National Bureau of Statistics 1993) and 2010 (National Bureau of Statistics 2012), after adjustment for estimated undercoverage of deaths, and calculated mortality risks directly.

Table 2.2 shows the regional mortality risks by gender for ages 5–9, 10–14, and 15–19 years for 1990 and 2010 derived from the regression equations outlined; the table also shows the annual average rates of change between 1990 and 2010. For all LMICs, the probabilities of dying per 1,000 survivors at the beginning of the age intervals 5–9, 10–14, and 15–19 years decline from 16 to 8, from 8.5 to 5.5, and from 11.5 to 8.0, respectively. Overall, and in all geographic areas studied except China, declines have been fastest for ages 5–9 years, and slowest for ages 15–19 years. In China, declines were fastest for ages 5–9 years but slowest for ages 10–14 years, with a notably rapid decline of more than 6 percent per year for females ages 15–19 years. Across all regions and all age ranges, the declines were faster for females than for males.

Figure 2.1 Observed Probabilities of Dying at Ages 10–14 versus Ages 5–9 Years, and at Ages 15–19 versus Ages 10–14 Years, Both Genders

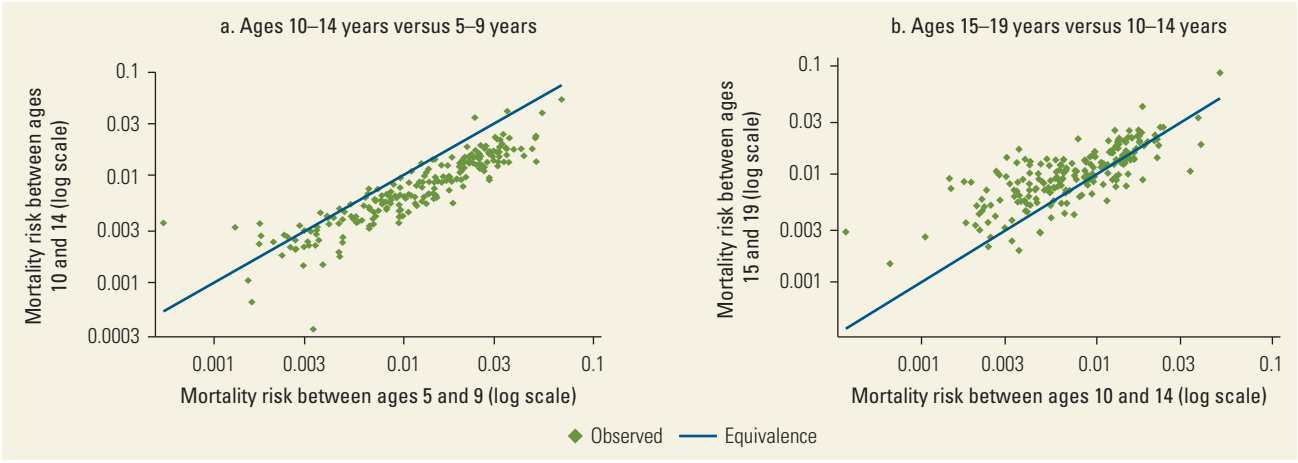


Figure 2.2 Observed Probabilities of Dying by Gender: Ages 5–9, 10–14, and 15–19 Years

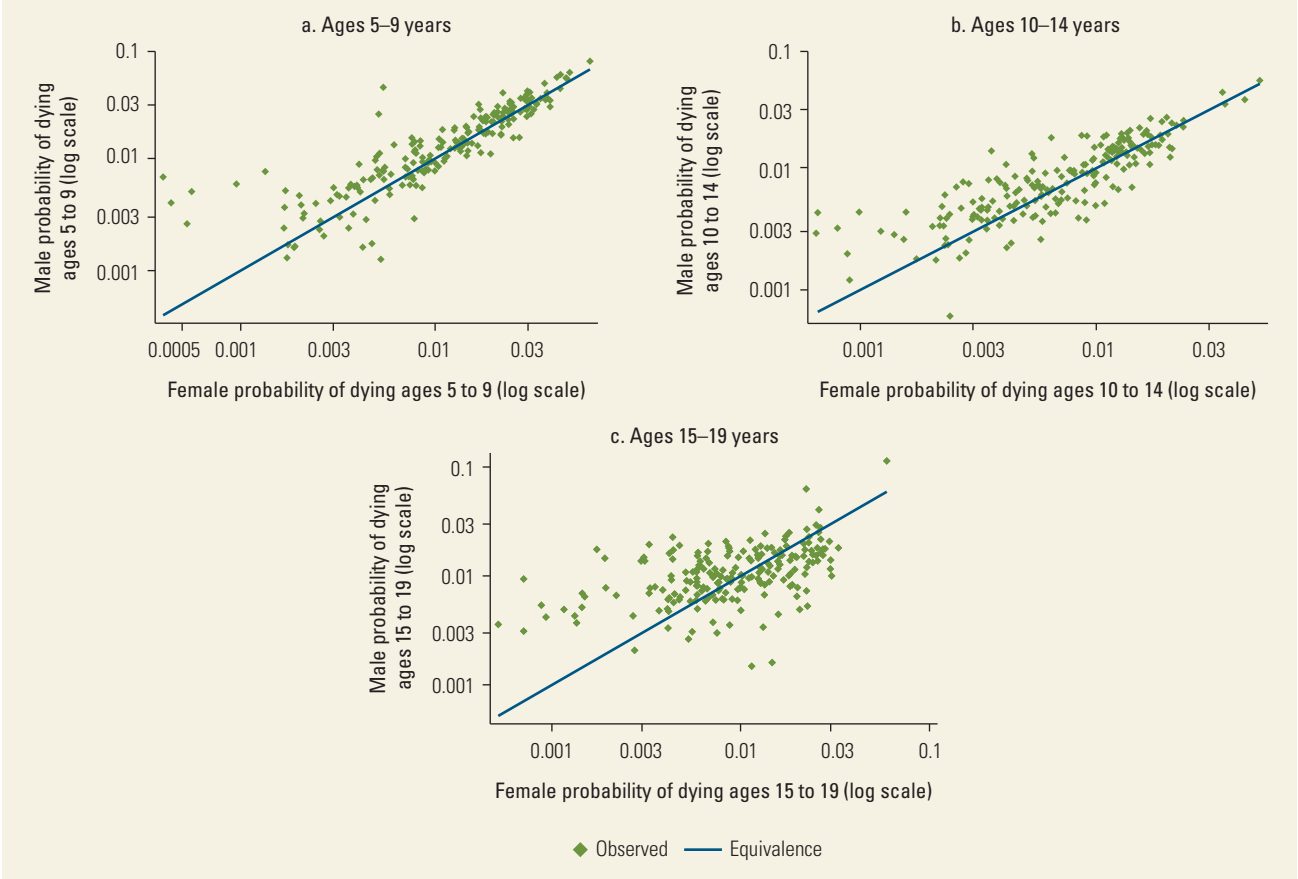


Table 2.2 Estimated Conditional Probabilities of Dying at Ages 5–9, 10–14, and 15–19 Years, by Gender: World Bank Regions, Annual Average Rates of Change, 1990 and 2010

		Probabilities of Dying per Survivor to Beginning of Age Group					
		Males			Females		
World Bank region	Year	5 to 9	10 to 14	15 to 19	5 to 9	10 to 14	15 to 19
East Asia and Pacific (excluding China)	1990	0.011	0.0068	0.0093	0.0098	0.0061	0.0086
	2010	0.0048	0.0039	0.0059	0.0038	0.0033	0.0051
	Annual rate of change (percent)	–4.3	–2.8	–2.3	–4.7	–3.1	–2.6
China[a]	1990	0.0043	0.0032	0.0056	0.0035	0.0026	0.0051
	2010	0.0020	0.0020	0.0029	0.0014	0.0013	0.0014
	Annual rate of change (percent)	–4.0	–2.3	–3.3	–4.7	–3.6	–6.3
Europe and Central Asia (low and middle income)	1990	0.0085	0.0055	0.0079	0.0069	0.0046	0.0069
	2010	0.0037	0.0032	0.0050	0.0028	0.0025	0.0042
	Annual rate of change (percent)	–4.2	–2.8	–2.3	–4.5	–3.0	–2.5

table continues next page

Table 2.2 Estimated Conditional Probabilities of Dying at Ages 5–9, 10–14, and 15–19 Years, by Gender: World Bank Regions, Annual Average Rates of Change, 1990 and 2010 (continued)

		Probabilities of Dying per Survivor to Beginning of Age Group					
		Males			Females		
World Bank region	Year	5 to 9	10 to 14	15 to 19	5 to 9	10 to 14	15 to 19
Latin America and the Caribbean	1990	0.0085	0.0054	0.0078	0.0068	0.0045	0.0069
	2010	0.0031	0.0028	0.0045	0.0024	0.0023	0.0039
	Annual rate of change (percent)	–5.0	–3.4	–2.8	–5.1	–3.4	–2.8
Middle East and North Africa	1990	0.010	0.0064	0.0088	0.0094	0.0059	0.0084
	2010	0.0038	0.0033	0.0051	0.0032	0.0029	0.0046
	Annual rate of change (percent)	–4.9	–3.3	–2.7	–5.4	–3.7	–3.0
South Asia	1990	0.022	0.012	0.014	0.023	0.012	0.014
	2010	0.0097	0.0068	0.0089	0.010	0.0070	0.0091
	Annual rate of change (percent)	–4.1	–2.8	–2.3	–4.1	–2.8	–2.3
Sub-Saharan Africa	1990	0.037	0.018	0.019	0.032	0.016	0.018
	2010	0.019	0.012	0.013	0.017	0.010	0.012
	Annual rate of change (percent)	–3.2	–2.1	–1.7	–3.2	–2.2	–1.8
Total, low- and middle-income countries	1990	0.017	0.0095	0.012	0.016	0.0074	0.011
	2010	0.0088	0.0063	0.0084	0.0081	0.0049	0.0080
	Annual rate of change (percent)	–3.2	–2.0	–1.7	–3.3	–2.1	–1.8

a. Estimates for China are based on populations and numbers of deaths recorded in the 1990 and 2010 Population Censuses, adjusted as described in the text.

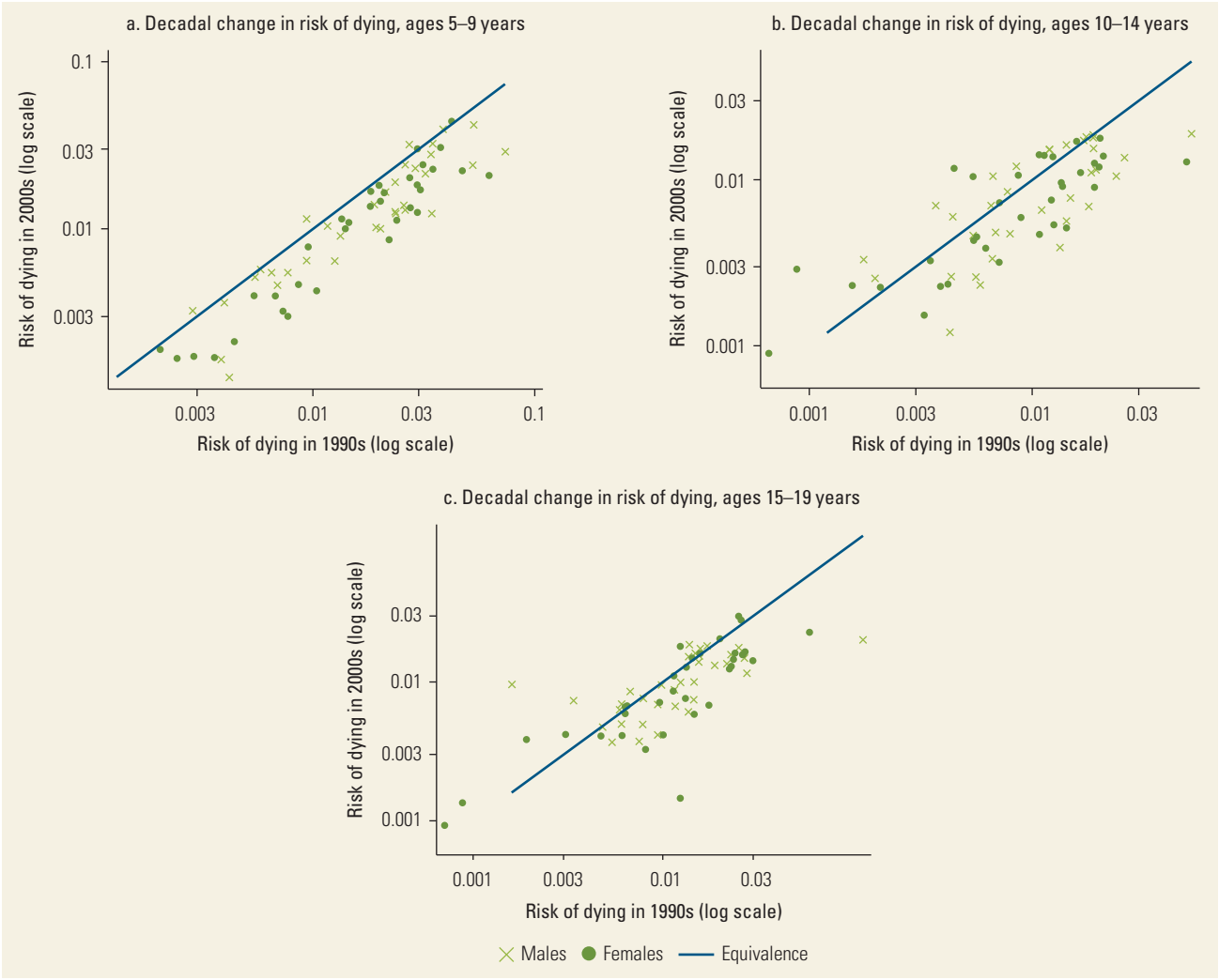
The rates of decline were slowest in Sub-Saharan Africa and generally fastest in Latin America and the Caribbean and the Middle East and North Africa, although China had the fastest declines at ages 15–19 years.

The rates of decline for all LMICs are similar to, or even slower than, the rates of decline for Sub-Saharan Africa, the worst performing region. This statistical oddity arises because Sub-Saharan Africa had the highest risks in both periods, had the slowest rates of decline, and sharply increased its proportional representation among all LMICs because of rapid population growth at these ages.

To confirm that the regional changes in mortality risks by gender and age range were not merely an artifact of the model, reflecting primarily the Interagency Group on Mortality Estimation changes in U5MR, we regressed the (logged) original observations derived directly from DHS data on the year of the survey (the observations are of average mortality risks for the 10 calendar years before each survey), using country fixed effects. These regressions confirmed the broad patterns of the results in table 2.2. The rates of decline were fastest for ages 5–9 years (about 3 percent per year), and slowest for ages 15–19 years (about 1 percent per year), although significantly different from zero for all groups except males ages 15–19 years; in each age range, rates of decline were faster for females than for males. Not surprisingly, the results are not identical to those in table 2.2; there are likely to be unobserved factors determining the selection of countries into the set in which at least two DHS have been conducted. However, the broad support of the basic observations for the results in table 2.2 is reassuring.

The results of an additional analysis drawing on survey data from those 34 countries that conducted two DHS separated by about 10 years (specifically by between 9 and 11 years), the first one in 2000 or earlier, the second in 2001 or later, are shown in figure 2.3, which plots

Figure 2.3 Changes in Probabilities of Dying by Age Group, 1990s and 2000s: Countries with DHS about 10 Years Apart in Each Decade (*N* = 27)



Note: DHS = Demographic and Health Surveys.

mortality risk in the later survey against that in the earlier, for each age range. For ages 5–9 years, the risks from the second survey are almost universally lower than those from the first; for ages 15–19 years, a large majority fits the same pattern. For ages 10–14 years, however, there is more scatter, and the pattern is less clear; before over-interpreting this result, it is important to remember that the number of deaths is lowest in this age group and sampling errors are largest.

Results: Number of Deaths

Table 2.3 repeats the general format of table 2.2 but reports numbers of deaths in 1990 and 2010 and annual rates of change by gender, age range, and region. The numbers of deaths were estimated by converting the probabilities of dying in table 2.2 into age-specific mortality rates using standard demographic methods (Preston, Heuveline, and Guillot 2001), and then applying those rates to regional populations as estimated by the United Nations Population Division (UN 2013). The resulting numbers are simply the product of population size and risk of dying, and the percentage changes reflect the changes in both of these factors.

The total number of deaths in LMICs between ages 5 and 19 years fell from 3.3 million in 1990 to 2.3 million in 2010; male deaths exceeded female deaths by an estimated 11 percent in 1990 and 15 percent in 2010. The largest number of deaths in both 1990 and 2010 was in

Table 2.3 Estimated Numbers of Deaths at Ages 5–9, 10–14, and 15–19 Years by Gender: World Bank Regions, with Annual Average Rates of Change, 1990 and 2010

		Annual Numbers of Deaths (Thousands)					
		Males			Females		
World Bank region	Year	5 to 9	10 to 14	15 to 19	5 to 9	10 to 14	15 to 19
East Asia and Pacific (excluding China)	1990	69	39	50	58	34	45
	2010	30	24	35	23	19	30
	Annual rate of change (percent)	–4.2	–2.5	–1.7	–4.7	–2.8	–2.0
China[a]	1990	45	32	69	33	25	59
	2010	15	17	31	9	9	14
	Annual rate of change (percent)	–5.5	–3.3	–4.0	–6.6	–5.0	–7.2
Europe and Central Asia (low and middle income)	1990	31	19	25	24	15	21
	2010	10	8	15	7	6	13
	Annual rate of change (percent)	–5.9	–4.1	–2.5	–6.3	–4.4	–2.7
Latin America and the Caribbean	1990	46	28	36	36	23	31
	2010	18	16	25	13	13	21
	Annual rate of change (percent)	–4.8	–2.8	–1.9	–4.9	–2.9	–2.0
Middle East and North Africa	1990	35	19	22	31	17	20
	2010	13	11	17	10	9	15
	Annual rate of change (percent)	–5.1	–2.8	–1.1	–5.5	–3.1	–1.3
South Asia	1990	340	160	170	330	160	160
	2010	170	120	150	160	110	140
	Annual rate of change (percent)	–3.4	–1.6	–0.65	–3.5	–1.7	–0.68
Sub-Saharan Africa	1990	280	120	100	240	100	94
	2010	250	130	130	210	110	110
	Annual rate of change (percent)	–0.72	0.42	0.97	–0.85	0.32	0.88
Total, low- and middle-income countries	1990	850	410	470	760	370	430
	2010	500	320	400	430	280	350
	Annual rate of change (percent)	–2.6	–1.1	–0.89	–2.8	–1.5	–1.1

a. Numbers of deaths for China are based on numbers of deaths recorded in the 1990 and 2010 Population Censuses, adjusted as described in the text.

ages 5–9 years, although this age group also experienced the fastest rate of decline between those two years; ages 10–14 years recorded the smallest number of deaths, and ages 15–19 years showed the slowest rate of decline from 1990 to 2010. South Asia had the highest number of deaths in 1990, but it was overtaken by Sub-Saharan Africa in 2010 except in ages 15–19 years. These two regions together accounted for almost 70 percent of all deaths in LMICs between ages 5 and 19 years in 1990, and almost 80 percent in 2010.

Comparison with Other Studies

Table 2.4 puts the estimates in this chapter of numbers of deaths in 2010 in the context of global estimates arrived at by the Global Burden of Disease (GBD) exercise (Wang and others 2012) and the United Nations Population Division (UN 2013). We only compared numbers for the world as a whole, for LMICs, and for Sub-Saharan Africa because the three exercises define regions differently. We arrived at the GBD estimates for LMICs by subtracting the sum of deaths in ages 5–9, 10–14, and 15–19 years for high-income Asia and Pacific, Australasia, Central Europe, Western Europe, and high-income North America from global deaths in those age groups; for Sub-Saharan Africa, we summed deaths for Central, Eastern, Southern, and Western Sub-Saharan Africa. The World Population Prospects (WPP) tabulates deaths by age group and five-year period only for 1995–2000, 2000–05, and 2005–10 (UN 2013). We estimated the numbers of deaths for the single year of 2010 by estimating rates of change from 2000–05 to 2005–10, and applying those rates of change to the 2005–10 estimate for 2.5 years, and dividing by 5 to get a single-year figure.

Table 2.4 shows differences between the GBD estimates and those of the other two exercises for ages 5–9 and 10–14 years. At the global level and for LMICs, the GBD numbers are only about 60 percent of the WPP numbers; for Sub-Saharan Africa, they are little more than 35 percent; for ages 15–19 years, the agreement is closer, although the GBD numbers are still 10 percent lower than the WPP numbers globally and for all LMICs, and almost 40 percent lower for Sub-Saharan Africa. In contrast, the Hill, Zimmerman, and Jamison (2015) and WPP (UN 2013) numbers are closer: almost identical for LMICs for ages 10–14 and 15–19 years, although the Hill, Zimmerman, and Jamison (2015) numbers are higher for LMIC deaths at ages 5–9 years, but lower for Sub-Saharan Africa at ages 10–14 and 15–19 years. The WPP and Hill, Zimmerman, and Jamison (2015) numbers are higher than the GBD estimates for every age-region combination in table 2.4. Hill, Zimmerman, and Jamison (2015) hypothesize that the differences between GBD and the other estimates at ages 5–14 years result from the model life table system used in constructing the GBD estimates.

DEATHS BY CAUSE

We report also in this chapter on deaths by cause. We develop no new estimates but instead rely on the WHO's Global Health Estimates (GHE) for 2012 (WHO 2013). We report only for the age range 5–14 years because the GHE does not provide five-year age breakdowns. A paper (Mokdad and others 2016) prepared in conjunction with *The Lancet* Commission on Adolescent Health and Wellbeing presents recent GBD estimates for the percentage breakdown of deaths by cause for ages 10–24 years.

Table 2.5 shows estimates of the percentage distribution of deaths by cause for LMICs. To provide comparison the table also shows the same results for the age group 1–59 months. Although diarrheal disease, malaria, and respiratory conditions account for an important fraction of mortality in both age groups, these conditions are substantially more important at younger ages. Injury, in contrast, is reported to be more important at older ages.

Table 2.6 shows the GHE estimates of death by cause by World Bank region.

Table 2.4 Comparison of Numbers of Deaths between Ages 5 and 19 Years, 2010, thousands

	GBD[a]			WPP[b]			Hill, Zimmerman, and Jamison (2015)[c]		
Geography	5–9	10–14	15–19	5–9	10–14	15–19	5–9	10–14	15–19
World	450	360	710	710	630	790	n.a.	n.a.	n.a.
Less developed regions	450	360	680	710	620	750	940	600	740
Sub-Saharan Africa	170	110	190	430	330	310	450	240	240

Note: GBD = Global Burden of Disease; WPP = World Population Prospects; n.a. = not applicable.

a. Wang and others 2012.

b. Calculated from UN 2013.

c. See table 2.3.

Table 2.5 Distribution of Deaths by Cause in Low- and Middle-Income Countries, Ages 1–59 Months and 5–14 Years, 2012

	Age Group	
Cause	**1–59 months**	**5–14 years**
All causes (thousands)[a]	3,701	1,446
1. Communicable disease		
1.1 Tuberculosis	1.5	0.98
1.2 HIV/AIDS	2.7	6.7
1.3 Diarrheal disease	16	9.8
1.4 Malaria	13	2.2
1.5 Respiratory conditions	23	8.5
2. Noncommunicable disease		
2.1 Malignant neoplasms	0.81	3.4
2.2 Cardiovascular diseases	0.88	3.1
2.3 Congenital anomalies	4.8	2.3
2.4 Epilepsy	0.52	2.2
2.5 Neonatal conditions	5.9	0.01
3. Injuries		
3.1 Unintentional	8.6	22
3.2 Intentional	0.42	3.4
Percentage of deaths in above categories	78	65

Note: HIV/AIDS = human immunodeficiency virus/acquired immune deficiency syndrome.
a. Global Health Estimates, "Estimates for 2000–2012: Causes of Death," WHO 2013. This chapter's estimates of deaths for ages 5–14 years in 2010 is higher at 1.53 million. Deaths by cause are given in percentages.

Table 2.6 Deaths by Cause in Low- and Middle-Income Countries, by World Regional Groups, Ages 5–14, 2012

	Regional Groups							
Causes	**High income**	**Low and middle income**	**East Asia and Pacific**	**Europe and Central Asia**	**Latin America and the Caribbean**	**Middle East and North Africa**	**South Asia**	**Sub-Saharan Africa**
All causes (in thousands)	23	1,424	120	18	44	42	342	858
1. Communicable disease								
1.1 Tuberculosis	0.10	1.0	0.50	0.05	0.25	0.36	0.42	1.4
1.2 HIV/AIDS	0.70	6.8	0.85	0.70	2.5	0.40	1.4	10
1.3 Diarrheal disease	1.0	10	2.8	1.1	2.8	1.0	12	11
1.4 Malaria	0.10	2.3	1.5	0	0.23	0.34	0.65	3.4
1.5 Respiratory conditions	4.9	8.5	4.9	6.8	6.7	11	9.9	8.5
2. Noncommunicable disease								
2.1 Malignant neoplasms	17	3.2	11	13	11	12	3.3	1.2
2.2 Cardiovascular diseases	6.2	3.1	6.6	12	6.1	8.8	2.5	2.2

table continues next page

Table 2.6 Deaths by Cause in Low- and Middle-Income Countries, by World Regional Groups, Ages 5–14, 2012 (continued)

Causes	Regional Groups							
	High-income	Low- and middle-income	East Asia and Pacific	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	South Asia	Sub-Saharan Africa
2.3 Congenital anomalies	5.8	2.2	5.1	5.8	4.3	3.2	2.5	1.5
2.4 Epilepsy	1.9	2.2	2.5	3.0	1.6	0.89	1.9	2.4
3. Injuries								
3.1 Unintentional	32	22	33	26	26	23	28	18
3.2 Intentional	7.0	3.3	2.4	5.4	8.5	20	3.5	2.2
Percentage of deaths in above categories	76	65	71	73	70	81	66	62

Note: HIV/AIDS = human immunodeficiency virus/acquired immune deficiency syndrome. Deaths by cause are given in percentages and are from Global Health Estimates, "Estimates for 2000–2012: Causes of Death" (WHO 2013).

CONCLUSIONS

The principle conclusion from this analysis is that, although mortality reaches its minimum in ages 5–19 years, the number of deaths in this age group in LMICs still represents a substantial burden, approximately 2.3 million in 2010. The data show that in most LMICs, mortality risks are lowest in ages 10–14 years; this finding is in contrast to low-mortality, high-income countries, where the risks are lowest in ages 5–9 years. This difference suggests that much of the LMIC burden of mortality at ages 5–9 years is residual mortality from infectious childhood diseases.

In other respects, mortality at ages 5–19 years has behaved largely as has mortality under age 5 years. Males have generally higher risks than females; the risks have fallen since 1990, although not quite as rapidly as for those under age 5 years.

Global estimates of mortality in this age group have shown a discrepancy between the numbers estimated by the United Nations Population Division and the numbers estimated as part of the GBD exercise. This study provides empirical support for the numbers estimated by the United Nations and arrives at numbers that are generally slightly higher still. The discrepancies are not the result of different estimates of U5MR, which are very similar on average, or of very different numbers of population, but of differences in estimated risks of dying.

The full birth histories collected by the DHS and by UNICEF's Multiple Indicator Cluster Surveys program (see http://www.mics.unicef.org) provide estimates of mortality for this age range. However, in many surveys the numbers are small, and the estimates have high uncertainty; as a result, we only estimated rates for periods of 10 years before each survey. The deaths reported at older ages of childhood are also increasingly selected for the young age of mother at the time of the relevant births, because the histories are only collected from women under age 50 years. In countries lacking complete and accurate civil registration systems, these limitations will adversely affect the ability to monitor changes or identify differentials in the mortality of older children and younger adolescents.

A final concern is that we have very little information about the cause-of-death structure for this age range. Verbal autopsy methods applied to deaths of children under age five years occurring shortly before a DHS have improved the data availability for cause of death of younger children (see, for example, Liu and others 2015), but no such efforts have been applied to deaths of older children; in general, sample sizes are probably too small for such an exercise to produce stable results. Nevertheless, our tables 2.5 and 2.6 reproduce current best estimates from WHO. However, some larger surveys in high-mortality settings would provide an adequate basis for such an exercise, which ought to be undertaken; the cost would be relatively modest since the survey identifies the target deaths at virtually zero marginal cost.

NOTE

World Bank Income Classifications as of July 2014 are as follows, based on estimates of gross national income (GNI) per capita for 2013:

- Low-income countries (LICs) = US$1,045 or less
- Middle-income countries (MICs) are subdivided:
  a) lower-middle-income = US$1,046 to US$4,125
  b) upper-middle-income (UMICs) = US$4,126 to US$12,745
- High-income countries (HICs) = US$12,746 or more.

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