



Incorporating Deaths Near the Time of Birth Into Estimates of the Global Burden of Disease

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Many countries, including all high-income ones, maintain vital registration systems that provide data on the number of deaths by cause, sex, and age. Some countries also report years of life lost because of premature mortality (YLL) due to each cause, a number that depends on the age of death and on the choice of an algorithm for how YLL should depend on the age of death. The tracking of stillbirths, however, is often incomplete and variable.

As of the early 1990s, no estimates of YLL were available for many developing countries or for regional groupings of such countries. The World Bank (1993), as part of the preparation for its *World Development Report 1993: Investing in Health*, initiated an effort to provide estimates of deaths by age and cause, and hence YLL, for around 100 conditions for eight regional groupings, including all low- and middle-income countries. By adding years of healthy life lost as a result of disability (YLD) to YLL, the World Bank was able to generate estimates of the global burden of disease measured both in deaths by cause and in disability-adjusted life-years (DALYs) (Murray, Lopez, and Jamison 1994; World Bank 1993, appendix B). Murray and Lopez (1997) provide updated and

extended results and a complete description of methods. Global burden of disease estimates have subsequently been used to help guide resource allocation in the health sector and to inform debates about national and international disease control priorities (see chapter 1 in this volume); however, the global burden of disease literature currently provides little insight into the importance of deaths near the time of birth.

The purpose of this chapter is to explore the sensitivity of results within the Global Burden of Disease (GBD) framework to alternative approaches to encompassing the large number of deaths that occur near the time of birth, namely almost 4 million neonatal deaths and 3.3 million stillbirths. The sensitivity analyses in this chapter thus complement those of chapter 5, which explore the effect of variations in discount rates, age weights, and disability weights. Chapter 3 in this volume describes the GBD framework and provides estimates of deaths and DALYs by cause for 2001 using the World Bank regional grouping of countries. (Map 1, inside the front cover of this volume, shows the World Bank regional groupings used throughout this book.) This

chapter uses the same framework and numbers to the extent possible, but with the following exceptions:

- We divide the newborn through age 4 category into neonatal (newborn through 27 days), postneonatal (28 days to less than 1 year), and child (1 through 4 years).
- We aggregate the 136 causes noted in chapter 3 into 35 causes.
- We allocate the substantial number of neonatal deaths attributed to pneumonia or sepsis to the chapter 3 category of respiratory infections.
- We explore the sensitivity of the results in chapter 3 to adding stillbirths as a new age category.
- We explore the sensitivity of the results to alternative ways of assigning YLL to deaths under the age of five.

The first section of this chapter deals with mortality: all-cause and cause specific. It uses the results presented in chapter 3, but adds to them estimates of the level of stillbirths and of the level and causes of neonatal mortality. The second section deals with estimation of the burden of disease in DALYs. The inclusion of stillbirths in the analysis highlights the more general issue of how to deal appropriately with deaths at different ages in constructing a measure of YLL.

As emphasized throughout this volume, data on causes of death and disability are fragmentary and are often inconsistent for many regions of the world. This is particularly true for the neonatal period and for stillbirths. One clear implication is the desirability of more and better data. Another implication is that any effort to construct an overall picture of population health must aggregate data of variable, often low, quality and completeness. In some instances this is done essentially as a political process, with various disease advocacy groups advancing their claims to policy makers and in the press. Alternatively, summary measures can be constructed systematically in a way that eliminates internal inconsistencies, describes methods carefully, and imposes the discipline of demographically derived totals into which cause-specific estimates must fit. This is the nature of our work on the global burden of disease.

STILLBIRTHS AND NEONATAL MORTALITY IN THE CONTEXT OF THE GLOBAL BURDEN OF DISEASE

This section first introduces the nomenclature used throughout the chapter. It then provides estimates of deaths and death rates that highlight stillbirths and neonatal deaths and discusses deaths by cause at different ages.

Nomenclature

This chapter follows standard usage where possible, but extends or tightens it as needed. Stillbirth refers to the birth of a dead fetus weighing more than 1,000 grams up to 0.25 years (13 weeks) prior to the expected time of birth (corresponding to 27 weeks of gestational age). Total births are the sum of the number of live births and of stillbirths. Stillbirths are conventionally divided into two categories, antepartum stillbirths, when a fetus dies before the onset of labor, and intrapartum stillbirths, when fetal death occurs during labor. The term fresh stillbirths denotes fetuses born dead but with intact skin, which are assumed to have died less than 12 hours before birth and serve as an observable surrogate measure for intrapartum stillbirths. Individuals younger than 28 days are in the neonatal period and younger than 1 year are infants. The neonatal period is divided into the early neonatal period, which refers to birth to less than 7 days old, and the remaining late neonatal period. The postneonatal period extends from 28 days to under 1 year. Child in this chapter refers to an individual from age one to under age five. (In some other usage, however, child refers to all individuals under age five).

We use standard demographic terminology to indicate death rates at different ages, that is, ${}_xq_y$ refers to the probability that an individual aged y will die before reaching age $y + x$ and is usually estimated using cross-sectional observations of age-specific mortality rates for individual ages in the age range y to $y + x$. Using this terminology, the mortality rate for those under one year old (or the infant mortality rate) is ${}_1q_0$. We extend this terminology to define the complete under one mortality rate as ${}_{1.25}q_{-.25}$, the child mortality rate as ${}_4q_1$,¹ the under five mortality rate as ${}_5q_0$, the stillbirth rate as ${}_{.25}q_{-.25}$, the neonatal mortality rate as ${}_{.077}q_0$, and the complete under five mortality rate as ${}_{5.25}q_{-.25}$. This chapter uses age-specific mortality rates for 2001.

Numbers of Deaths and Death Rates

In 2001, approximately 10.6 million children born alive died before their fifth birthday (8.2 percent of births). Of these deaths, 3.9 million occurred during the neonatal period, that is, under the age of 28 days. Another 3.3 million stillborn children remained outside the vital registration systems of most countries (WHO 2005a). When stillbirths are included among deaths, about half of all deaths of children under five occur under the age of 28 days.

Table 6.1 provides estimates of the numbers of stillbirths in 2001, with numbers broken down by World Bank income categories. The stillbirth numbers in the table come from rates

Table 6.1 Population Totals and Numbers of Births, 2001
thousands

Region	Population (mid-2001)	Live births	Stillbirths	Total births
Low- and middle-income countries	5,221,572	118,505	3,228	121,733
High-income countries	928,660	11,371	45	11,416
World	6,150,233	129,876	3,274	133,150

Sources: Population is calculated from United Nations Population Division 2003, table 1. Live births are calculated from population totals and crude birth rates in World Bank 2003. Stillbirths are calculated from live births, using rates from WHO 2005a.

Table 6.2 Age Distribution of Deaths under Age 5, 2001
thousands

Region	Stillbirths		Neonatal deaths			Deaths ages 28 days to < 1 year	Infant deaths (0 ≤ age < 1 year)	Child deaths (1 ≤ age < 5 years)	Deaths under age 5		
	Antepartum	Intrapartum	Total	Early ^a	Late ^a				Total	After live birth (0 ≤ age < 5 years)	Including stillbirth
	a	b	c (a + b)	d	e				f (d + e)	g	h (f + g)
Low- and middle-income countries	2,152	1,077	3,228	2,889	965	3,854	3,745	7,599	2,935	10,530	13,758
High-income countries	40	5	45	32	9	41	18	59	13	73	119
World	2,192	1,082	3,274	2,921	974	3,896	3,762	7,658	2,948	10,602	13,876

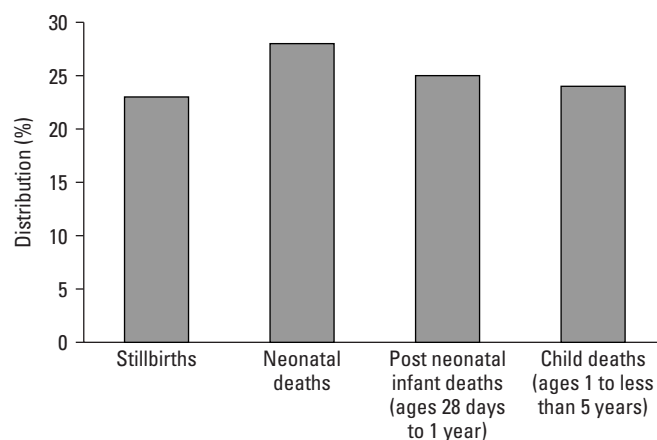
Sources: Columns a, b, c, d, e, and f are calculated from rates provided by WHO 2005a, using live birth totals from table 6.1 of this chapter. Column j is from chapter 3 of this volume. Column h = (infant mortality rate/under-five mortality rate) × total number of deaths from column j. Column i = [(under five mortality rate – infant mortality rate)/under five mortality]; under five mortality rates are from the World Bank (2003, table 2.20). The World Bank under five mortality rates are very close to, but not identical with, those reported in this volume (chapter 2, table 2.3). The World Bank numbers are used because they are accompanied by a consistently generated set of infant mortality rates.

a. The early neonatal period extends from birth to under 7 days of age; the late neonatal period extends from 7 days to under 28 days.

estimated by the World Health Organization (WHO) (WHO 2005a) applied to the birth numbers reported in the table. The table shows that in 2001, the high-income countries (those with a gross national income per capita of more than US \$9,076 in 2002) had 11.37 million live births and the low- and middle-income countries had 118.51 million live births.

Table 6.2 provides an age breakdown of deaths among children under five, again with a breakdown by World Bank income category. Early neonatal deaths account for 75 percent of all neonatal deaths. The eight-day period encompassing intrapartum stillbirths and early neonatal deaths accounts for almost 30 percent of the 13.9 million deaths occurring under the age of five. Thus, as shown in figure 6.1 for the low- and middle-income countries, roughly a quarter of the deaths under age five occur in each of the following categories: stillbirths, neonatal deaths, postneonatal infant deaths, and child deaths.

Three recent studies provide extensive literature reviews and model-based estimates of the number of stillbirths and neonatal deaths that extend the WHO estimates used here (WHO 2005a). Lawn, Shibuya, and Stein (2005, tables A–J)



Source: Table 6.2.

Figure 6.1 Age Distribution of Deaths of Children under Five in Low- and Middle-Income Countries, 2001

focus on intrapartum stillbirths and intrapartum-related neonatal deaths. Stanton and others (forthcoming) provide estimates of the number of stillbirths for 190 countries and Hill (forthcoming) provides estimates for neonatal deaths.

Table 6.3 Estimated Death Rates under Age 5, by Country Income Level, 2001
Probability of dying in the x years following age y (${}_xq_y$), expressed per thousand live births

	Stillbirth rate (${}_{0.25}q_{-0.25}$)	Neonatal mortality rate (${}_{0.77}q_0$)	Under 1 mortality rate (${}_1q_0$)	Complete under 1 mortality rate (${}_{1.25}q_{-0.25}$)	Child mortality rate (${}_4q_1$)	Under 5 mortality rate (${}_5q_0$)	Complete under 5 mortality rate (${}_{5.25}q_{-0.25}$)
Region	a	b	c	d	e	f	g
Low- and middle-income countries	27	33	64	89	25	89	113
High-income countries	4	4	5	9	1	6	10
World	25	30	58	82	23	82	104

Sources: Columns c and f are based on data from the World Bank (2003, table 2.20). Data for columns a, b, d, e, and g are provided by WHO (2005a).

Note: Column a = (total stillbirths)/(total births). Column b = (neonatal deaths)/(live births). Column c = (infant deaths)/(live births). Column d = (infant deaths + stillbirths)/(total births).

Column e = (total deaths from ages one to four years)/(live births). Column f = (total deaths under age five)/(live births). Column g = (total deaths under age five including stillbirths)/(total births).

The midpoints of their fairly wide confidence intervals accord with the numbers we use.

Table 6.3 shows death rates, expressed per 1,000 live births, that correspond to the death totals in table 6.2. Column (c), for example, shows an under one or infant mortality rate (${}_1q_0$) for low- and middle-income countries of 64 per 1,000. Column (d) shows the effect of including stillbirths to give the complete under one mortality rate (${}_{1.25}q_{-0.25}$), which is markedly higher at 89 per 1,000 live births. By including stillbirths and providing relatively fine-grained age breakdowns, table 6.3 provides a more comprehensive set of estimates of mortality rates under age five than has hitherto been available. The wide confidence interval that needs to be attached to the estimates (Stanton and others forthcoming) indicates both the need for caution when using these numbers and the importance of further research. Nevertheless, the estimates in table 6.3 are reasonable given currently available information.

Deaths by Cause

Estimates of the total number of deaths in different age groups provide a starting point for breaking those totals down into deaths by cause. This task inevitably involves some degree of arbitrariness because of problems with classifying multiple causes of death or underlying versus proximal causes. That said, available data from vital registration, sentinel surveillance, and verbal autopsy can provide reasonable approximations for most causes. Chapter 3 provides background on how this was done and generates the death by cause estimates used throughout this book.

We use the estimates from chapter 3 for deaths by cause in the newborn through age four age group and aggregate chapter 3 data on age groups over age five into a single category of

deaths for those age five and older. In their preparatory work for chapter 3, its authors estimated cause-specific breakdowns of deaths under age five both for infant deaths and for deaths from age one through age four, that is, deaths occurring at one year of age or older but under age five, and we have used their data in this chapter. Table 6.4 presents this information on deaths by cause aggregated, as previously indicated, into 35 groups of conditions rather than the 136 used in chapter 3.

The aggregate numbers for neonatal deaths and for stillbirths come from WHO (2005a) as reported in table 6.2 (see also WHO 2005b, pp. 170–71). Table 6.4 breaks down neonatal deaths into six causes: diarrheal diseases, tetanus, respiratory infections, low birthweight (essentially preterm birth), birth asphyxia and birth trauma, and congenital anomalies.² The estimates by cause were generated for WHO's Child Health Epidemiology Reference Group (CHERG) (see Bryce and others 2005 for a comprehensive presentation of data sources and methods of estimation). WHO (2005b, annex table 4) provides a summary of the numbers.

For the most part, the neonatal death categories used by CHERG align with the categories used by the GBD assessment in chapter 3; however, note the following exceptions:

- CHERG includes a pneumonia and sepsis category, which accounts for 26 percent of neonatal deaths globally and 27 percent in low- and middle-income countries. The GBD categories include respiratory infections (category I.B in our tables), which account for 1.945 million deaths worldwide in the age group 0–4. We allocate all the CHERG-estimated deaths from the combined category sepsis and pneumonia to the neonatal age group's respiratory infections category in order to remain as consistent as possible with the GBD framework in chapter 3. A number of

studies have estimated the percentage of the broad category sepsis and pneumonia that is pneumonia with a wide range of findings (see, for example, Bhutta and others 2004 and Bhutta, Ali, and Wajid 2004). Even with blood cultures and chest x-rays, one cannot say for sure if a newborn has sepsis or pneumonia or both, and in any case, the treatment is the same, so one programmatic category is currently appropriate (Lawn, Cousens, and Wilczynska forthcoming).

- CHERG's percentage of neonatal deaths due to tetanus (7 percent) exceeds the GBD estimate for all infant deaths from tetanus but is very close to WHO and GAVI estimates for the year 2000 of 220,000. In keeping with this chapter's spirit of staying as close as possible to GBD estimates from chapter 3, we remain within the GBD envelope for the under-five age group and, as a first approximation, allocate all under one tetanus deaths to the neonatal period. However, while remaining within the under five GBD envelope for tetanus, we have modified, in this case only, the (unpublished) GBD age breakdown between ages 0–1 and 1–4 to allocate 90 percent of under five tetanus deaths to under age one (see table 6.4, note a). The difference between the CHERG and WHO with the GBD estimates for tetanus deaths is substantial and is clearly a priority area for further work.
- The GBD work uses the category low birthweight, which is an outcome of either preterm birth or intrauterine growth retardation. Preterm birth is a major cause of neonatal death. Again in the spirit of remaining within the GBD framework, we allocate preterm births to the low birthweight GBD category. This should not cause confusion as long as it is understood that, for neonatal deaths, low birthweight refers almost entirely to preterm birth. The quantitative importance of preterm birth suggests that this is another category that could be presented separately in the next GBD effort.

We are not aware of any effort to aggregate data on causes of stillbirths that parallels the CHERG effort for neonatal deaths, hence the GBD calculations in this chapter do not attempt to allocate stillbirths by cause. However, even though this chapter does not attempt a review of the CHERG type of the causes of stillbirth, we can advance a few tentative hypotheses. First, an important cause of stillbirth is intrapartum complications. A recent systematic analysis of intrapartum stillbirths gives estimates for 192 countries based on 73 study populations (52 countries, $n = 46,779$ [73 populations]) suggesting that 1.02 million intrapartum stillbirths (uncertainty 0.66–1.48 million) occur annually, accounting

for 26 percent of global stillbirths. Second, congenital anomalies constitute an important cause of antepartum stillbirth. Third, sexually transmitted diseases and other infections cause antepartum stillbirth, but systematic global estimates are currently limited.

Our categorization of neonatal deaths within the GBD framework has been deliberately conservative in that where interpretation was in any way uncertain, we assigned deaths to the not allocated category. We expect future efforts to be able to substantially reduce the not allocated component for both stillbirths and neonatal deaths, but doing so will require both improved empirical information and modification of the current GBD framework to include classifications important for deaths near the time of birth. Until such improvements are possible, table 6.4 provides a plausible extension of the GBD cause of death framework to include causes of infant and neonatal deaths.

THE BURDEN OF DISEASE RESULTING FROM EVENTS NEAR THE TIME OF BIRTH

This section explains the use of DALYs as a measure of the disease burden and identifies a number of problems associated with the traditional DALY formulation when dealing with events around the time of birth. It proposes a generalized formulation (which annex 6A describes more fully). The chapter then calculates the disease burden using two approaches to explore the sensitivity of GBD estimates to alternative formulations as follows:

- the current DALY formulation extended so as to value the DALY loss from a stillbirth the same as the DALY loss from a death at age 0,
- a generalized DALY formulation allowing the acquisition of life potential (ALP) to be gradual rather than instantaneous.

Defining and Redefining DALYs

The DALY family of indicators measures the disease burden from the age of onset of a condition by summing an indicator of YLL due to the condition and an indicator of disability-adjusted YLD resulting from the condition. While, in principle, the disability weights used in this adjustment could arise from any of the procedures typically used to construct quality-adjusted life years, obtaining disability weights for a large number of causes using any procedure other than the judgments of selected reference groups is currently impractical. Chapter 3 describes the methods currently used.

Table 6.4 Deaths by Age and Cause, 2001 (*thousands*)

	Low- and middle-income countries					
	Deaths under age 5					
	Stillbirth			Neonatal	Deaths aged 28 days to ≤ 1 year	Infant deaths (0 ≤ age < 1 year)
	Antepartum	Intrapartum	Total			
	a	b	(a + b) c	d	e	f
Total deaths	2,152	1,077	3,228	3,854	3,745	7,599
I. Communicable, maternal, perinatal, and nutritional conditions				3,088		6,875
A. Infectious and parasitic diseases				284		2,884
1. Tuberculosis						16
2. Sexually transmitted diseases excluding HIV/AIDS						55
3. HIV/AIDS						202
4. Diarrheal diseases				116	1,105	1,221
5. Childhood-cluster diseases						381
a. Pertussis						96
b. Poliomyelitis						
c. Diphtheria						2
d. Measles ^a						115
e. Tetanus ^b				168		168
6. Meningitis						47
8. Malaria ^c						726
Other ^d						218
B. Respiratory infections ^e				1,002	533	1,535
C. Maternal conditions						
D. Perinatal conditions				1,802		2,384
1. Low birthweight ^f				1,079	136	1,215
2. Birth asphyxia and birth trauma ^g				723		723
3. Other perinatal conditions						446
E. Nutritional deficiencies						96
II. Noncommunicable diseases				308		599
A. Malignant neoplasms						11
C. Diabetes mellitus						2
E. Neuropsychiatric disorders						21
1. Unipolar depressive disorders						
2. Bipolar affective disorder						
3. Schizophrenia						
Other ^h						14
G. Cardiovascular diseases						56
3. Ischemic heart disease						4
4. Cerebrovascular disease						8
Other ⁱ						42
H. Respiratory diseases						43
I. Digestive diseases						73
M. Congenital anomalies				308	44	352
Other ^j						36
III. Injuries						124
A. Unintentional						121
1. Road traffic accidents						12
Other ^k						109
B. Intentional						5
1. Self-inflicted						
Other ^l						3
IV. Not allocated	2,152	1,077	3,228	458		

Sources: WHO 2005a for columns a–d, unreported estimates undertaken as part of the GBD study, reported in chapter 3 for columns f–g, and chapter 3 of this volume.

Note: The absence of an entry in columns a–d denotes either a value of less than 1,000 deaths or that no estimate was allocated to that entry. For columns f–k, a blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. Infant and child deaths in columns f and g are based on unreported estimates undertaken as part of the GBD study, reported in chapter 3, of the percentage of under-five deaths that were under age one. Because the sources used for neonatal deaths left a large number unallocated, it is not appropriate to calculate values of column e by subtracting column d from column f except where explicitly noted.

a. WHO 2005b and Bryce and others (2005) estimate that 395,000 deaths occur due to measles. Chapter 3 provides an estimate for measles deaths age zero to four of 763,000.

b. Lawn, Wilczynska, and Cousens (forthcoming) for the CHERG estimate (2005) that 7 percent (260,000) of the 3.854 million global neonatal deaths occur due to tetanus, similar to the WHO and GAVI estimates of 220,000 for the year 2000. Chapter 3 provides an estimate for tetanus deaths ages zero to four of only 187,000. The (unpublished) GBD files used here to allocate deaths under age five to over and under age one allocated 52 percent of tetanus deaths to under age one. The CHERG review (Lawn, Wilczynska, and Cousens forthcoming) suggests this to be a major underestimate, and the 52 percent figure has thus here been revised upward to 90 percent. Consistent with the objectives of this chapter, GBD numbers have been used wherever possible, and the CHERG and WHO estimates are accordingly revised downward by allocating all infant tetanus deaths to the neonatal period.

c. WHO 2005b and Bryce and others (2005) estimate that 853,000 deaths occur due to malaria. Chapter 3 provides an estimate for malaria deaths age zero to four of 1,208,000.

d. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

e. Deaths for respiratory infections in the neonatal age group are those estimated by Lawn, Cousens, and Wilczynska (forthcoming) for their category sepsis or pneumonia. This number was then subtracted from the GBD number of respiratory infections between age zero and one to derive the total in column e.

f. Low-birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low-birthweight deaths in the neonatal period result from preterm birth.

Table 6.4 Continued

Low- and middle-income countries				
Deaths under age 5				
Child deaths (1 ≤ age < 5 years)	After live birth	Including stillbirth	Deaths age 5+	Total
(h – f) g	(f + g) h	(h + c) i	j	(i + j) k
29,345	10,533	13,761	37,843	51,605
2,521	9,396	9,396	8,226	17,622
1,884	4,768	4,768	5,923	10,692
25	40	40	1,550	1,590
13	68	68	108	176
138	340	340	2,214	2,554
378	1,599	1,599	179	1,778
667	1,048	1,048	313	1,363
205	301	301		301
2	5	5	1	6
442	557	557	206	763
19	187	187	106	293
18	64	64	105	169
361	1,087	1,087	58	1,208
299	518	518	1,334	1,854
408	1,943	1,943	1,539	3,483
			507	507
106	2,490	2,490		2,490
76	1,291	1,291		1,291
5	728	728		728
25	471	471		471
99	194	194	257	451
236	835	835	25,202	26,037
26	37	37	4,921	4,957
1	3	3	755	758
23	43	43	605	701
			10	10
			21	21
30	43	43	627	670
26	82	82	13,279	13,362
2	6	6	5,696	5,702
4	12	12	4,598	4,611
22	64	64	2,985	3,049
21	63	63	3,063	3,127
42	115	115	1,487	1,602
69	421	421	56	477
34	71	71	983	1,053
178	302	302	4,415	4,717
170	289	289	2,926	3,216
38	49	49	1,020	1,070
146	240	240	1,903	2,146
8	13	13	1,488	1,501
			749	749
10	13	13	740	753
		3,228		3,228

g. Lawn, Wilczynska, and Cousens (forthcoming) for the CHERG estimate that 23 percent (887,000) of the 4 million global neonatal deaths occur due to birth asphyxia. Chapter 3 of this volume provides an estimate for birth asphyxia and birth trauma deaths ages zero to four of only 739,000 globally, of which 734,000 were estimated to occur under age one.

Consistent with the objectives of this chapter, GBD numbers have been used wherever possible, and the CHERG and WHO estimates are accordingly revised downward by allocating all infant birth asphyxia deaths to the neonatal period. Better data in the future will allow for improved estimates.

h. Epilepsy, alcohol use disorders, Alzheimer's disease and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

i. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

j. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

k. Poisonings, falls, fires, drownings, and other unintentional injuries.

l. Violence, war, and other intentional injuries.

(Continues on the following page.)

Table 6.4 Continued

	High-income countries					
	Deaths under age 5					
	Stillbirth			Neonatal	Deaths aged 28 days to ≤ 1 year	Infant deaths (0 ≤ age < 1 year)
	Antepartum	Intrapartum	Total			
	a	b	(a + b) c	d	e	f
Total deaths	40	5	45	41	18	59
I. Communicable, maternal, perinatal, and nutritional conditions				16		35
A. Infectious and parasitic diseases				16		2
1. Tuberculosis						
2. Sexually transmitted diseases excluding HIV/AIDS						
3. HIV/AIDS						
4. Diarrheal diseases						
5. Childhood-cluster diseases						
a. Pertussis						
b. Poliomyelitis						
c. Diphtheria						
d. Measles						
e. Tetanus						
6. Meningitis						
8. Malaria						
Other ^a						1
B. Respiratory infections ^b						1
C. Maternal conditions						
D. Perinatal conditions				16		32
1. Low birthweight ^c				10		10
2. Birth asphyxia and birth trauma ^d				6	5	11
3. Other perinatal conditions						12
E. Nutritional deficiencies						
II. Noncommunicable diseases				12		19
A. Malignant neoplasms						
C. Diabetes mellitus						
E. Neuropsychiatric disorders						1
1. Unipolar depressive disorders						
2. Bipolar affective disorder						
3. Schizophrenia						
Other ^e						1
G. Cardiovascular diseases						1
3. Ischemic heart disease						
4. Cerebrovascular disease						
Other ^f						1
H. Respiratory diseases						1
I. Digestive diseases						1
M. Congenital anomalies				12	4	16
Other ^g						1
III. Injuries						2
A. Unintentional						2
1. Road traffic accidents						
Other ^h						1
B. Intentional						1
1. Self-inflicted						
Other ⁱ						1
IV. Not allocated	40	5	45	13		

Sources: WHO 2005a for columns a–d, unreported estimates undertaken as part of the GBD study, reported in chapter 3 for columns f–g, and chapter 3 of this volume.

Note: The absence of an entry in columns a–d denotes either a value of less than 1,000 deaths or that no estimate was allocated to that entry. For columns f–k, a blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. Infant and child deaths in columns f and g are based on unreported estimates undertaken as part of the GBD study, reported in chapter 3, of the percentage of under five deaths that were under age one. Because the sources used for neonatal deaths left a large number unallocated, it is not appropriate to calculate values of column e by subtracting column d from column f except where explicitly noted.

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. This table does not attempt to partition by age the very small number of deaths from respiratory infections under age 5.

c. Low-birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low-birthweight deaths in the neonatal period result from preterm birth.

d. The World Health Report 2005 cites that 45 percent (19,000) of the 4 million global neonatal deaths occur due to pre-term birth. Chapter 3 of this volume provides an estimate for low birthweight deaths ages zero to four of only 10,000, of which 10,000 were estimated to occur under age one. Consistent with the objectives of this chapter, GBD numbers have been used wherever possible, and the World Health Report 2005 estimates are accordingly revised downward by allocating all low-birthweight deaths to the neonatal period. Better data in the future will allow for improved estimates.

Table 6.4 Continued

High-income countries				
Deaths under age 5				
Child deaths (1 ≤ age < 5 years)	After live birth	Including stillbirth	Deaths age 5+	Total
(h – f) g	(f + g) h	(h + c) i	j	(i + j) k
13	73	118	7,864	7,982
2	37	37	515	552
1	3	3	149	152
			16	16
			1	1
			22	22
			5	6
			1	2
			1	1
			1	1
	1	1	3	4
1	2	2	100	101
1	2	2	347	349
			1	1
	32	32		32
	10	39		10
	11	17		11
	12	12		12
			18	18
9	28	28	6,840	6,868
1	2	2	2,065	2,066
			202	202
1	2	2	376	378
			3	3
			2	2
2	2	2	371	373
1	2	2	3,037	3,039
			1,364	1,364
			781	781
1	2	2	892	894
	1	1	476	477
	1	1	334	335
2	18	18	12	30
1	2	2	338	340
5	7	7	464	471
4	6	6	315	321
1	2	2	119	121
3	4	4	196	200
1	1	1	149	151
			126	126
1	1	1	24	25
		45		45

e. Epilepsy, alcohol use disorders, Alzheimer's disease and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

f. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

g. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

h. Poisonings, falls, fires, drownings, and other unintentional injuries.

i. Violence, war, and other intentional injuries.

(Continues on the following page.)

Table 6.4 Continued

	World					
	Deaths under age 5					
	Stillbirth			Neonatal	Deaths aged 28 days to ≤ 1 year	Infant deaths (0 ≤ age < 1 year)
	Antepartum	Intrapartum	Total			
	a	b	(a + b) c	d	e	f
Total deaths	2,192	1,082	3,274	3,896	3,762	7,658
I. Communicable, maternal, perinatal, and nutritional conditions				3,129		6,910
A. Infectious and parasitic diseases				300		2,886
1. Tuberculosis						16
2. Sexually transmitted diseases excluding HIV/AIDS						55
3. HIV/AIDS						202
4. Diarrheal diseases				116	1,105	1,222
5. Childhood-cluster diseases						381
a. Pertussis						96
b. Poliomyelitis						2
c. Diphtheria						115
d. Measles ^a						168
e. Tetanus ^b				168		47
6. Meningitis						726
8. Malaria ^c						219
Other ^d						1,536
B. Respiratory infections ^e				1,013	523	2,416
C. Maternal conditions						2,416
D. Perinatal conditions				1,832		1,225
1. Low birthweight ^f				1,098	136	734
2. Birth asphyxia and birth trauma ^g				734		457
3. Other perinatal conditions						96
E. Nutritional deficiencies						11
II. Noncommunicable diseases				321		618
A. Malignant neoplasms						2
C. Diabetes mellitus						22
E. Neuropsychiatric disorders						14
1. Unipolar depressive disorders						58
2. Bipolar affective disorder						4
3. Schizophrenia						8
Other ^h						43
G. Cardiovascular diseases						43
3. Ischemic heart disease						73
4. Cerebrovascular disease						368
Other ⁱ						38
H. Respiratory diseases						43
I. Digestive diseases						73
M. Congenital anomalies				321	48	368
Other ^j						38
III. Injuries						126
A. Unintentional						121
1. Road traffic accidents						12
Other ^k						109
B. Intentional						6
1. Self-inflicted						4
Other ^l						
IV. Not allocated	2,192	1,082	3,274	446		

Sources: WHO 2005a for columns a–d, unreported estimates undertaken as part of the GBD study, reported in chapter 3 for columns f–g, and chapter 3 of this volume.

Note: The absence of an entry in columns a–d denotes either a value of less than 1,000 deaths or that no estimate was allocated to that entry. For columns f–k, a blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. Infant and child deaths in columns f and g are based on unreported estimates undertaken as part of the GBD study, reported in chapter 3, of the percentage of under five deaths that were under age one. Because the sources used for neonatal deaths left a large number unallocated, it is not appropriate to calculate values of column e by subtracting column d from column f except where explicitly noted.

a. WHO 2005b and Bryce and others (2005) estimate that 395,000 deaths occur due to measles. Chapter 3 provides an estimate for measles deaths age zero to four of 763,000.

b. Lawn, Wilczynska, and Cousens (forthcoming) for the CHERG estimate (2005) that 7 percent (260,000) of the 3.854 million global neonatal deaths occur due to tetanus, similar to the WHO and GAVI estimates of 220,000 for the year 2000. Chapter 3 provides an estimate for tetanus deaths ages zero to four of only 187,000. The (unpublished) GBD files used here to allocate deaths under age five to over and under age one allocated 52 percent of tetanus deaths to under age one. The CHERG review (Lawn, Wilczynska, and Cousens forthcoming) suggests this to be a major underestimate, and the 52 percent figure has thus here been revised upward to 90 percent. Consistent with the objectives of this chapter, GBD numbers have been used wherever possible, and the CHERG and WHO estimates are accordingly revised downward by allocating all infant tetanus deaths to the neonatal period.

c. WHO 2005b and Bryce and others (2005) estimate that 853,000 deaths occur due to malaria. Chapter 3 provides an estimate for malaria deaths age zero to four of 1,208,000.

d. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

e. Deaths for respiratory infections in the neonatal age group are those estimated by Lawn, Cousens, and Wilczynska (forthcoming) for their category sepsis or pneumonia. This number was then subtracted from the GBD number of respiratory infections between age zero and one to derive the total in column e.

Table 6.4 Continued

World				
Deaths under age 5				
Child deaths (1 ≤ age < 5 years)	After live birth	Including stillbirth	Deaths age 5+	Total
(h – f) g	(f + g) h	(h + c) i	j	(i + j) k
2,948	10,606	13,880	45,662	59,542
2,523	9,433	9,433	8,741	18,174
1,886	4,771	4,771	6,072	10,843
25	40	40	1,566	1,606
13	68	68	109	177
138	340	340	2,236	2,576
378	1,600	1,600	184	1,784
668	1,049	1,049	315	1,364
205	301	301		301
			1	1
2	5	5	1	6
442	557	557	206	763
19	187	187	107	293
18	65	65	108	173
361	1,087	1,087	121	1,208
303	522	522	1,434	1,955
409	1,945	1,945	1,886	3,831
			508	508
107	2,522	2,522		2,523
76	1,301	1,301		1,301
5	739	739		739
25	482	482		482
99	194	194	274	469
245	864	864	32,042	32,905
27	38	38	6,986	7,024
1	3	3	958	961
24	46	46	1,034	1,079
			13	13
			1	1
			23	23
31	45	45	997	1,043
27	84	84	16,316	16,401
2	6	6	7,060	7,066
4	13	13	5,379	5,392
23	66	66	3,877	3,943
21	64	64	3,540	3,604
42	116	116	1,821	1,936
71	439	439	68	507
35	73	73	1,320	1,393
183	310	310	4,879	5,188
175	295	295	3,241	3,536
39	51	51	1,139	1,190
150	244	244	2,102	2,346
8	14	14	1,638	1,652
			875	875
10	14	14	763	777
		3,274		3,274

f. Low-birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low-birthweight deaths in the neonatal period result from preterm birth.

g. Lawn, Wilczynska, and Cousens (forthcoming) for the CHERG estimate that 23 percent (887,000) of the 4 million global neonatal deaths occur due to birth asphyxia. Chapter 3 of this volume provides an estimate for birth asphyxia and birth trauma deaths ages zero to four of only 739,000 globally, of which 734,000 were estimated to occur under age one. Consistent with the objectives of this chapter, GBD numbers have been used wherever possible, and the CHERG and WHO estimates are accordingly revised downward by allocating all infant birth asphyxia deaths to the neonatal period. Better data in the future will allow for improved estimates.

h. Epilepsy, alcohol use disorders, Alzheimer's disease and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

i. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

j. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

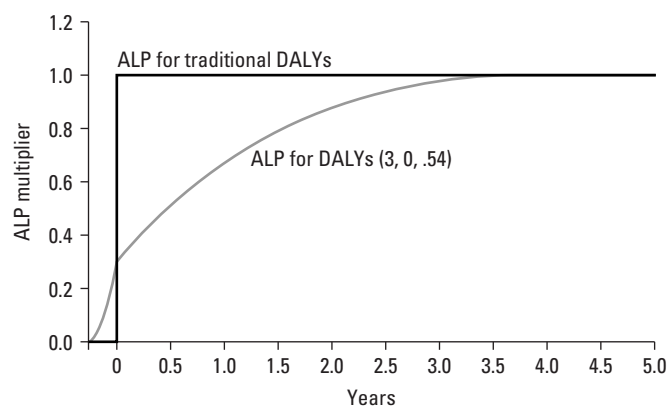
k. Poisonings, falls, fires, drownings, and other unintentional injuries.

l. Violence, war, and other intentional injuries.

DALYs generate a measure of the disease burden resulting from premature mortality by integrating a discounted, age-weighted, disability-adjusted stream of life years from the age of death (see equation 6A.2 in annex 6A). The formulation within the family of DALYs previously used to empirically assess the global burden of disease specifies a constant discount rate of 3 percent per year and an age-weighting function that gives low weight to early childhood and older ages and greater weight to middle ages. This volume reports global burden of disease estimates generated using uniform age weights. Chapter 5 provides an extensive exploration of the uncertainty and sensitivity inherent in disease burden assessment, including the results of differing assumptions about age weighting and discount rates.

To be clear about the particular form of DALY being used, the following terminology is employed throughout this volume. $DALYs(r,K)$ are DALYs constructed using a discount rate of r percent per year and an amount of age weighting indexed by a parameter K . Two versions of the DALY are discussed at some length in chapter 5, both using a discount rate of 3 percent per year. $DALYs(3,1)$ are DALYs generated with a discount rate of 3 percent per year and with full age weighting, that is, $K = 1$. $DALYs(3,0)$ are DALYs generated with a discount rate of 3 percent per year and with no age weighting, that is, $K = 0$. This volume's results concerning the burden of disease (chapter 3) and of risk (chapter 4) are based on $DALYs(3,0)$. Annex 6B contains tables summarizing alternative calculations of the global burden of disease, and table 6B.4 presents the chapter 3 GBD results based on $DALYs(3,0)$, using this chapter's aggregation of causes, for age groups under five and over five as an aggregate.

This chapter extends the DALY family by modeling a concept of ALP. The intuition behind the ALP concept is that an infant (or fetus) only gradually acquires the full life potential reflected in a stream of life years beginning at birth, that is, ALP can be gradual. The ethical understanding of the concept is based on two judgments: (a) an individual life acquires value only as it acquires self-awareness, and (b) an individual life acquires additional value as it develops bonds with others. (See the discussion in Steinbock 1992, who argues that what we label as life potential is probably acquired some time in the second trimester of pregnancy. Her position is, implicitly, that whenever it occurs, ALP is instantaneous.) To some extent, the age-weighting function of the current DALY formulation attempts to capture these judgments, and in this chapter, gradual acquisition of ALP is modeled as an alternative to age weighting.³ Mathematically, however, ALP



Source: Authors' calculations.

Figure 6.2 ALP, Traditional DALYs, and DALYs (3,0,.54)

and age weighting are independent and can be introduced simultaneously.

Our objective in this chapter is not to provide a detailed philosophical, economic, or medical rationale for gradual ALP, but to generate and apply a straightforward mechanism that allows for it. Annex 6A describes this mechanism, which essentially consists of multiplying the DALYs conventionally generated by a factor that is less than one for younger ages. This factor is zero for an age of -13 weeks (or -0.25 years), rises to a factor value of f^0 at birth, then rises to 1 at time T . Figure 6.2 graphs both the ALP function used later in this chapter and the special case of ALP that jumps from 0 to 1 at age 0 (instantaneous ALP). The ALP implicit in traditional DALYs is instantaneous.

Annex 6A introduces a parameter, A , that indicates the speed of ALP (see equations 6A.3 through 6A.5 for a precise definition of A). A is constructed so that for the fastest possible speed of ALP, namely, instantaneous ALP, $A = 1$. A is bounded below by 0. This chapter extends the notation $DALYs(r,K)$ used elsewhere in the book in two ways. First, it explicitly indicates the level of A by extending the DALY nomenclature to $DALYs(r,K,A)$. Thus using this nomenclature, $DALYs(3,0)$ become $DALYs(3,0,1)$, because the standard DALY is the special case with instantaneous ALP. Second, when stillbirths are included in the range of events to be measured in the global burden of disease, this is explicitly noted in the DALY nomenclature as $DALY_{SB}(r,K,A)$. Notation around YLL is similarly extended.

Explicit modeling of ALP allows not only the reflection of the ethical judgments just indicated, but also permits three

instrumentally useful improvements to the current family of DALYs:

- The DALY loss from a death seconds before birth is, in the current formulation, 0; it jumps to more than 30 years at birth. The ALP formulation allows, but does not require, this discontinuity to be avoided. See column (a) of table 6.5 for values at different ages of the ALP function associated with traditional DALYs and columns (c), (d), and (e) for values of three ALP functions defined in annex 6A.
- The ALP formulation allows, but does not require, a positive DALY loss associated with stillbirths.
- The ratio of the DALY loss from a death at age 20, say, to that at birth is close to 1 for any reasonable set of parameter values in the current DALY formulation. Many people’s

Table 6.5 Values of Selected ALP Functions

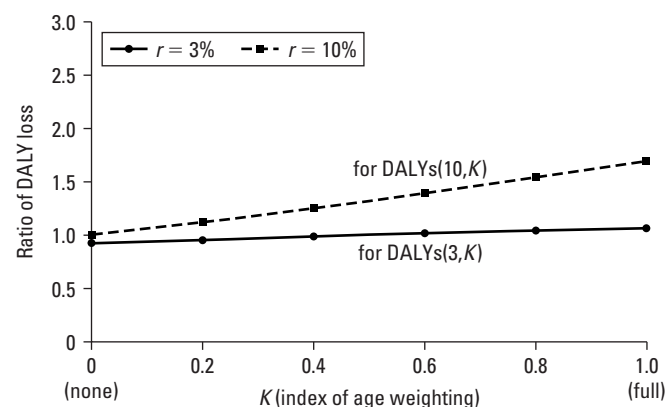
(a) t (age)	(b) $f_D(t)^a$	(c) $f_{DSB}(t)^b$	(d) $f_1(t)$	(e) $f_2(t)^c$	(f) $f_3(t)$
-0.25	0.00	1.00	0.00	0.00	0.00
-0.08	0.00	1.00	0.12	0.16	0.30
0.00	1.00	1.00	0.25	0.30	0.50
0.02	1.00	1.00	0.25	0.31	0.52
0.08	1.00	1.00	0.26	0.34	0.59
0.25	1.00	1.00	0.29	0.41	0.74
0.30	1.00	1.00	0.30	0.43	0.78
0.50	1.00	1.00	0.34	0.51	0.88
1.00	1.00	1.00	0.41	0.67	0.98
2.00	1.00	1.00	0.55	0.87	1.00
3.00	1.00	1.00	0.66	0.97	1.00
5.00	1.00	1.00	0.83	1.00	1.00

Source: Authors’ calculations.

a. $f_D(t)$ is the traditional DALY formulation that is, stillbirths are not incorporated, and ALP is instantaneous.

b. $f_{DSB}(t)$ is the traditional DALY formulation extended to give equal weight to stillbirths as to deaths at age 0, that is, it leads to $DALY_{SB}(3,0,1)$.

c. $f_2(t)$ is the ALP function used to generate the $DALY_{SB}(3,0,.54)$ GBD estimates reported in table 6B.8. These are DALYs that incorporate stillbirth and gradual ALP.



Source: Authors’ calculations.

Figure 6.3 Ratio of DALYs Lost at Age 20 to Age 0 as a Function of Age Weighting

ethical judgments would give this ratio a value substantially greater than 1. The ALP formulation allows, but does not require, these judgments. Figure 6.3 shows how this ratio varies as a function of the age-weighting parameter (K) for values of r equal to 3 percent and 10 percent. The ratio rises only to 1.7 with full age weighting and an implausibly high discount rate of 10 percent.

Alternative Calculations of the Burden of Disease

As previously indicated, annex table 6B.4 (based on annex tables 6B.1 to 6B.3) presents the chapter 3 GBD estimates in terms of $DALYs(3,0)$ —or $DALYs(3,0,1)$ —for the under and over five age groups. The $DALY(3,0)$ is the sum of the $YLL(3,0,1)$ and YLD . Annex tables 6B.1, 6B.2, and 6B.3 report deaths by cause, $YLL(3,0,1)$ by cause, and YLD by cause from chapter 3. The numbers in table 6B.4 are the sum of the corresponding numbers in tables 6B.2 and 6B.3.

We generate two alternative assessments of the global burden of disease. Both incorporate stillbirths and the second permits gradual ALP. The YLD numbers that we use come from annex table 6B.3. The YLL differ from $YLL(3,0,1)$ for ages under age five, but are the same for over age five.

Our first alternative is probably the simplest way to incorporate stillbirths. It does so by having an instantaneous ALP function, as with traditional DALYs, but by having that function jump from 0 to 1 at age -13 weeks (-0.25 years) instead of at age 0. Stillbirths are then given the same DALY loss as a death at birth in generating YLL . Column (b) of table 6.5 shows values for this ALP function, which is uniformly 1. We label the YLL generated from this ALP function and a 3 percent discount rate the $YLL_{SB}(3,0,1)$. We label the DALYs based on this YLL as $DALY_{SB}(3,0,1)$. Table 6.6 shows values of $YLL_{SB}(3,0,1)$ compared with $YLL(3,1)$ and $YLL(3,0)$ for different ages. Annex table 6B.5 shows values for $YLL_{SB}(3,0,1)$ and annex table 6B.6 shows the resulting burden of disease estimates in terms of $DALY_{SB}(3,0,1)$.

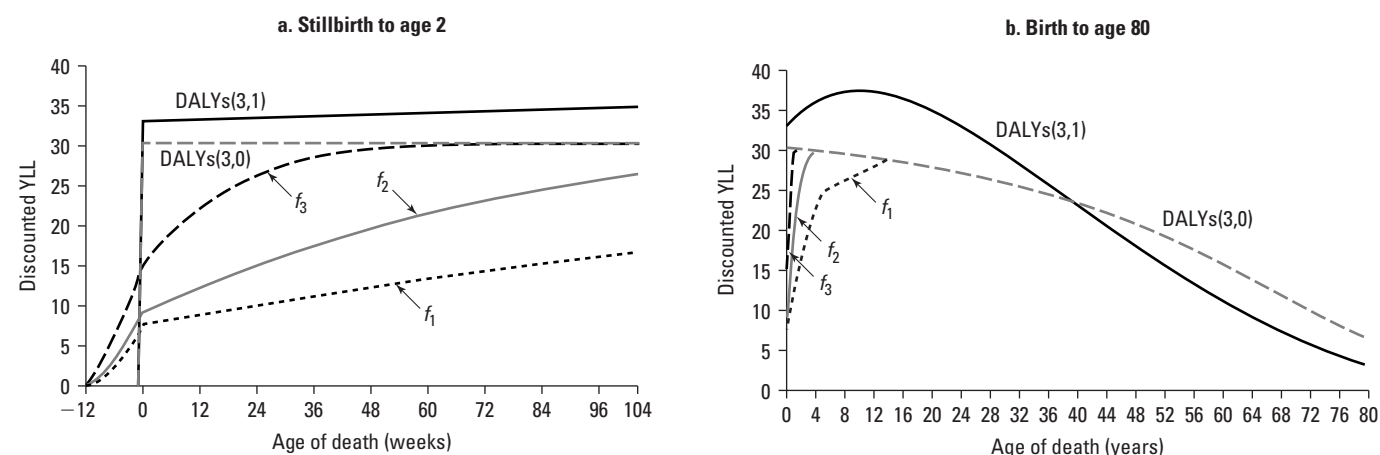
Our second alternative burden of disease assessment is based on gradual ALP. Equation 6A.1 in annex 6A provides our general ALP function and the text describes the meaning of its four parameters. One of the parameters, f^0 , is the value of the function at age 0. The intuitive interpretation of f^0 is that it is approximately the ratio of the YLL loss associated with a death at age 0 to that from a death at age 20. Another parameter is T , the age at which the function becomes 1. Annex 6A characterizes three alternative gradual ALPs: f_1 , f_2 , and f_3 . Figure 6.4 shows YLL at different ages for these functions and for $YLL(3,0)$ and $YLL(3,1)$. Table 6.5 shows values for the functions at different ages in

Table 6.6 Discounted YLL at Different Ages of Death for Several DALY Formulations

Age group	Representative age of death (years)	YLL(3,1)	YLL(3,0)	YLL _{SB} (3,0,1)	YLL _{SB} (3,0,.54)
Antepartum	-0.080	0	0	30.42	4.95
Intrapartum	-0.001	0	0	30.42	9.13
Neonatal	0.020	33.09	30.42	30.42	9.40
Infant	0.300	33.36	30.40	30.40	12.95
Postneonatal	0.500	33.56	30.39	30.39	15.42
Child	2.000	34.81	30.28	30.28	26.40

Source: Authors' calculations.

Note: YLL(3,1), YLL(3,0), and YLL_{SB}(3,0,1) assume instantaneous ALP ($A = 1$). YLL(3,1) assumes full age weighting ($K = 1$); the other three formulations assume uniform age weights ($K = 0$). YLL_{SB}(3,0,.54) assumes gradual acquisition of life potential ($A = .54$); table 6B.7 reports these YLL and 6B.8 reports the GBD based on their use.



Source: Authors' calculations.

Figure 6.4 YLL for Deaths at Different Ages

columns (c), (d), and (e). We use f_2 (with $A = .54$) to construct the disease burden estimates reported in this chapter and label the resulting YLL and DALYs as YLL_{SB}(3,0,.54) and DALY_sSB(3,0,.54). Table 6.6 shows YLL_{SB}(3,0,.54), which are, as intended, markedly lower than YLL_{SB}(3,0,1) for very young ages. That is, YLL_{SB}(3,0,.54) gives less weight to deaths near the time of birth or to deaths immediately after birth than YLL_{SB}(3,0,1).

Only a limited number of empirical studies have attempted to assess directly the views of individuals concerning deaths at different ages. In an important early study, Crawford, Salter, and Jang (1989) relate grief from a death to the concept of reproductive potential in population biology. They conclude that for several diverse human groups the relationship shows grief to be closely related to prehistoric reproductive value. Cropper, Aydede, and Portney (1994) and Johannesson and Johansson (1997) survey members

of populations of high-income countries for trade-offs between deaths in middle and older ages. All three of these studies find that people judge deaths at older middle age as much less important than deaths at younger middle age, but provide no information concerning the trade-off for deaths near the time of birth.

An Institute of Medicine (1985) review of vaccine development priorities uses infant mortality equivalence in cost-effectiveness calculations. The committee members preparing the report collectively judged that the loss from a death at age 20 should be about two times that from an infant death, well above the numbers shown in figure 6.3 for any standard DALY. However, some preliminary trade-off studies by one of the authors of this chapter suggest a value closer to three or four times. What is clear is that no defensible estimate (or even range) is currently available, and hence the numbers we report should be viewed only as

perhaps reasonable but only suggestive and as indicating the sensitivity of global burden of disease results from younger ages to better estimates of this parameter.

Annex tables 6B.7 and 6B.8 show $YLL_{SB}(3,0,.54)$ and $DALY_{SB}(3,0,.54)$. While table 6B.7 only shows the total of DALYs for ages under five, the calculations underlying those totals reflect the age distribution of deaths under age five shown in table 6.4 and the $YLL_{SB}(3,0,.54)$ for deaths at different ages as shown in table 6.6.

Annex tables 6B.1, 6B.6, and 6B.8 provide three alternative assessments of the global burden of disease based on deaths by cause, on $DALYs(3,0)$, $DALY_{SB}(3,0,1)$, and $DALY_{SB}(3,0,.54)$. Table 6.4 provides estimates of deaths by cause that include stillbirths (table 6.4, column [k]). We thus have five alternative indicators of the importance of disease at different ages and from different causes. Table 6.7 provides a summary for low- and middle-income countries of the

distribution of the disease burden at different ages as assessed by these different measures. $DALY_{SB}(3,0,1)$ and $DALY_{SB}(3,0,.54)$ both point to the significance of stillbirths relative to $DALYs(3,0)$, which exclude them altogether, but the gradual ALP approach of $DALY_{SB}(3,0,.54)$ gives much less importance to stillbirths than $DALY_{SB}(3,0,1)$ and substantially less importance to the under five burden than $DALYs(3,0)$.

Table 6.8 provides a similar summary of how the assessed burden across groups varies with the measure used. $DALY_{SB}(3,0,.54)$ give more weight to Group II (noncommunicable diseases) and Group III (injuries) causes than do $DALYs(3,0)$, while $DALY_{SB}(3,0,1)$ give less weight to these groups than $DALYs(3,0)$. For example, $DALY_{SB}(3,0,.54)$ give about a 10 percent greater weight to cardiovascular disease than does the DALY (3,0), that is, 14.2 percent versus 12.9 percent.

Table 6.7 Disease Burden at Different Ages Using Different Measures, Low- and Middle-Income Countries, 2001

Age group	Percentage of deaths		Percentage of disease burden		
	Stillbirths excluded	Stillbirths included	$DALYs(3,0)$	$DALY_{SB}(3,0,1)$	$DALY_{SB}(3,0,.54)$
Total deaths or DALYs (millions)	48.4	51.6	1,387.4	1,485.6	1,260.6
Stillbirths	0%	6.3%	0%	6.6%	1.6%
Under age one	15.7	21.0			
Under age five	21.8	26.7	30.6	35.2	23.6
Over age five	78.2	73.3	69.4	64.8	76.4

Source: Authors' calculations.

Note: All three percentage of disease burden formulations assume a 3% discount rate and uniform age weights (that is, $K = 0$). $DALYs(3,0)$ and $DALY_{SB}(3,0,1)$ assume instantaneous ALP ($A = 1$). For $DALY_{SB}(3,0,.54)$, $A = .54$.

Table 6.8 Disease Burden from Selected Groups of Causes Using Different Measures, Low- and Middle-Income Countries, 2001

Cause	Percentage of deaths		Percentage of disease burden		
	Stillbirths excluded	Stillbirths included	$DALYs(3,0)$	$DALY_{SB}(3,0,1)$	$DALY_{SB}(3,0,.54)$
Total deaths or DALYs (millions)	48.4	51.6	1,387.4	1,485.6	1,260.6
Group I ^a	36.4%	40.4%	39.8%	43.8%	35.5%
Group II (Of which cardiovascular diseases)	53.8 (27.6)	50.5 (25.9)	48.9 (12.9)	45.7 (12.0)	52.4 (14.2)
Group III	9.8	9.1	11.2	10.5	12.1

Source: Authors' calculations.

Note: All three percentage of disease burden formulations assume a 3% discount rate and uniform age weights (that is, $K = 0$). $DALYs(3,0)$ and $DALY_{SB}(3,0,1)$ assume instantaneous ALP ($A = 1$). For $DALY_{SB}(3,0,.54)$, $A = .54$.

a. The "not allocated" category (from Table 6.4) consists principally of Group I causes and is included with Group I here.

CONCLUSIONS

Previous assessments of the global burden of disease have not included stillbirths or sufficiently emphasized the important causes of neonatal death. This was understandable given the intended focus of these studies. In addition, the inclusion of stillbirths would have highlighted issues about how to weight deaths at different ages that would have been difficult to incorporate into the DALY metrics being used to assess the global burden of disease.

Data on the numbers of stillbirths and neonatal deaths have improved, and a recent major effort by CHERG now provides a much better picture than before of the causes of neonatal death. (Annex C describes the CHERG effort and compares its results with estimates that result from fitting the CHERG estimates into the overall death envelope of chapter 3.) This chapter proposes an approach that incorporates modeling ALP, which allows flexibility in assessing how to weight stillbirths and other early deaths in constructing aggregate measures of the disease burden. This chapter combines new information and new methods into a reassessment of the global burden of disease that is based closely on, but goes beyond, what is reported in chapter 3.

We draw the following conclusions from this exercise:

- The numbers of stillbirths and of neonatal deaths are large. This underscores the importance of implementing tools and policies for addressing them. A number of recent publications point to directions for policy (for example, Darmstadt and others 2005; Institute of Medicine 2003; Lawn and others 2006; Martines and others 2005; Stoll and Measham 2001; Tinker and others 2005; WHO 2005b; Zupan 2005).
- The inclusion of stillbirths within the standard GBD framework is now feasible, and future assessments of the global burden of disease could consider doing so.
- The GBD cause structure would need relatively minor modifications to incorporate deaths at early ages. Birth asphyxia and preterm births could be separate subcategories and sepsis and pneumonia could also be included as a separate category. Rather than reporting a single burden estimate for the under five age group, the more fine-grained age breakdown of table 6.4 could be used.
- The databases on numbers and causes of stillbirths and neonatal deaths require major investments so they can be improved. Undertaking a CHERG type of review of the existing literature to gain a better understanding of the causes of stillbirths is also a priority.

- The selection of a generally appropriate ALP function requires more data on preferences or trade-offs concerning deaths at different ages.

ANNEX 6A: FLEXIBLE FUNCTIONAL FORMS FOR THE ACQUISITION OF LIFE POTENTIAL

This annex provides a technical discussion of issues raised by incorporating late fetal deaths (stillbirths) into the global burden of disease, as measured within the disability-adjusted life year (DALY) framework. One approach is simply to take the DALY loss at birth and discount back to the time of the stillbirth, indicating that there are no life years to lose before birth, but that there are still all the postpartum life years. Essentially this is the standard DALY, but with an age-weighting function equal to 0 before birth. This is feasible, but has several potential drawbacks, in particular, any reasonable discount rate (for example, 3 percent) would thence count all late fetal losses almost the same as a loss at birth. This approach yields the $DALY_{SB}(3,0,1)$ measure as described in the main text, and table 6B.6 presents global burden of disease estimates using $DALY_{SB}(3,0,1)$ because these are the simplest extension of $DALY(3,0)$.

However, as with traditional DALYs, $DALY_{SB}(3,0,1)$ assume instantaneous acquisition of life potential (ALP), as illustrated in figure 6.2 and discussed in the main text. Whether or not one wishes to include stillbirths in the global burden of disease, this discontinuity (at some given age) is troublesome. The purpose of this annex is to provide a flexible, yet tractable, explicit function that allows for gradual ALP.

One natural approach is to weight the YLL from outside the integral instead of from the inside (as with age weighting), that is, to create a multiplier function (the ALP function), which takes on values between 0 and 1 as a function of age, and use it to ratchet down the YLL function, potentially starting before birth. For convenience and with some regard to the known physiological underpinnings, we take this starting point in time to be the beginning of the third trimester of pregnancy. Roughly speaking, the rate of natural fetal loss becomes noticeable after the beginning of some level of consciousness during the second half of the second trimester. One could force this function to equal 1 at birth, recovering the standard DALYs from that point onward, and this will be a special case of our formulation. However, we have no definitive reason to think that ALP is necessarily complete at birth. Indeed, quite a bit of evidence suggests that in many (if not all) societies worldwide, infants are not given full status, for instance, they are not always named immediately. Thus we

wish to allow for continued gradual acquisition after birth and up to some time T that signifies full standing or full ALP. Likewise, starting the acquisition only at birth but proceeding gradually afterward is perfectly possible.

Turning to the specifics, denote the ALP multiplier function by $f(t)$, where t is measured in years and ranges from -0.25 (that is, 13 weeks before birth, the beginning of the third trimester) to T . The function is meaningfully defined for any finite value of T , though it is natural to assume that full life potential is achieved by puberty at the latest. Thus $f(-0.25) = 0$ and $f(T) = 1$. We let $f^0 = f(0)$ be the value at 0. Of course, starting times other than -0.25 are perfectly legitimate as well, but -0.25 is the natural choice given the standard definitions of stillbirth and the gathering and reporting of data using that definition.

We need a functional form that smoothly begins at 0 and rises to f^0 , which is at least weakly convex (following the intuition that life potential is acquired increasingly rapidly as birth is approached), and whose curvature is parametrizable. The natural choice is x^γ with $\gamma \geq 1$. This has canonical endpoints of 0 and 1, where x^γ takes on the values 0 and 1, respectively, for any γ , so that as we change the curvature (or skewness), the endpoints remain fixed. Fitting this to our specific domain, we get $x = 4t + 1$ for $-0.25 \leq t < 0$. Finally, if we wish the skewness parameter to lie between 0 and 1 as well (for clarity), we can define g so that $g = 1/(1 - g)$ for $0 \leq g < 1$. This yields $f_-(t) = f^0(4t + 1)^{1/(1-g)}$ for $-0.25 \leq t < 0$. Thus $g = 0$ produces a straight line (zero curvature), while $g = 1$ (defined by fiat) is infinitely skewed: 0 until birth and then jumping to f^0 .

For $t \geq 0$, we consider the symmetric version of the same polynomial, that is, $1 - (1 - x)^\beta$. Again we fit this to our domain, namely, from $t = 0$ to $t = T$, and define b so that $b = 1/(1 - b)$ for the skewness. This yields $f_+(t) = 1 - (1 - f^0)[(T - t)/T]^{1/(1-b)}$ for $0 \leq t \leq T$. We check that indeed $f_+(0) = f^0$ and $f_+(T) = 1$ according to this formula for any $0 \leq \beta \leq 1$. If $T = 1$, the formula simplifies to $f_+(t) = 1 - (1 - f^0)(1 - t)^{1/(1-b)}$. This leaves four parameters: f^0 , T , g , and b . We can additionally impose $g = b$ if we wish, but this is unnecessary.

Summarizing, the function we use for ALP is

$$f(t) = \begin{cases} f_-(t) = f^0(4t + 1)^{1/(1-g)} \\ \text{(for } -0.25 \leq t < 0) \\ f_+(t) = 1 - (1 - f^0) [(T - t)/T]^{1/(1-b)} \\ \text{(for } 0 \leq t \leq T). \end{cases} \quad (6A.1)$$

If $f_D(t)$ is the standard DALY formulation (whether or not age weighting or discounting is used), then $g = b = 1$

(that is, discontinuous jumps around birth from 0 to 1) and $f_D^0 = 1$, so that technically at age 0 the value is already 1 (so the discontinuity is on the left side of age 0 only). Given these parameters, T is immaterial, because the function achieves its maximum immediately. However, the fact that we can replicate the standard DALY means that the gradual acquisition function does indeed generalize it.

Combining these equations with the standard definition of DALYs, the total loss $L(a)$ for a death at age $a \geq -0.25$ is

$$L(a) = f(a) \int_a^\infty C x e^{-\beta x} e^{-r(x-a)} s_a(x) dx, \quad (6A.2)$$

where β is the age-weighting parameter (typically 0.04) if age weighting is used, r is the discount rate (typically 0.03), $s_a(x)$ is the survival probability for reaching age $x \geq a$ conditional on having reached age a , and C is the normalization parameter for the age weights ($C = 0.16243$, see the discussion in chapter 5).

The normalization parameter C in equation (6A.2) was chosen so that the total global burden of disease would be the same with and without age weighting. The index of age weighting referred to in the main text, K , is generated by having a weighted average—with weights of K and $(1 - K)$, where $0 \leq K \leq 1$ —of loss functions $L(a)$ that result from equation (6A.2) with the indicated values of β and C and a loss function assuming uniform age weights. That this is at least approximately the case is apparent from figure 6.4b, where the two functions cross at about age 40. Clearly this will not be true when any of the acquisition functions are used, because they reduce the YLL burden at younger ages with no corresponding increase elsewhere, leading to a reduced total burden as measured by absolute DALY levels.

Note, however, that the total burden is no longer the same even for DALYs(3,0) and DALYs(3,1), because the specific value of C was calibrated to 1990 morbidity and mortality statistics. One can readily imagine more neutral (and invariant) normalizations, such as requiring a constant integral over age of death for each of these YLL functions, or perhaps weighting this integral using an idealized survival table. Any variant along these lines would raise the total level of DALYs(3,0,54) relative to both DALYs(3,0) and DALYs(3,1). Of course, we are for the most part interested only in the relative burden across ages or disease categories, so the absolute totals are of secondary importance.

Finally, to somewhat simplify the number of parameters in the ALP function, we introduce a notion of speed of acquisition, A . Recall that f^0 can be anywhere between 0 and 1, regardless of whether the function $f(t)$ takes on positive values before birth. If $f^0 = 1$ (as in the original DALY),

then $f = 1$ thereafter and the speed A is in some sense as large as possible. To generalize this idea, we look at the total area between the ALP function $f(t)$ and the constant function 1.

Formally, this area is given by the integral of $1 - f(t)$, evaluated from t^0 to T , where t^0 is the first t such that $f(t) > 0$. It is thus typically either -0.25 or 0 , depending on whether we are including stillbirths. Call this integral I :

$$I = \int_{t^0}^T [1 - f(t)] dt, \quad (6A.3)$$

Substituting the second part of equation (6A.1), we can evaluate this integral as

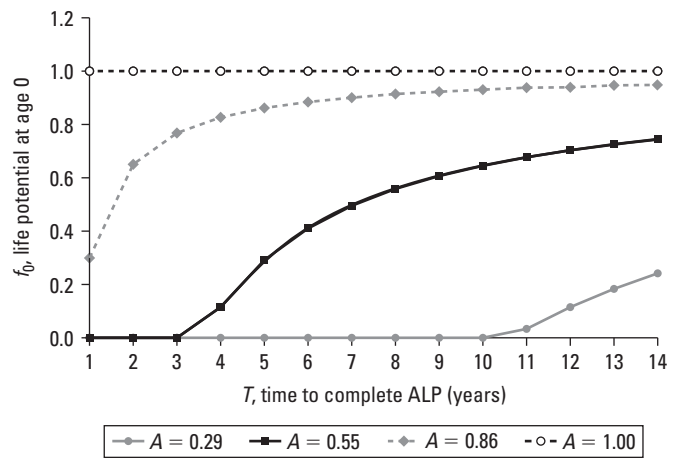
$$I = T(1 - f^0)(1 - t^0/T)(1 - b)/(2 - b). \quad (6A.4)$$

Normalizing so that the speed A lies between 0 and 1 (and higher values denote faster acquisition), we define

$$A = 1/(1 + I). \quad (6A.5)$$

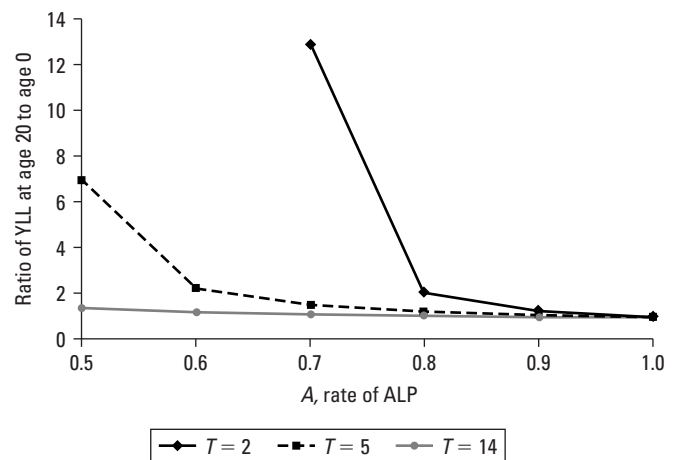
For example, for $b = 0.7$ (a typical value) and $t^0 = 0$, we obtain a simple formula for the speed parameter A , encapsulating the acquisition function in a single number: $A = 1/[1 + 0.23T(1 - f^0)]$. There is still a trade-off between T and f^0 , that is, the relationship between the underlying parameters and A is not one-to-one. A single value for A could have arisen from multiple combinations parameter values, but it still serves as a useful summary statistic. Figure 6A.1 graphs (as a function of T , fixing $b = 0.7$ and $t^0 = 0$) the value of f^0 that yields various specified acquisition speeds A . The analogous figure 6.3 shows less variability in this ratio.

We evaluate three specifications (parameter choices) for the acquisition function. These are, in order of value at birth: f_1 , given by ($f_1^0 = 0.25$, $T_1 = 14$, $g_1 = 0.5$, $b_1 = 0.7$); f_2 , given by ($f_2^0 = 0.3$, $T_2 = 5$, $g_2 = 0.4$, $b_2 = 0.7$); and f_3 , given by ($f_3^0 = 0.5$, $T_3 = 2$, $g_3 = 0.3$, $b_3 = 0.8$). The respective values for A (using $t^0 = -0.25$) are 0.29, 0.54, and 0.84. These three acquisition functions were graphed in figure 6.4. Representative values for specific ages were listed in table 6.5, along with the corresponding values for $f_D(t)$, the traditional formulation for DALYs. Figure 6A.2 shows how the ratio of years of life lost at age 20 to age 0 for these three functions varies with A . We view f_2 (with $T = 5$) as a reasonable



Source: Authors' calculations.
Note: A is rate of ALP.

Figure 6A.1 Relationship between Time to Complete ALP and Life Potential at Age 0 for Several Values of A



Source: Authors' calculations.
Note: A is rate of ALP. T is the time to complete acquisition of life potential.

Figure 6A.2 Ratio of DALYs Lost at Age 20 to Age 0 as a Function of A

intermediate choice and, with a 3 percent discount rate, have used f_2 to generate what we define as DALYs(3,0,.54). Complete burden of disease calculations are reported using DALYs(3,0,.54) in table 6B.8.

ANNEX B: SUPPLEMENTARY TABLES

Table 6B.1 Deaths (Excluding Stillbirths) from Selected Causes, by Age, 2001 (thousands)

Cause	Low- and middle-income countries			High-income countries			World		
	Deaths			Deaths			Deaths		
	0–4	5+	Total	0–4	5+	Total	0–4	5+	Total
Total deaths	10,533	37,843	48,377	73	7,819	7,891	10,606	45,662	56,268
I. Communicable, maternal, perinatal, and nutritional conditions	9,396	8,226	17,622	37	515	552	9,433	8,741	18,174
A. Infectious and parasitic diseases	4,768	5,923	10,692	3	149	152	4,771	6,072	10,843
1. Tuberculosis	40	1,550	1,590		16	16	40	1,566	1,606
2. Sexually transmitted diseases excluding HIV/AIDS	68	108	176		1	1	68	109	177
3. HIV/AIDS	340	2,214	2,554		22	22	340	2,236	2,576
4. Diarrheal diseases	1,599	179	1,778		5	6	1,600	184	1,784
5. Childhood-cluster diseases	1,048	313	1,363		1	2	1,049	315	1,364
a. Pertussis	301		301				301		301
b. Poliomyelitis					1	1		1	1
c. Diphtheria	5	1	6				5	1	6
d. Measles	557	206	763		1	1	557	206	763
e. Tetanus	187	106	293				187	107	293
6. Meningitis	64	105	169	1	3	4	65	108	173
8. Malaria	1,087	58	1,208				1,087	121	1,208
Other I.A. (7, 9–15) ^a	518		1,854	2	100	101	522	1,434	1,955
B. Respiratory infections	1,943	1,539	3,483	2	347	349	1,945	1,886	3,831
C. Maternal conditions		507	507		1	1		508	508
D. Perinatal conditions	2,490		2,490	32		32	2,522		2,523
1. Low birthweight	1,291		1,291	10		10	1,301		1,301
2. Birth asphyxia and birth trauma	728		728	11		11	739		739
3. Other perinatal conditions	471		471	12		12	482		482
E. Nutritional deficiencies	194	257	451		18	18	194	274	469
II. Noncommunicable diseases	835	25,202	26,037	28	6,840	6,868	864	32,042	32,905
A. Malignant neoplasms	37	4,921	4,957	2	2,065	2,066	38	6,986	7,024
C. Diabetes mellitus	3	755	758		202	202	3	958	961
E. Neuropsychiatric disorders	43	605	701	2	376	378	46	1,034	1,079
1. Unipolar depressive disorders		10	10		3	3		13	13
2. Bipolar affective disorder								1	1
3. Schizophrenia		21	21		2	2		23	23
Other II.E. (4–16) ^b			670	2	371	373	45	997	1,043
G. Cardiovascular diseases	82	13,279	13,362	2	3,037	3,039	84	16,316	16,401
3. Ischemic heart disease	6	5,696	5,702		1,364	1,364	6	7,060	7,066
4. Cerebrovascular disease	12	4,598	4,611		781	781	13	5,379	5,392
Other II.G. (1, 2, 5, 6) ^c	64		3,049	2	892	894	66	3,877	3,943
H. Respiratory diseases	63	3,063	3,127	1	476	477	64	3,540	3,604
I. Digestive diseases	115	1,487	1,602	1	334	335	116	1,821	1,936
M. Congenital anomalies	421	56	477	18	12	30	439	68	507
Other II. (B, D, F, J, K, L, N) ^d	71		1,053	2	338	340	73	1,320	1,393
III. Injuries	302	4,415	4,717	7	464	471	310	4,879	5,188
A. Unintentional	289	2,926	3,216	6	315	321	295	3,241	3,536
1. Road traffic accidents	49	1,020	1,070	2	119	121	51	1,139	1,190
Other III.A. (2–6) ^e	240		2,146	4	196	200	244	2,102	2,346
B. Intentional	13	1,488	1,501	1	149	151	14	1,638	1,652
1. Self-inflicted		749	749		126	126		875	875
Other III.B. (2–4) ^f	13		753	1	24	25	14	763	777

Source: Chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause.

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

c. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

d. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

e. Poisonings, falls, fires, drownings, and other unintentional injuries.

f. Violence, war, and other intentional injuries.

Table 6B.2 YLL(3,0) from Selected Causes, by Age, 2001 (thousands)

Cause	Low- and middle-income countries			High-income countries			World		
	YLL			YLL			YLL		
	0–4	5+	Total	0–4	5+	Total	0–4	5+	Total
Total YLL	319,558	590,267	909,825	2,209	75,650	77,859	321,767	665,917	987,684
I. Communicable, maternal, perinatal, and nutritional conditions	285,058	169,531	454,589	1,133	4,258	5,391	286,191	173,789	459,980
A. Infectious and parasitic diseases	144,555	129,584	274,138	96	1,878	1,975	144,651	131,462	276,113
1. Tuberculosis	1,215	30,528	31,743	1	171	172	1,216	30,699	31,915
2. Sexually transmitted diseases excluding HIV/AIDS	2,067	2,079	4,146	1	6	7	2,068	2,085	4,153
3. HIV/AIDS	10,299	54,537	64,836	2	491	493	10,301	55,027	65,328
4. Diarrheal diseases	48,534	2,350	50,884	13	40	53	48,547	2,390	50,937
5. Childhood-cluster diseases	31,751	8,756	40,507	4	30	34	31,755	8,786	40,540
a. Pertussis	9,113		9,113	1		1	9,114		9,114
b. Poliomyelitis	9	1	10		6	6	9	7	16
c. Diphtheria	137	27	164				137	27	164
d. Measles	16,840	6,057	22,897	2	19	21	16,843	6,076	22,918
e. Tetanus	5,652	2,671	8,323	1	5	5	5,653	2,675	8,328
6. Meningitis	1,952	2,391	4,343	23	59	82	1,975	2,450	4,425
8. Malaria	32,981	2,481	35,462	2	2	4	32,982	2,483	35,466
Other I.A. (7, 9–15) ^a	15,705	26,514	42,219	51	1,079	1,130	15,808	36,570	52,378
B. Respiratory infections	58,979	21,810	80,789	52	2,227	2,279	59,031	24,037	83,068
C. Maternal conditions		13,363	13,363		27	27		13,390	13,390
D. Perinatal conditions	75,642		75,643	981	4	984	76,623	4	76,627
1. Low birthweight	39,228		39,228	291		291	39,520		39,520
2. Birth asphyxia and birth trauma	22,118		22,118	336	1	338	22,454	2	22,455
3. Other perinatal conditions	14,296		14,297	353	2	355	14,650	2	14,652
E. Nutritional deficiencies	5,882	4,773	10,656	4	122	126	5,887	4,895	10,782
II. Noncommunicable diseases	25,345	322,376	347,721	857	63,397	64,255	26,203	385,773	411,976
A. Malignant neoplasms	1,110	71,503	72,613	50	23,265	23,315	1,160	94,768	95,928
C. Diabetes mellitus	87	10,054	10,141	1	1,942	1,943	87	11,997	12,084
E. Neuropsychiatric disorders	1,317	10,310	11,626	63	3,259	3,322	1,380	13,569	14,949
1. Unipolar depressive disorders		205	205		21	21	1	226	227
2. Bipolar affective disorder		5	5		4	4		9	9
3. Schizophrenia		373	374		24	24		397	398
Other II.E. (4–16) ^b	1,314	9,727	11,041	63	3,210	3,273	1,377	12,937	14,314
G. Cardiovascular diseases	2,493	155,750	158,243	63	24,166	24,229	2,557	179,915	182,472
3. Ischemic heart disease	177	67,751	67,928	2	11,483	11,485	179	79,234	79,412
4. Cerebrovascular disease	371	51,170	51,541	11	5,886	5,896	382	57,056	57,438
Other II.G. (1, 2, 5, 6) ^c	1,946	36,828	38,774	50	6,797	6,848	1,996	43,626	45,622
H. Respiratory diseases	1,925	34,570	36,495	30	3,914	3,945	1,955	38,484	40,439
I. Digestive diseases	3,482	23,888	27,370	35	3,680	3,715	3,516	27,568	31,084
M. Congenital anomalies	12,785	1,480	14,265	543	229	771	13,328	1,709	15,037
Other II. (B, D, F, J, K, L, N) ^d	2,147	14,821	16,967	72	2,943	3,015	2,219	17,764	19,983
III. Injuries	9,155	98,361	107,516	218	7,995	8,213	9,373	106,356	115,729
A. Unintentional	8,757	64,384	73,141	186	5,003	5,189	8,943	69,387	78,330
1. Road traffic accidents	1,491	23,331	24,822	52	2,496	2,548	1,543	25,827	27,370
Other III.A. (2–6) ^e	7,266	41,053	48,320	134	2,507	2,640	7,400	43,560	50,960
B. Intentional	398	33,977	34,374	33	2,992	3,024	430	36,969	37,399
1. Self-inflicted	4	16,435	16,439		2,432	2,433	4	18,868	18,871
Other III.B. (2–4) ^f	394	17,542	17,936	32	559	592	426	18,101	18,527

Source: Chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause.

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

c. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

d. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

e. Poisonings, falls, fires, drownings, and other unintentional injuries.

f. Violence, war, and other intentional injuries.

Table 6B.3 YLD from Selected Causes, by Age, 2001 (thousands)

Cause	Low- and middle-income countries			High-income countries			World		
	YLD			YLD			YLD		
	0–4	5+	Total	0–4	5+	Total	0–4	5+	Total
Total YLD	104,557	372,465	477,022	4,592	66,717	71,309	109,148	439,182	548,330
I. Communicable, maternal, perinatal, and nutritional conditions	45,068	52,890	97,958	1,041	2,127	3,169	46,109	55,018	101,127
A. Infectious and parasitic diseases	15,016	31,552	46,568	467	934	1,401	15,483	32,486	47,969
1. Tuberculosis	170	3,964	4,134	1	46	47	170	47,799	47,969
2. Sexually transmitted diseases excluding HIV/AIDS	1,127	4,065	5,192	12	126	138	1,139	4,190	5,329
3. HIV/AIDS	173	5,802	5,975	1	171	173	175	5,974	6,148
4. Diarrheal diseases	4,814	3,022	7,836	222	170	392	5,036	3,192	8,228
5. Childhood-cluster diseases	2,359	266	2,625	138	4	141	2,496	269	2,766
a. Pertussis	2,192	98	2,290	137	1	138	2,328	100	2,428
b. Poliomyelitis	21	105	126		2	2	21	107	128
c. Diphtheria									
d. Measles	136	58	194	1	1	2	137	58	195
e. Tetanus	9	4	14				9	4	14
6. Meningitis	829	302	1,131	27	22	49	856	324	1,180
8. Malaria	3,158	1,341	4,499		5	5	3,158	1,346	4,504
Other I.A. (7, 9–15) ^a	2,386	12,791	15,177	66	391	457	2,452	13,182	15,634
B. Respiratory infections	3,855	2,095	5,949	46	150	197	3,901	2,245	6,146
C. Maternal conditions					364	364		13,385	13,385
D. Perinatal conditions	13,523		13,523	422		422	13,945		13,945
1. Low birthweight	3,377		3,377	175		175	3,552		3,552
2. Birth asphyxia and birth trauma	9,352		9,352	191		191	9,543		9,543
3. Other perinatal conditions	794		794	56		56	850		850
E. Nutritional deficiencies	12,674	6,223	18,897	107	679	785	12,781	6,902	19,683
II. Noncommunicable diseases	53,465	277,249	330,714	3,371	61,737	65,108	56,836	338,987	395,823
A. Malignant neoplasms	37	2,072	2,109	4	2,566	2,570	41	4,639	4,680
C. Diabetes mellitus	15	5,647	5,662	1	2,249	2,249	16	7,896	7,912
E. Neuropsychiatric disorders	18,854	106,595	125,449	913	26,996	27,909	19,767	133,592	153,358
1. Unipolar depressive disorders		43,222	43,222		8,387	8,387		51,608	51,608
2. Bipolar affective disorder		8,673	8,673		1,052	1,052		9,725	9,725
3. Schizophrenia		10,153	10,153		1,091	1,091		11,244	11,244
Other II.E. (4–16) ^b	18,854	44,548	63,402	913	16,466	17,379	19,767	61,015	80,781
G. Cardiovascular diseases	540	20,091	20,631	15	5,623	5,638	554	25,714	26,268
3. Ischemic heart disease	1	3,923	3,923		908	908	1	4,831	4,831
4. Cerebrovascular disease		11,102	11,102		3,460	3,460		14,562	14,562
Other II.G. (1, 2, 5, 6) ^c	539	5,066	5,605	15	1,255	1,270	554	6,321	6,875
H. Respiratory diseases	4,040	17,546	21,586	539	5,319	5,857	4,578	22,865	27,443
I. Digestive diseases	10,972	14,074	25,045	440	2,382	2,821	11,412	16,455	27,867
M. Congenital anomalies	9,293		9,293	647		647	9,940		9,940
Other II. (B, D, F, J, K, L, N) ^d	9,375	111,564	120,939	813	16,603	17,416	10,528	127,826	138,354
III. Injuries	6,024	42,326	48,349	180	2,852	3,032	6,203	45,178	51,381
A. Unintentional	5,864	34,242	40,106	178	2,510	2,688	6,042	36,752	42,794
1. Road traffic accidents	783	6,413	7,196	16	481	497	798	6,894	7,693
Other III.A. (2–6) ^e	5,082	27,829	32,911	162	2,029	2,191	5,244	29,857	35,101
B. Intentional	159	8,084	8,243	2	342	344	161	8,426	8,587
1. Self-inflicted		1,237	1,237		148	148		1,385	1,385
Other III.B. (2–4) ^f	159	6,847	7,007	2	194	195	161	7,041	7,202

Source: Chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause.

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

c. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

d. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

e. Poisonings, falls, fires, drownings, and other unintentional injuries.

f. Violence, war, and other intentional injuries.

Table 6B.4 The Burden of Disease—DALYs(3,0) from Selected Causes, by Age, 2001 (Excluding Stillbirths) (thousands)

Cause	Low- and middle-income countries			High-income countries			World		
	DALYs			DALYs			DALYs		
	0–4	5+	Total	0–4	5+	Total	0–4	5+	Total
Total DALYs(3,0)	424,062	963,364	1,387,426	6,804	142,358	149,161	430,866	1,105,721	1,536,587
I. Communicable, maternal, perinatal, and nutritional conditions	330,086	222,553	552,639	2,177	6,384	8,561	332,263	228,937	561,200
A. Infectious and parasitic diseases	159,602	161,226	320,828	563	2,812	3,375	160,165	164,039	324,203
1. Tuberculosis	1,385	34,502	35,887	2	217	219	1,387	34,719	36,106
2. Sexually transmitted diseases excluding HIV/AIDS	3,194	6,149	9,343	13	132	145	3,207	6,280	9,488
3. HIV/AIDS	10,467	60,362	70,830	3	662	665	10,471	61,024	71,495
4. Diarrheal diseases	53,343	5,376	58,719	235	210	444	53,578	5,586	59,164
5. Childhood-cluster diseases	34,124	9,031	43,155	141	33	175	34,266	9,064	43,330
a. Pertussis	11,310	99	11,408	138	2	139	11,448	100	11,548
b. Poliomyelitis	30	106	136		8	8	30	114	144
c. Diphtheria	137	28	164				137	28	164
d. Measles	16,984	6,121	23,106	3	20	23	16,988	6,141	23,129
e. Tetanus	5,663	2,677	8,340	1	5	5	5,664	2,681	8,345
6. Meningitis	2,784	2,695	5,479	50	81	131	2,834	2,776	5,610
8. Malaria	36,159	3,827	39,986	2	7	9	36,161	3,834	39,995
Other I.A. (7, 9–15) ^a	18,144	39,285	57,429	117	1,470	1,587	18,261	40,755	59,016
B. Respiratory infections	62,826	23,926	86,752	98	2,376	2,474	62,924	26,302	89,227
C. Maternal conditions		26,398	26,398		391	391		26,789	26,789
D. Perinatal conditions	89,096		89,096	1,405	4	1,408	90,501	4	90,505
1. Low birthweight	42,606		42,606	467		467	43,072		43,073
2. Birth asphyxia and birth trauma	31,442		31,443	528	1	530	31,971	2	31,972
3. Other perinatal conditions	15,048		15,048	410	2	412	15,458	2	15,460
E. Nutritional deficiencies	18,562	11,002	29,564	111	801	912	18,673	11,803	30,475
II. Noncommunicable diseases	78,798	600,044	678,842	4,229	125,127	129,356	83,027	725,171	808,198
A. Malignant neoplasms	1,148	73,644	74,792	54	25,834	25,888	1,202	99,478	100,680
C. Diabetes mellitus	102	15,715	15,817	1	4,191	4,192	103	19,906	20,009
E. Neuropsychiatric disorders	20,180	116,960	137,140	976	30,254	31,230	21,156	147,214	168,371
1. Unipolar depressive disorders		43,444	43,445		8,408	8,408	1	51,852	51,853
2. Bipolar affective disorder		8,681	8,681		1,056	1,056		9,737	9,737
3. Schizophrenia	1	10,530	10,531		1,115	1,115	1	11,645	11,646
Other II.E. (4–16) ^b	20,178	54,305	74,483	976	19,675	20,651	21,154	73,981	95,134
G. Cardiovascular diseases	3,033	175,983	179,016	78	29,780	29,859	3,111	205,764	208,875
3. Ischemic heart disease	177	71,735	71,913	2	12,388	12,390	180	84,124	84,303
4. Cerebrovascular disease	371	62,326	62,697	11	9,344	9,354	382	71,669	72,051
Other II.G. (1, 2, 5, 6) ^c	2,484	41,922	44,406	65	8,049	8,114	2,550	49,970	52,520
H. Respiratory diseases	5,966	52,146	58,112	569	9,233	9,801	6,535	61,379	67,914
I. Digestive diseases	14,442	37,990	52,433	475	6,061	6,536	14,917	44,051	58,968
M. Congenital anomalies	22,061	1,483	23,544	1,191	228	1,420	23,252	1,712	24,964
Other II. (B, D, F, J, K, L, N) ^d	11,866	126,121	137,987	885	19,546	20,431	12,751	145,667	158,418
III. Injuries	15,178	140,767	155,945	398	10,846	11,244	15,576	151,613	167,189
A. Unintentional	14,621	98,684	1,13,306	364	7,513	7,876	14,985	106,197	121,182
1. Road traffic accidents	2,275	29,766	32,041	68	2,978	3,045	2,343	32,744	35,087
Other III.A. (2–6) ^e	12,346	68,918	81,264	296	4,535	4,831	12,642	73,453	86,095
B. Intentional	557	42,083	42,640	34	3,334	3,368	591	45,416	46,007
1. Self-inflicted	4	17,674	17,678		2,581	2,581	4	20,255	20,259
Other III.B. (2–4) ^f	553	24,409	24,962	34	753	787	587	25,161	25,749

Source: Chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause.

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

c. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

d. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

e. Poisonings, falls, fires, drownings, and other unintentional injuries.

f. Violence, war, and other intentional injuries.

Table 6B.5 YLL_{SB}(3,0,1) Calculated to Include Stillbirths (Valued the Same as Newborn Deaths) (thousands)

Cause	Low- and middle-income countries						
	YLL						
	Stillbirth			Under age 5			
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	Total
Total YLL	65,463	32,755	98,198	319,558	417,756	590,267	1,008,023
I. Communicable, maternal, perinatal, and nutritional conditions				285,058	285,058	169,531	454,589
A. Infectious and parasitic diseases				144,555	144,555	129,584	274,138
1. Tuberculosis				1,215	1,215	30,528	31,743
2. Sexually transmitted diseases excluding HIV/AIDS				2,067	2,067	2,079	4,146
3. HIV/AIDS				10,299	10,299	54,537	64,836
4. Diarrheal diseases				48,534	48,534	2,350	50,884
5. Childhood-cluster diseases				31,751	31,751	8,756	40,507
a. Pertussis				9,113	9,113		9,113
b. Poliomyelitis				9	9	1	10
c. Diphtheria				137	137	27	164
d. Measles				16,840	16,840	6,057	22,897
e. Tetanus				5,652	5,652	2,671	8,323
6. Meningitis				1,952	1,952	2,391	4,343
8. Malaria				32,981	32,981	2,481	35,462
Other I.A. (7, 9–15) ^a				15,705	15,705	26,514	42,219
B. Respiratory infections				58,979	58,979	21,810	80,789
C. Maternal conditions						13,363	13,363
D. Perinatal conditions				75,642	75,642		75,643
1. Low birthweight ^b				39,228	39,228		39,228
2. Birth asphyxia and birth trauma				22,118	22,118		22,118
3. Other perinatal conditions				14,296	14,296		14,297
E. Nutritional deficiencies				5,882	5,882	4,773	10,656
II. Noncommunicable diseases				25,345	25,345	322,376	347,721
A. Malignant neoplasms				1,110	1,110	71,503	72,613
C. Diabetes mellitus				87	87	10,054	10,141
E. Neuropsychiatric disorders				1,317	1,317	10,310	11,626
1. Unipolar depressive disorders						205	205
2. Bipolar affective disorder						5	5
3. Schizophrenia				1	1	373	374
Other II.E. (4–16) ^c				1,314	1,314	9,727	11,041
G. Cardiovascular diseases				2,493	2,493	155,750	158,243
3. Ischemic heart disease				177	177	67,751	67,928
4. Cerebrovascular disease				371	371	51,170	51,541
Other II.G. (1, 2, 5, 6) ^d				1,946	1,946	36,828	38,774
H. Respiratory diseases				1,925	1,925	34,570	36,495
I. Digestive diseases				3,482	3,482	23,888	27,370
M. Congenital anomalies				12,785	12,785	1,480	14,265
Other II. (B, D, F, J, K, L, N) ^e				2,147	2,147	14,821	16,967
III. Injuries				9,155	9,155	98,361	107,516
A. Unintentional				8,757	8,757	64,384	73,141
1. Road traffic accidents				1,491	1,491	23,331	24,822
Other III.A. (2–6) ^f				7,266	7,266	41,053	48,320
B. Intentional				398	398	33,977	34,374
1. Self-inflicted				4	4	16,435	16,439
Other III.B. (2–4) ^g				394	394	17,542	17,936
IV. Not allocated	65,463	32,755	98,198		98,198		98,198

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause.

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

(Continues on the following page.)

Table 6B.5 Continued

Cause	High-income countries						
	YLL						
	Stillbirth			Under age 5			
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	Total
Total YLL	1,222	153	1,375	2,209	3,583	75,650	79,233
I. Communicable, maternal, perinatal, and nutritional conditions				1,133	1,133	4,258	5,391
A. Infectious and parasitic diseases				96	96	1,878	1,975
1. Tuberculosis				1	1	171	172
2. Sexually transmitted diseases excluding HIV/AIDS				1	1	6	7
3. HIV/AIDS				2	2	491	493
4. Diarrheal diseases				13	13	40	53
5. Childhood-cluster diseases				4	4	30	34
a. Pertussis				1	1		1
b. Poliomyelitis						6	6
c. Diphtheria							
d. Measles				2	2	19	21
e. Tetanus				1	1	5	5
6. Meningitis				23	23	59	82
8. Malaria				2	2	2	4
Other I.A. (7, 9–15) ^a				51	51	1,079	1,130
B. Respiratory infections				52	52	2,227	2,279
C. Maternal conditions						27	27
D. Perinatal conditions				981	981	4	984
1. Low birthweight ^b				291	291		291
2. Birth asphyxia and birth trauma				336	336	1	338
3. Other perinatal conditions				353	353	2	355
E. Nutritional deficiencies				4	4	122	126
II. Noncommunicable diseases				857	857	63,397	64,255
A. Malignant neoplasms				50	50	23,265	23,315
C. Diabetes mellitus				1	1	1,942	1,943
E. Neuropsychiatric disorders				63	63	3,259	3,322
1. Unipolar depressive disorders						21	21
2. Bipolar affective disorder						4	4
3. Schizophrenia						24	24
Other II.E. (4–16) ^c				63	63	3,210	3,273
G. Cardiovascular diseases				63	63	24,166	24,229
3. Ischemic heart disease				2	2	11,483	11,485
4. Cerebrovascular disease				11	11	5,886	5,896
Other II.G. (1, 2, 5, 6) ^d				50	50	6,797	6,848
H. Respiratory diseases				30	30	3,914	3,945
I. Digestive diseases				35	35	3,680	3,715
M. Congenital anomalies				543	543	229	771
Other II. (B, D, F, J, K, L, N) ^e				72	72	2,943	3,015
III. Injuries				218	218	7,995	8,213
A. Unintentional				186	186	5,003	5,189
1. Road traffic accidents				52	52	2,496	2,548
Other III.A. (2–6) ^f				134	134	2,507	2,640
B. Intentional				33	33	2,992	3,024
1. Self-inflicted						2,432	2,433
Other III.B. (2–4) ^g				32	32	559	592
IV. Not allocated	1,222	153	1,375		1,375		1,375

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause.

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

Cause	World						
	YLL						
	Stillbirth			Under age 5			
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	Total
Total YLL	66,685	32,907	99,592	321,767	421,360	566,325	987,684
I. Communicable, maternal, perinatal, and nutritional conditions				286,191	286,191	173,789	459,980
A. Infectious and parasitic diseases				144,651	144,651	131,462	276,113
1. Tuberculosis				1,216	1,216	30,699	31,915
2. Sexually transmitted diseases excluding HIV/AIDS				2,068	2,068	2,085	4,153
3. HIV/AIDS				10,301	10,301	55,027	65,328
4. Diarrheal diseases				48,547	48,547	2,390	50,937
5. Childhood-cluster diseases				31,755	31,755	8,786	40,540
a. Pertussis				9,114	9,114		9,114
b. Poliomyelitis				9	9	7	16
c. Diphtheria				137	137	27	164
d. Measles				16,843	16,843	6,076	22,918
e. Tetanus				5,653	5,653	2,675	8,328
6. Meningitis				1,975	1,975	2,450	4,425
8. Malaria				32,982	32,982	2,483	35,466
Other I.A. (7, 9–15) ^a				15,808	15,808	36,570	52,378
B. Respiratory infections				59,031	59,031	24,037	83,068
C. Maternal conditions						13,390	13,390
D. Perinatal conditions				76,623	76,623	4	76,627
1. Low birthweight ^b				39,520	39,520		39,520
2. Birth asphyxia and birth trauma				22,454	22,454	2	22,455
3. Other perinatal conditions				14,650	14,650	2	14,652
E. Nutritional deficiencies				5,887	5,887	4,895	10,782
II. Noncommunicable diseases				26,203	26,203	385,773	411,976
A. Malignant neoplasms				1,160	1,160	94,768	95,928
C. Diabetes mellitus				87	87	11,997	12,084
E. Neuropsychiatric disorders				1,380	1,380	13,569	14,949
1. Unipolar depressive disorders				1	1	226	227
2. Bipolar affective disorder						9	9
3. Schizophrenia				1	1	397	398
Other II.E. (4–16) ^c				1,377	1,377	12,937	14,314
G. Cardiovascular diseases				2,557	2,557	179,915	182,472
3. Ischemic heart disease				179	179	79,234	79,412
4. Cerebrovascular disease				382	382	57,056	57,438
Other II.G. (1, 2, 5, 6) ^d				1,996	1,996	43,626	45,622
H. Respiratory diseases				1,955	1,955	38,484	40,439
I. Digestive diseases				3,516	3,516	27,568	31,084
M. Congenital anomalies				13,328	13,328	1,709	15,037
Other II. (B, D, F, J, K, L, N) ^e				2,219	2,219	17,764	19,983
III. Injuries				9,373	9,373	106,356	115,729
A. Unintentional				8,943	8,943	69,387	78,330
1. Road traffic accidents				1,543	1,543	25,827	27,370
Other III.A. (2–6) ^f				7,400	7,400	43,560	50,960
B. Intentional				430	430	36,969	37,399
1. Self-inflicted				4	4	18,868	18,871
Other III.B. (2–4) ^g				426	426	18,101	18,527
IV. Not allocated	66,685	32,907	99,592		99,592		99,592

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause.

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

Table 6B.6 The Burden of Disease—DALYs_{SB}(3,0,1). Calculated to Include Stillbirths (Valued the Same as Newborn Deaths) (thousands)

Cause	Low- and middle-income countries						
	DALYs						
	Stillbirth			Under age 5			
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	Total
Total DALYs	65,463	32,755	98,198	424,062	522,260	963,364	1,485,623
I. Communicable, maternal, perinatal, and nutritional conditions				330,086	330,086	222,553	552,639
A. Infectious and parasitic diseases				159,602	159,602	161,226	320,828
1. Tuberculosis				1,385	1,385	34,502	35,887
2. Sexually transmitted diseases excluding HIV/AIDS				3,194	3,194	6,149	9,343
3. HIV/AIDS				10,467	10,467	60,362	70,830
4. Diarrheal diseases				53,343	53,343	5,376	58,719
5. Childhood-cluster diseases				34,124	34,124	9,031	43,155
a. Pertussis				11,310	11,310	99	11,408
b. Poliomyelitis				30	30	106	136
c. Diphtheria				137	137	28	164
d. Measles				16,984	16,984	6,121	23,106
e. Tetanus				5,663	5,663	2,677	8,340
6. Meningitis				2,784	2,784	2,695	5,479
8. Malaria				36,159	36,159	3,827	39,986
Other I.A. (7, 9–15) ^a				18,144	18,144	8	18,152
B. Respiratory infections				62,826	62,826	23,926	86,752
C. Maternal conditions						26,398	26,398
D. Perinatal conditions				89,096	89,096		89,096
1. Low birthweight ^b				42,606	42,606		42,606
2. Birth asphyxia and birth trauma				31,442	31,442		31,443
3. Other perinatal conditions				15,048	15,048		15,048
E. Nutritional deficiencies				18,562	18,562	11,002	29,564
II. Noncommunicable diseases				78,798	78,798	600,044	678,842
A. Malignant neoplasms				1,148	1,148	73,644	74,792
C. Diabetes mellitus				102	102	15,715	15,817
E. Neuropsychiatric disorders				20,180	20,180	116,960	137,140
1. Unipolar depressive disorders						43,444	43,445
2. Bipolar affective disorder						8,681	8,681
3. Schizophrenia				1	1	10,530	10,531
Other II.E. (4–16) ^c				7	7	20	27
G. Cardiovascular diseases				3,033	3,033	175,983	179,016
3. Ischemic heart disease				177	177	71,735	71,913
4. Cerebrovascular disease				371	371	62,326	62,697
Other II.G. (1, 2, 5, 6) ^d				2,484	2,484		2,484
H. Respiratory diseases				5,966	5,966	52,146	58,112
I. Digestive diseases				14,442	14,442	37,990	52,433
M. Congenital anomalies				22,061	22,061	1,483	23,544
Other II. (B, D, F, J, K, L, N) ^e				11,866	11,866	1	11,867
III. Injuries				15,178	15,178	140,767	155,945
A. Unintentional				14,621	14,621	98,684	113,306
1. Road traffic accidents				2,275	2,275	29,766	32,041
Other III.A. (2–6) ^f				12,346	12,346	12	12,358
B. Intentional				557	557	42,083	42,640
1. Self-inflicted				4	4	17,674	17,678
Other III.B. (2–4) ^g				553	553	2	555
IV. Not allocated	65,463	32,755	98,198		98,198		98,198

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. DALYs used here: DALYs(3,0,1).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

Cause	High-income countries						
	DALYs						
	Stillbirth			Under age 5			
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	Total
Total DALYs	1,222	153	1,375	6,804	8,178	142,358	150,536
I. Communicable, maternal, perinatal, and nutritional conditions				2,177	2,177	6,384	8,561
A. Infectious and parasitic diseases				563	563	2,812	3,375
1. Tuberculosis				2	2	217	219
2. Sexually transmitted diseases excluding HIV/AIDS				13	13	132	145
3. HIV/AIDS				3	3	662	665
4. Diarrheal diseases				235	235	210	444
5. Childhood-cluster diseases				141	141	33	175
a. Pertussis				138	138	2	139
b. Poliomyelitis						8	8
c. Diphtheria							
d. Measles				3	3	20	23
e. Tetanus				1	1	5	5
6. Meningitis				50	50	81	131
8. Malaria				2	2	7	9
Other I.A. (7, 9–15) ^a				117	117	1,470	1,587
B. Respiratory infections				98	98	2,376	2,474
C. Maternal conditions						391	391
D. Perinatal conditions				1,405	1,405	4	1,408
1. Low birthweight ^b				467	467		467
2. Birth asphyxia and birth trauma				528	528	1	530
3. Other perinatal conditions				410	410	2	412
E. Nutritional deficiencies				111	111	801	912
II. Noncommunicable diseases				4,229	4,229	125,127	129,356
A. Malignant neoplasms				54	54	25,834	25,888
C. Diabetes mellitus				1	1	4,191	4,192
E. Neuropsychiatric disorders				976	976	30,254	31,230
1. Unipolar depressive disorders						8,408	8,408
2. Bipolar affective disorder						1,056	1,056
3. Schizophrenia						1,115	1,115
Other II.E. (4–16) ^c				976	976	19,675	20,651
G. Cardiovascular diseases				78	78	29,780	29,859
3. Ischemic heart disease				2	2	12,388	12,390
4. Cerebrovascular disease				11	11	9,344	9,354
Other II.G. (1, 2, 5, 6) ^d				65	65	8,049	8,114
H. Respiratory diseases				569	569	9,233	9,801
I. Digestive diseases				475	475	6,061	6,536
M. Congenital anomalies				1,191	1,191	228	1,420
Other II. (B, D, F, J, K, L, N) ^e				885	885	19,546	20,431
III. Injuries				398	398	10,846	11,244
A. Unintentional				364	364	7,513	7,876
1. Road traffic accidents				68	68	2,978	3,045
Other III.A. (2–6) ^f				296	296	4,535	4,831
B. Intentional				34	34	3,334	3,368
1. Self-inflicted						2,581	2,581
Other III.B. (2–4) ^g				34	34	753	787
IV. Not allocated	1,222	153	1,375		1,375		1,375

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. DALYs used here: DALYs(3,0,1).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

Table 6B.6 Continued

Cause	World						
	DALYs						
	Stillbirth			Under age 5			
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	Total
Total DALYs	66,685	32,907	99,592	430,866	530,458	1,105,721	1,636,179
I. Communicable, maternal, perinatal, and nutritional conditions				332,263	332,263	228,937	561,200
A. Infectious and parasitic diseases				160,165	160,165	164,039	324,203
1. Tuberculosis				1,387	1,387	34,719	36,106
2. Sexually transmitted diseases excluding HIV/AIDS				3,207	3,207	6,280	9,488
3. HIV/AIDS				10,471	10,471	61,024	71,495
4. Diarrheal diseases				53,578	53,578	5,586	59,164
5. Childhood-cluster diseases				34,266	34,266	9,064	43,330
a. Pertussis				11,448	11,448	100	11,548
b. Poliomyelitis				30	30	114	144
c. Diphtheria				137	137	28	164
d. Measles				16,988	16,988	6,141	23,129
e. Tetanus				5,664	5,664	2,681	8,345
6. Meningitis				2,834	2,834	2,776	5,610
8. Malaria				36,161	36,161	3,834	39,995
Other I.A. (7, 9–15) ^a				18,261	18,261	40,755	59,016
B. Respiratory infections				62,924	62,924	26,302	89,227
C. Maternal conditions						26,789	26,789
D. Perinatal conditions				90,501	90,501	4	90,505
1. Low birthweight ^b				43,072	43,072		43,073
2. Birth asphyxia and birth trauma				31,971	31,971	2	31,972
3. Other perinatal conditions				15,458	15,458	2	15,460
E. Nutritional deficiencies				18,673	18,673	11,803	30,475
II. Noncommunicable diseases				83,027	83,027	725,171	808,198
A. Malignant neoplasms				1,202	1,202	99,478	100,680
C. Diabetes mellitus				103	103	19,906	20,009
E. Neuropsychiatric disorders				21,156	21,156	147,214	168,371
1. Unipolar depressive disorders				1	1	51,852	51,853
2. Bipolar affective disorder						9,737	9,737
3. Schizophrenia				1	1	11,645	11,646
Other II.E. (4–16) ^c				21,154	21,154	73,981	95,134
G. Cardiovascular diseases				3,111	3,111	205,764	208,875
3. Ischemic heart disease				180	180	84,124	84,303
4. Cerebrovascular disease				382	382	71,669	72,051
Other II.G. (1, 2, 5, 6) ^d				2,550	2,550	49,970	52,520
H. Respiratory diseases				6,535	6,535	61,379	67,914
I. Digestive diseases				14,917	14,917	44,051	58,968
M. Congenital anomalies				23,252	23,252	1,712	24,964
Other II. (B, D, F, J, K, L, N) ^e				12,751	12,751	145,667	158,418
III. Injuries				15,576	15,576	151,613	167,189
A. Unintentional				14,985	14,985	106,197	121,182
1. Road traffic accidents				2,343	2,343	32,744	35,087
Other III.A. (2–6) ^f				12,642	12,642	73,453	86,095
B. Intentional				591	591	45,416	46,007
1. Self-inflicted				4	4	20,255	20,259
Other III.B. (2–4) ^g				587	587	25,161	25,749
IV. Not allocated	66,685	32,907	99,592		99,592		99,592

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. DALYs used here: DALYs(3,0,1).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

Table 6B.7 YLL_{SB}(3,0,54) Calculated to Include Stillbirths and Gradual ALP (in thousands)

Cause	Low- and middle-income countries										
	YLL—Stillbirth			YLL 0 ≤ age < 1			YLL under age 5				Total YLL _{SB} (3,0,54)
	Ante-partum	Intra-partum	Total	Neonatal	YLL aged 28 days to ≤ 1 year	Infant YLL (0 ≤ age < 1 year)	Child YLL (1 ≤ age < 5 years)	After live birth	Including stillbirth	YLL age 5+	
Total YLL	10,652	9,831	20,483	36,232	57,748	98,401	77,480	175,881	196,364	590,267	786,631
I. Communicable, maternal, perinatal, and nutritional conditions				29,027		89,029	66,554	155,583	155,583	169,531	325,113
A. Infectious and parasitic diseases				2,666		37,346	49,747	87,093	87,093	129,584	216,677
1. Tuberculosis						202	648	850	850	30,528	31,378
2. Sexually transmitted diseases excluding HIV/AIDS						710	349	1,059	1,059	2,079	3,138
3. HIV/AIDS						2,615	3,638	6,252	6,252	54,537	60,789
4. Diarrheal diseases				1,087	17,039	15,815	9,983	25,798	25,798	2,350	28,149
5. Childhood-cluster diseases						4,934	17,617	22,551	22,551	8,756	31,307
a. Pertussis						1,247	5,407	6,654	6,654		6,654
b. Poliomyelitis						2	4	6	6	1	7
c. Diphtheria						32	53	85	85	27	113
d. Measles						1,486	11,673	13,158	13,158	6,057	19,215
e. Tetanus				1,579		2,176	502	2,677	2,677	2,671	5,348
6. Meningitis						606	1,235	1,841	1,841	2,391	4,231
8. Malaria						9,404	9,537	18,941	18,941	2,481	21,422
Other I.A. (7, 9–15) ^a						2,826	7,904	10,730	10,730	26,514	37,244
B. Respiratory infections				9,420	8,219	19,880	10,773	30,653	30,653	21,810	52,463
C. Maternal conditions										13,363	13,364
D. Perinatal conditions				16,939		30,871	2,808	33,679	33,679		33,679
1. Low birthweight ^b				10,143	2,097	15,739	2,007	17,746	17,746		17,746
2. Birth asphyxia and birth trauma				6,795		9,361	142	9,503	9,503		9,503
3. Other perinatal conditions						5,769	662	6,432	6,432		6,432
E. Nutritional deficiencies						1,237	2,602	3,840	3,840	4,773	8,613
II. Noncommunicable diseases				2,899		7,755	6,242	13,992	13,992	322,376	336,372
A. Malignant neoplasms						142	679	821	821	71,503	72,324
C. Diabetes mellitus						24	27	51	51	10,054	10,105
E. Neuropsychiatric disorders						271	594	866	866	10,310	11,176
1. Unipolar depressive disorders										205	205
2. Bipolar affective disorder										5	5
3. Schizophrenia								1	1	373	374
Other II.E. (4–16) ^c							786	963	963	9,727	10,690
G. Cardiovascular diseases						728	685	1,413	1,413	155,750	157,163
3. Ischemic heart disease						54	44	98	98	67,751	67,849
4. Cerebrovascular disease						102	115	217	217	51,170	51,387
Other II.G. (1, 2, 5, 6) ^d						540	591	1,131	1,131	36,828	37,959
H. Respiratory diseases						552	551	1,103	1,103	34,570	35,673
I. Digestive diseases						939	1,113	2,052	2,052	23,888	25,940
M. Congenital anomalies				2,899		4,559	1,823	6,382	6,382	1,480	7,862
Other II. (B, D, F, J, K, L, N) ^e						471	909	1,380	1,380	14,821	16,201
III. Injuries						1,607	4,706	6,312	6,312	98,361	104,673
A. Unintentional						1,538	4,499	6,037	6,037	64,384	70,421
1. Road traffic accidents						153	990	1,143	1,143	23,331	24,474
Other III.A. (2–6) ^f						1,212	3,863	5,074	5,074	41,053	46,128
B. Intentional						69	206	275	275	33,977	34,252
1. Self-inflicted						1	1	2	2	16,435	16,437
Other III.B. (2–4) ^g						44	254	298	298	17,542	17,840
IV. Not allocated	10,652	9,831	20,483	4,301					20,483		20,483

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. YLL used here: YLL(3,0,54).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

(Continues on the following page.)

Table 6B.7 Continued

Cause	High-income countries										
	YLL—Stillbirth			YLL 0 ≤ age < 1			YLL under age 5				
	Ante-partum	Intra-partum	Total	Neonatal	YLL aged 28 days to ≤ 1 year	Infant YLL (0 ≤ age < 1 year)	Child YLL (1 ≤ age < 5 years)	After live birth	Including stillbirth	YLL age 5+	Total YLL _{SB} (3,0,.54)
Total YLL	199	46	245	388	278	769	353	1,122	1,366	75,650	77,016
I. Communicable, maternal, perinatal, and nutritional conditions				150		457	53	510	510	4,258	4,768
A. Infectious and parasitic diseases				150		26	30	57	57	1,878	1,935
1. Tuberculosis							1	1	1	171	172
2. Sexually transmitted diseases excluding HIV/AIDS										6	7
3. HIV/AIDS							1	1	1	491	492
4. Diarrheal diseases							2	2	7	40	47
5. Childhood-cluster diseases							2	2	3	30	32
a. Pertussis									1		1
b. Poliomyelitis										6	6
c. Diphtheria											
d. Measles							1	1	1	19	21
e. Tetanus										5	5
6. Meningitis							9	9	9	59	73
8. Malaria										2	3
Other I.A. (7, 9–15) ^a						10	24	34	34	1,079	1,113
B. Respiratory infections						14	16	30	30	2,227	2,258
C. Maternal conditions										27	27
D. Perinatal conditions				150		415	5	420	420	4	424
1. Low birthweight ^b				90		124		124	124		124
2. Birth asphyxia and birth trauma				58	77	142	289	431	431	1	146
3. Other perinatal conditions						150	305	455	455	2	153
E. Nutritional deficiencies						1	2	3	3	122	125
II. Noncommunicable diseases				116		251	511	761	761	63,397	63,883
A. Malignant neoplasms						3	7	10	10	23,265	23,305
C. Diabetes mellitus										1,942	1,943
E. Neuropsychiatric disorders						14	26	40	40	3,259	3,299
1. Unipolar depressive disorders										21	21
2. Bipolar affective disorder										4	4
3. Schizophrenia										24	24
Other II.E. (4–16) ^c						7	19	26	26	3,210	3,236
G. Cardiovascular diseases						18	18	36	36	24,166	24,202
3. Ischemic heart disease						1	1	1	1	11,483	11,484
4. Cerebrovascular disease						3	19	22	22	5,886	5,908
Other II.G. (1, 2, 5, 6) ^d						12	19	31	31	6,797	6,829
H. Respiratory diseases						8	10	18	18	3,914	3,932
I. Digestive diseases						11	7	19	19	3,680	3,698
M. Congenital anomalies				116	62	208	48	256	256	229	484
Other II. (B, D, F, J, K, L, N) ^e						17	28	45	45	2,943	2,988
III. Injuries						31	127	158	158	7,995	8,153
A. Unintentional						24	112	137	137	5,003	5,140
1. Road traffic accidents						4	37	41	41	2,496	2,537
Other III.A. (2–6) ^f						14	87	100	100	2,507	2,607
B. Intentional						7	15	21	21	2,992	3,013
1. Self-inflicted										2,432	2,433
Other III.B. (2–4) ^g						7	15	21	21	559	581
IV. Not allocated	199	46	245	124					245		245

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. YLL used here: YLL(3,0,.54).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

Cause	World										
	YLL—Stillbirth			YLL 0 ≤ age < 1			YLL under age 5				Total YLL _{SB} (3,0,.54)
	Ante-partum	Intra-partum	Total	Neonatal	YLL aged 28 days to ≤ 1 year	Infant YLL (0 ≤ age < 1 year)	Child YLL (1 ≤ age < 5 years)	After live birth	Including stillbirth	YLL age 5+	
Total YLL	10,851	9,877	20,728	36,620	58,010	99,170	77,833	177,003	197,730	590,267	787,998
I. Communicable, maternal, perinatal, and nutritional conditions				29,413		89,486	66,607	156,092	156,109	169,531	325,623
A. Infectious and parasitic diseases				2,817		37,373	49,777	87,150	88,105	129,584	216,734
1. Tuberculosis						202	649	850	850	30,528	31,379
2. Sexually transmitted diseases excluding HIV/AIDS						711	349	1,059	1,059	2,079	3,138
3. HIV/AIDS							2,615	3,639	6,254	6,254	54,537
4. Diarrheal diseases				1,087	17,044	15,819	9,986	25,888	25,888	2,350	28,155
5. Childhood-cluster diseases						4,935	17,648	22,580	22,580	8,756	31,335
a. Pertussis						1,248	5,407	6,655	6,655		6,655
b. Poliomyelitis						2	4	6	6	1	7
c. Diphtheria						32	53	85	85	27	113
d. Measles						1,486	11,674	13,160	13,160	6,057	19,217
e. Tetanus				1,579		2,176	489	2,665	2,665	2,671	5,336
6. Meningitis						611	472	1,083	1,083	2,391	3,474
8. Malaria						9,404	9,537	18,942	18,942	2,481	21,423
Other I.A. (7, 9–15) ^a						2,836	7,988	10,825	10,825	26,514	37,338
B. Respiratory infections				9,521	8,065	19,894	10,789	30,683	30,683	21,810	52,493
C. Maternal conditions										13,363	13,364
D. Perinatal conditions				17,221		31,286	2,813	34,099	34,099		34,100
1. Low birthweight ^b				10,320	2,097	15,863	2,007	17,874	17,871		17,871
2. Birth asphyxia and birth trauma				6,898		9,503	145	9,647	9,647		9,648
3. Other perinatal conditions						5,919	664	6,583	6,583		6,583
E. Nutritional deficiencies						1,239	2,604	3,843	3,843	4,773	8,616
II. Noncommunicable diseases				3,015		8,006	6,477	14,482	14,482	322,376	336,858
A. Malignant neoplasms						146	716	861	861	71,503	72,364
C. Diabetes mellitus						24	27	51	51	10,054	10,106
E. Neuropsychiatric disorders						285	621	906	906	10,310	11,216
1. Unipolar depressive disorders										205	205
2. Bipolar affective disorder										5	5
3. Schizophrenia								1	1	373	374
Other II.E. (4–16) ^c						183	827	1,010	1,010	9,727	10,737
G. Cardiovascular diseases						746	704	1,450	1,450	155,750	157,199
3. Ischemic heart disease						54	45	99	99	67,751	67,850
4. Cerebrovascular disease						105	118	223	223	51,170	51,394
Other II.G. (1, 2, 5, 6) ^d						553	609	1,162	1,162	36,828	37,990
H. Respiratory diseases						560	561	1,121	1,121	34,570	35,691
I. Digestive diseases						951	1,120	2,071	2,071	23,888	25,959
M. Congenital anomalies				3,015	740	4,767	1,871	6,638	6,638	1,480	8,118
Other II. (B, D, F, J, K, L, N) ^e						488	937	1,425	1,425	14,821	16,246
III. Injuries						1,638	4,833	6,470	6,470	98,361	104,832
A. Unintentional						1,563	4,611	6,174	6,174	64,384	70,558
1. Road traffic accidents						157	1,027	1,184	1,184	23,331	24,515
Other III.A. (2–6) ^f						1,225	3,951	5,176	5,176	41,053	46,230
B. Intentional						75	221	297	297	33,977	34,053
1. Self-inflicted						1	1	2	2	16,435	16,437
Other III.B. (2–4) ^g						51	269	319	319	17,542	17,861
IV. Not allocated	10,851	9,877	20,728	4,193					20,728		20,728

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. YLL used here: YLL(3,0,.54).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

Table 6B.8 The Burden of Disease—DALYs_{SB}(3,0,.54). Calculated to Include Stillbirths and Gradual ALP (A = .54) (thousands)

Cause	Low- and middle-income countries						Total DALYs _{SB} (3,0,.54)
	DALYs						
	Stillbirth			Under age 5			
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	
Total DALYs	10,652	9,831	20,483	276,796	297,279	963,364	1,260,643
I. Communicable, maternal, perinatal, and nutritional conditions				201,606	201,606	222,553	424,158
A. Infectious and parasitic diseases				103,064	103,064	161,226	264,291
1. Tuberculosis				1,020	1,020	34,502	35,521
2. Sexually transmitted diseases excluding HIV/AIDS				2,186	2,186	6,149	8,334
3. HIV/AIDS				6,929	6,929	60,362	67,292
4. Diarrheal diseases				27,489	27,489	5,376	32,865
5. Childhood-cluster diseases				21,653	21,653	9,031	30,684
a. Pertussis				8,846	8,846	99	8,945
b. Poliomyelitis				27	27	106	133
c. Diphtheria				86	86	28	113
d. Measles				13,294	13,294	6,121	19,416
e. Tetanus				3,626	3,626	2,677	6,302
6. Meningitis				1,898	1,898	2,695	4,593
8. Malaria				22,099	22,099	3,827	25,926
Other I.A. (7, 9–15) ^a				13,116	13,116	39,285	52,401
B. Respiratory infections				34,508	34,508	23,926	58,434
C. Maternal conditions						26,398	26,398
D. Perinatal conditions				47,202	47,202		47,202
1. Low birthweight ^b				17,624	17,624		17,624
2. Birth asphyxia and birth trauma				18,854	18,854		18,854
3. Other perinatal conditions				7,226	7,226		7,226
E. Nutritional deficiencies				16,514	16,514	11,002	27,516
II. Noncommunicable diseases				60,277	60,277	600,044	660,320
A. Malignant neoplasms				858	858	73,644	74,502
C. Diabetes mellitus				65	65	15,715	15,781
E. Neuropsychiatric disorders				19,720	19,720	116,960	136,680
1. Unipolar depressive disorders						43,444	43,444
2. Bipolar affective disorder						8,681	8,681
3. Schizophrenia				1	1	10,530	10,531
Other II.E. (4–16) ^c				19,816	19,816	54,305	74,122
G. Cardiovascular diseases				2,709	2,709	175,983	178,692
3. Ischemic heart disease				99	99	71,735	71,834
4. Cerebrovascular disease				217	217	62,326	62,543
Other II.G. (1, 2, 5, 6) ^d				1,670	1,670	41,922	43,591
H. Respiratory diseases				5,142	5,142	52,146	57,289
I. Digestive diseases				13,024	13,024	37,990	51,015
M. Congenital anomalies				14,689	14,689	1,483	16,172
Other II. (B, D, F, J, K, L, N) ^e				10,755	10,755	126,122	136,876
III. Injuries				12,177	12,177	140,767	152,944
A. Unintentional				11,901	11,901	98,684	110,586
1. Road traffic accidents				1,926	1,926	29,766	31,692
Other III.A. (2–6) ^f				10,156	10,156	68,918	79,074
B. Intentional				435	435	42,083	42,517
1. Self-inflicted				2	2	17,674	17,676
Other III.B. (2–4) ^g				457	457	24,409	24,866
IV. Not allocated	10,652	9,831	20,483	2,599	23,082		23,082

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. DALYs used here: DALYs(3,0,.54).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

Cause	High-income countries						
	DALYs						
	Stillbirth			Under age 5			Total DALYs _{SB} (3.0,.54)
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	
Total DALYs	199	46	245	5,713	5,958	142,358	148,316
I. Communicable, maternal, perinatal, and nutritional conditions				1,551	1,551	6,384	7,935
A. Infectious and parasitic diseases				523	523	2,812	3,335
1. Tuberculosis				1	1	217	219
2. Sexually transmitted diseases excluding HIV/AIDS				12	12	132	144
3. HIV/AIDS				2	2	662	665
4. Diarrheal diseases				224	224	210	438
5. Childhood-cluster diseases				139	139	33	174
a. Pertussis				137	137	2	139
b. Poliomyelitis						8	8
c. Diphtheria							
d. Measles				2	2	20	22
e. Tetanus						5	5
6. Meningitis				36	36	81	122
8. Malaria				1	1	7	8
Other I.A. (7, 9–15) ^a				100	100	1,470	1,570
B. Respiratory infections				76	76	2,376	2,453
C. Maternal conditions						391	391
D. Perinatal conditions				842	842	4	846
1. Low birthweight ^b				299	299		300
2. Birth asphyxia and birth trauma				622	622	1	623
3. Other perinatal conditions				510	510	2	513
E. Nutritional deficiencies				110	110	801	911
II. Noncommunicable diseases				4,132	4,132	125,127	129,860
A. Malignant neoplasms				14	14	25,834	25,848
C. Diabetes mellitus				1	1	4,191	4,192
E. Neuropsychiatric disorders				953	953	30,254	31,208
1. Unipolar depressive disorders						8,408	8,408
2. Bipolar affective disorder						1,056	1,056
3. Schizophrenia						1,115	1,115
Other II.E. (4–16) ^c				939	939		20,614
G. Cardiovascular diseases				51	51	29,780	29,832
3. Ischemic heart disease				1	1	12,388	12,390
4. Cerebrovascular disease				22	22	9,344	9,366
Other II.G. (1, 2, 5, 6) ^d				46	46	8,049	8,095
H. Respiratory diseases				557	557	9,233	9,789
I. Digestive diseases				458	458	6,061	6,519
M. Congenital anomalies				903	903	228	1,132
Other II. (B, D, F, J, K, L, N) ^e				858	858	19,546	20,403
III. Injuries				338	338	10,846	11,184
A. Unintentional				315	315	7,513	7,827
1. Road traffic accidents				57	57	2,978	3,034
Other III.A. (2–6) ^f				263	263	4,535	4,798
B. Intentional				23	23	3,334	3,357
1. Self-inflicted						2,581	2,581
Other III.B. (2–4) ^g				23	23	753	776
IV. Not allocated	10,851	9,877	20,728		20,728		20,728

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. DALYs used here: DALYs(3.0,.54).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

(Continues on the following page.)

Table 6B.8 Continued

Cause	World						
	DALYs						
	Stillbirth			Under age 5			Total DALYs _{SB} (3,0,.54)
	Antepartum	Intrapartum	Total	After live birth	Including stillbirth	age 5+	
Total DALYs	10,851	9,877	20,728	286,151	306,879	1,105,721	1,412,600
I. Communicable, maternal, perinatal, and nutritional conditions				202,202	202,202	228,937	431,139
A. Infectious and parasitic diseases				102,633	102,633	164,039	266,671
1. Tuberculosis				1,021	1,021	34,719	35,740
2. Sexually transmitted diseases excluding HIV/AIDS				2,198	2,198	6,280	8,478
3. HIV/AIDS				6,428	6,428	61,024	67,453
4. Diarrheal diseases				30,841	30,841	5,586	36,427
5. Childhood-cluster diseases				25,076	25,076	9,064	34,140
a. Pertussis				8,983	8,983	100	9,083
b. Poliomyelitis				27	27	114	141
c. Diphtheria				86	86	28	113
d. Measles				13,297	13,297	6,141	19,438
e. Tetanus				2,674	2,674	2,681	5,356
6. Meningitis				1,939	1,939	2,776	4,715
8. Malaria				22,100	22,100	3,834	25,934
Other I.A. (7, 9–15) ^a				13,276	13,276	40,755	54,032
B. Respiratory infections				34,584	34,584	26,302	60,886
C. Maternal conditions						26,789	26,790
D. Perinatal conditions				48,044	48,044	4	48,048
1. Low birthweight ^b				21,422	21,422		21,423
2. Birth asphyxia and birth trauma				19,190	19,190	2	19,192
3. Other perinatal conditions				7,433	7,433	2	7,435
E. Nutritional deficiencies				16,623	16,623	11,803	28,426
II. Noncommunicable diseases				71,318	71,318	725,171	796,489
A. Malignant neoplasms				902	902	99,478	100,380
C. Diabetes mellitus				67	67	19,906	19,973
E. Neuropsychiatric disorders				20,673	20,673	147,214	167,887
1. Unipolar depressive disorders						51,852	51,852
2. Bipolar affective disorder						9,737	9,737
3. Schizophrenia				1	1	11,645	11,646
Other II.E. (4–16) ^c				20,777	20,777	73,981	97,757
G. Cardiovascular diseases				2,044	2,044	205,764	207,768
3. Ischemic heart disease				100	100	84,124	84,224
4. Cerebrovascular disease				223	223	71,669	71,893
Other II.G. (1, 2, 5, 6) ^d				1,716	1,716	49,970	51,686
H. Respiratory diseases				5,699	5,699	61,379	67,078
I. Digestive diseases				13,483	13,483	44,051	57,534
M. Congenital anomalies				16,578	16,578	1,712	18,290
Other II. (B, D, F, J, K, L, N) ^e				11,953	11,953	145,667	157,620
III. Injuries				12,674	12,674	151,613	164,287
A. Unintentional				12,216	12,216	106,197	118,413
1. Road traffic accidents				1,983	1,983	32,744	34,726
Other III.A. (2–6) ^f				10,420	10,420	73,453	83,874
B. Intentional				237	237	45,416	45,654
1. Self-inflicted				2	2	20,255	20,257
Other III.B. (2–4) ^g				480	480	25,161	25,642
IV. Not allocated	10,851	9,877	20,728		20,728		20,728

Sources: Stillbirth data are from WHO 2005a. Neonatal and perinatal mortality are country, regional, and global estimates. Age 5+ and total data are from table 6.4 for low- and middle-income countries. All other data are from chapter 3 of this volume.

Note: A blank cell indicates that fewer than 1,000 deaths are attributable to the specific cause. DALYs used here: DALYs(3,0,.54).

a. Hepatitis, tropical-cluster diseases, leprosy, dengue, Japanese encephalitis, trachoma, intestinal nematode infections, and other infectious diseases.

b. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

c. Epilepsy, alcohol use disorders, Alzheimer's and other dementias, Parkinson's disease, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, and other neuropsychiatric disorders.

d. Rheumatic heart disease, hypertensive heart disease, inflammatory heart diseases, and other cardiovascular diseases.

e. Other neoplasms, endocrine disorders, sense organ diseases, genitourinary diseases, skin diseases, musculoskeletal diseases, and oral conditions.

f. Poisonings, falls, fires, drownings, and other unintentional injuries.

g. Violence, war, and other intentional injuries.

ANNEX C: CAUSES OF NEONATAL MORTALITY: COMPARISON OF NUMBERS FROM THE GLOBAL BURDEN OF DISEASE WITH THOSE FROM THE CHILD HEALTH EPIDEMIOLOGY REFERENCE GROUP

This chapter has examined the consequences of incorporating stillbirths and neonatal deaths (deaths in the 28 days following live birth) into the Global Burden of Disease (GBD) framework. Methods and results of the GBD are presented elsewhere in this book and, in particular, chapter 3 discusses the estimates of deaths by age and cause for 2001 that form the basis for results throughout this book and in this chapter. Estimates of deaths from specific causes undergo continual revision as new data and syntheses become available, yet establishing a time cutoff is a necessary (if somewhat arbitrary) condition for preparing a volume with consistent estimates across chapters. For this volume, the cutoff date for the estimates of deaths by cause in 2001 was late 2003. That date was itself established in response to the need for a separate book—Jamison and others (2006)—to have a consistent set of demographic and epidemiological numbers feeding into its highly diverse chapters.

During 2001, the World Health Organization (WHO) established the Child Health Epidemiology Reference Group (CHERG) to undertake a new synthesis of data on causes of death among children under five. While some early CHERG results influenced the GBD numbers in this volume, for the most part, CHERG's work became available well after the cutoff date for this iteration of the GBD. For this reason, the 2005 WHO estimates (Bryce and others 2005; WHO 2005b) of causes of death among children under five based on CHERG (CHERG/WHO) differ to some extent from the GBD ones used in this volume. Chapter 5 further discusses the two sets of estimates for under-five deaths, and the importance of envelope and epidemiological consistency constraints in generating the GBD numbers. In terms of data sources, the GBD uses epidemiological data together with vital registration data (where available), models extrapolating from vital registration data, and epidemiological consistency checks. CHERG relies relatively more on verbal autopsy based epidemiological data for causes of child death.

The work of CHERG, however, provides a critical input to this chapter not available from the GBD work, that is, a breakdown of the causes of death specifically for the neonatal period. One of the motivations of this chapter is that neonatal deaths account for fully 37 percent of the worldwide total of deaths among children under age five. In preparing this chapter, therefore, we needed to draw fully on

the CHERG analyses of neonatal deaths while—to ensure consistency and comparability with numbers elsewhere in this volume—we use the GBD estimates of total deaths among children under five. This allows estimates of the neonatal burden to be inserted into the larger context of the GBD with its inclusion of 136 causes as well as all age groups older than age five. The specific assumptions we made to reconcile GBD and CHERG numbers are made clear in the text with table 6.4 and in the notes to table 6.4.

The CHERG/WHO results appear as percentages of deaths by one set of causes for neonates and by a mostly different set of causes for children ages 28 days to 5 years. This makes direct comparison with the GBD numbers difficult in the formats in which the two sets of numbers are presented. The difficulty is compounded by occasional differences in the labels (and content) of cause categories and by the fact that the GBD deals with far more causes than CHERG/WHO. Even the truncated GBD cause list used in this chapter uses 35 instead of 136 causes, in contrast to the 10 used by CHERG/WHO. To facilitate comparison of the two sets of findings, annex table 6C.1 uses the 6 of the 10 CHERG/WHO cause categories that are relevant to neonates to compare this chapter's and CHERG's findings for neonatal deaths. To construct table 6C.1 we took proportional allocations of deaths from CHERG/WHO presented in figure 2 of Bryce and others (2005) and applied those proportions to the estimated number of neonatal deaths (3.896 million) used in this chapter. The table is for the world as a whole.

Table 6C.1 Causes of Neonatal Mortality, Worldwide in 2001 (*thousands*)

Cause	Neonatal deaths	
	GBD	CHERG/WHO
Diarrheal disease	116	117
Tetanus ^a	187	273
Respiratory infection ^b	1,013	1,013
Low birthweight ^c	1,098	1,091
Birth asphyxia and birth trauma ^d	739	896
Congenital anomalies	321	312
Other	446	194
TOTAL	3,896	3,896

Sources: See text.

a. CHERG/WHO conclude that 7 percent (273,000) of global neonatal deaths occur due to tetanus. Chapter 3 of this volume provides an estimate for tetanus deaths for ages zero to four of only 187,000. Consistent with the objectives of this chapter, the GBD numbers are used here, and the CHERG/WHO estimates accordingly revised downward.

b. Deaths for respiratory infections in the neonatal age group are those reported by CHERG/WHO for their category sepsis or pneumonia.

c. Low birthweight deaths are those resulting from intrauterine growth retardation or preterm birth. Almost all low birthweight deaths in the neonatal period result from preterm birth.

d. Chapter 3 provides an estimate for birth asphyxia and birth trauma deaths for ages zero to four of only 739,000 globally. Consistent with the objectives of this chapter, the GBD numbers are used here, and the CHERG/WHO estimates accordingly revised downward.

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NOTES

1. The term child mortality rate is sometimes used to denote what we call the under five mortality rate. We try to avoid confusion by being explicit about the age range covered.

2. Murray and Lopez (1998) and Shibuya and Murray (1998a, 1998b, 1998c) provide an earlier overall assessment of the burden from some of the major causes of neonatal mortality. Low birthweight as a risk factor is further discussed in Fishman and others (2004) and in chapter 4 of this volume.

3. Allowing the use of negative age weights could achieve some of the same effects as gradual ALP.

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