

## Chapter 2

# Global Burden of Disease Among Women, Children, and Adolescents

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**Learning Objectives** After reading this chapter and answering the discussion questions that follow, you should be able to

- Identify and discuss the conditions that contribute the most significantly to loss of health for children (ages 0–9 years), adolescents (ages 10–19 years), and women (ages 20 years and over) in different regions of the world.
- Appraise the burden of disease attributable to key risk factors for children, adolescents, and women in different regions of the world.
- Discuss the global distribution of mortality among children, women, and adolescents.
- Evaluate the importance of the global burden of disease studies and the implications for global health policy.

### Introduction

Using the latest available estimates of mortality and disease burden from World Health Organization's (WHO) Global Burden of Disease (GBD) study for the year 2002, this chapter presents an analysis of major diseases and injuries that contribute most significantly to loss of health for children (ages 0–9 years), adolescents (ages 10–19 years), and women (ages 20 and over) for different regions of the world. The chapter draws heavily on an extensive WHO study of risk factors to provide further information

on attributable disease burden for selected key risk factors for children, adolescents, and women in different geographic regions of the world. As the analyses reveal, much of the global mortality among children is concentrated in middle- and low-income countries, particularly in south Asia and sub-Saharan Africa. Infectious diseases are the principal causes of mortality among children under 5, with five largely preventable conditions (lower respiratory infections, diarrheal diseases, malaria, HIV/AIDS, and measles) accounting for 70% of all child deaths in sub-Saharan Africa. A third of the mortality among children under the age of 10 was attributable to underweight, with unsafe water, sanitation, and hygiene accounting for another 13%. For adolescents aged 10–19, mental disorders (particularly depression, schizophrenia, and bipolar disorders), injuries (especially road traffic accidents), violence, and suicide were the leading causes of burden of disease. Alcohol use disorders were the second leading cause of burden of disease in adolescents in high-income countries. Globally among women aged 20–59, HIV/AIDS was the leading cause of burden of disease; it is responsible for one-half of deaths and disability-adjusted life years (DALYs) in this age group in sub-Saharan Africa.

Detailed description of the level and distribution of diseases, injuries, and their causes are important inputs to public health policies and programs. When we are interested in assessing all important causes of loss of health, the statistics that must be compared rapidly become large, and we face difficulties in comparing indicators relating to different health states, mortality risks, or disease events. Such statistics also suffer from several other limitations that reduce their practical value for policy making.

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First, they are partial and fragmented. Basic information on causes of death are not available for all important causes in many countries, and mortality statistics fail to capture the impact of non-fatal conditions, such as mental disorders, musculoskeletal disorders, blindness, or deafness. Second, analyses of incidence, prevalence, or mortality for single causes often result in under- or over-estimates, when not constrained to fit within demographically plausible limits or to be internally consistent.

Diseases that cause a large number of deaths are clear public health priorities, but mortality statistics alone do not capture the burden of disease caused by chronic diseases, injuries, and mental health disorders. A substantial body of work in the last two decades has focused on the quantification of burden of disease using a summary measure that includes both disability (or loss of full health) and premature death and gives extra weight to diseases that primarily affect younger people, since mortality at younger ages results in a greater loss of years of life.

## Global Burden of Disease (GBD) Studies

The initial Global Burden of Disease (GBD) Study was commissioned by the World Bank to provide a comprehensive assessment of disease burden in 1990 from more than 100 diseases and injuries, and from 10 selected risk factors (Murray and Lopez 1996a, b). As well as generating a comprehensive and consistent set of estimates of mortality and morbidity by age, sex, and region for the world, the GBD study introduced a new metric – the disability-adjusted life year (DALY) – to simultaneously quantify the burden of disease from premature mortality and the non-fatal consequences of over 100 diseases and injuries.

The WHO has undertaken a new assessment of the global burden of disease for the years 1999–2002, with annual assessments published in Annex Tables to the World Health Reports from 1998 to 2004 (World Health Organization 2004). Additionally, a major and expanded research program, the Comparative Risk Assessment (CRA) project, was undertaken to quantify the global and regional attributable mortality and burden for 26 major risk factors (Ezzati et al. 2004). These assessments

were used as the framework for cost-effectiveness and priority setting analyses carried out for the Disease Control Priorities Project, a joint project of the World Bank, the World Health Organization, and the National Institutes of Health, funded by the Gates Foundation. The GBD results were documented in detail, with information on data sources and methods as well as uncertainty and sensitivity analyses, in a book published as part of the Disease Control Priorities Project (Lopez et al. 2006). The estimates for 2002 remain the latest available at the time of writing, although an incremental update which will include 2004 results will soon be available.

## The Disability-Adjusted Life Year (DALY)

The disability-adjusted life year (DALY) extends the concept of potential years of life lost due to premature death (PYLL) to include equivalent years of “healthy” life lost from living in states of poor health or disability. One lost DALY can be thought of as one lost year of “healthy” life (either through death or illness/disability), and total DALYs (the burden of disease) as a measurement of the gap between the current health of a population and an ideal situation where everyone in the population lives into old age in full health. DALYs for a specific disease or injury cause are calculated as the sum of the years of life lost due to premature mortality (YLL) from that cause and the years lost due to disability (YLD) for incident cases of the disease or injury. The YLL are calculated from the number of deaths,  $d_x$ , at each age  $x$  multiplied by a global standard life expectancy,  $L_x$ , which is a function of age  $x$ :

$$YLL_x = \sum_x d_x \times L_x$$

The loss function  $L_x$  was specified in terms of the life expectancies at various ages in standard life tables with life expectancy at birth fixed at 82.5 years for females and 80.0 years for males, rather than using an arbitrary age cutoff such as 70 years. The loss function was specified to be the same for all deaths of a given age and sex, in all regions of the

world (Murray and Lopez 1996b). Because YLL measure the incident stream of lost years of life due to deaths, an incidence perspective is taken for the calculation of YLD. The YLD for a particular cause in a particular time period are calculated by multiplying the number of incident cases  $i_x$ , at each age  $x$  in that period by the average duration of the disease for each age of incidence,  $l_x$ , and a weight factor  $dw_x$  that reflects the severity of the disease on a scale from 0 (full health) to 1 (dead):

$$YLD_x = \sum_x i_x \times l_x \times dw_x$$

YLD are calculated either for the average incident case of the disease or for one or more disabling sequelae of the disease. For example, YLD for diabetes are calculated by adding the YLD for uncomplicated cases and the YLD for sequelae such as diabetic neuropathy, retinopathy, and amputation. The “valuation” of time lived in non-fatal health states formalizes and quantifies social preferences for different states of health as *disability weights* ( $dw_x$ ). These weights can also be described as health state valuations or health state preferences. In the formulation of the DALY, the disability weight is conceived of as quantifying the relative loss of health for different conditions or states and does not carry any implication about quality of life or the overall value of a life lived in particular health or disability states.

The disability weights used in the GBD for 2002, and the methods used to obtain them, are described elsewhere (Mathers et al. 2006). Murray and Lopez chose to apply a 3% time discount rate to the years of life lost in the future to estimate the net present value of years of life lost in calculating DALYs. Based on a number of studies that suggest the existence of a broad social preference to value a year lived by a young adult more highly than a year lived by a young child or an older person, Murray incorporated non-uniform age weights. When discounting and age weighting are both applied, a death in infancy corresponds to 33 DALYs, while deaths at ages 5–20 equate to around 36 DALYs. Discounting and age weighting essentially modify the loss function,  $L_x$ , in the calculation of YLL and the average duration,  $l_x$ , in the calculation of YLD. A more complete account of

the DALY, calculation formulae, and the philosophy underlying parameter choices is given by Murray (1996).

## Data Sources and Methods

The GBD study developed methods and approaches to make estimates for causes of burden for which there was limited data and considerable uncertainty, to ensure that causes with limited information were not implicitly considered to have zero burden and hence ignored by health policy makers (Murray et al. 2003). The basic philosophy guiding the GBD approach is that there is likely to be useful information content in many sources of health data, provided they are carefully screened for plausibility and completeness and that internally consistent estimates of the global descriptive epidemiology of major conditions are possible with appropriate tools, investigator commitment, and expert opinion. Diseases and injuries are classified in the GBD using a tree structure based on the International Classification of Diseases. The highest level of aggregation consists of three broad cause groups: Group I (communicable, maternal, perinatal, and nutritional conditions), Group II (non-communicable diseases), and Group III (injuries). Group I causes are those conditions that typically decline at a faster pace than all-cause mortality during the epidemiological transition and occur largely in poor populations (see Table 2.1).

The GBD study produced comprehensive estimates for mortality and YLL by country, cause, and sex for 5-year age groups up to age 85 years and over. For incidence, prevalence, and YLD, estimates were made for 17 geographic regions and for 8 age groups: 0–4, 5–14, 15–29, 30–44, 45–59, 60–69, 70–79, and 80+. For the purposes of this chapter, the YLD estimates were imputed to the age groups 0–4, 5–9, 10–19, and 20–29 as follows: For cause–age–sex groups where the YLD/YLL ratio was less than 5, YLD were imputed to 5-year age groups using the YLL estimates for the 5-year age groups and the YLD/YLL ratio for the relevant broader age group. For other cause–age–sex groups where the DALY was dominated by non-fatal loss of health, the YLD rate per capita was assumed to be constant for the 5-year age groups within the

**Table 2.1** Estimated global deaths and burden of disease by cause for children, adolescents, and women, 2002. Within each major group, disease and injury causes resulting in greater than 1% of total deaths or DALYs for all ages combined are shown, ranked within each group by global DALYs

	Children aged 0–9		Adolescents aged 10–19		Women aged 20 and over		All ages, both sexes	
	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)
Total number (thousands)	11,401	501,067	1,380	116,331	21,035	413,737	57,243	1,490,168
Rate per 1,000 population	9.3	409.9	1.2	98.1	10.9	215.2	9.2	239.4
<b>Selected cause groups</b>								
<b>I. Communicable, maternal, perinatal, and nutritional conditions</b>								
<b>Group I total</b>	9,905	388,643	533	31,656	3,920	104,146	18,538	612,185
Perinatal conditions*	2,462	97,300	0	2	0	1	2,462	97,303
Lower respiratory infections	1,986	71,410	155	6,315	918	7,847	3,947	93,617
HIV/AIDS	434	15,244	54	2,171	1,127	33,036	2,919	85,581
Diarrheal diseases	1,686	59,378	4	1,137	87	1,781	1,869	64,368
Malaria	827	31,634	11	991	36	1,037	908	34,604
Tuberculosis	62	2,460	55	2,447	479	10,405	1,566	34,726
Maternal conditions	0	113	66	7,787	444	25,698	510	33,599
Measles	599	21,004	9	346	0	1	607	21,352
Protein-energy malnutrition	166	15,537	18	661	39	335	260	16,883
<b>II. Non-communicable diseases</b>								
<b>Group II total</b>	961	76,144	300	56,402	15,848	273,930	33,537	696,298
Unipolar depressive disorders	0	3,003	0	11,775	7	32,347	13	67,052
Ischemic heart disease	8	420	14	863	3,395	23,691	7,208	58,632
Cerebrovascular disease	17	582	14	502	2,946	23,298	5,509	49,169
Chronic obstructive pulmonary disease	4	154	1	149	1,333	12,268	2,748	27,721
Hearing loss, adult onset	–	–	–	447	–	12,465	–	25,948
Cataracts	–	152	–	721	–	13,751	–	25,152
Alcohol use disorders	0	126	0	3,424	13	2,493	91	20,258
Diabetes mellitus	4	199	5	423	542	8,244	988	16,161

– Number (thousands) –

Table 2.1 (continued)

All causes	Children aged 0–9		Adolescents aged 10–19		Women aged 20 and over		All ages, both sexes	
	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)
Schizophrenia	0	803	0	5,241	12	5,298	23	16,090
Asthma	6	4,049	12	4,108	110	3,086	240	15,285
Osteoarthritis	0	5	0	485	3	8,730	5	14,809
Congenital heart anomalies	230	14,401	11	408	11	256	262	15,309
Vision disorders, age related	–	54	–	296	–	7,686	–	14,102
Bipolar disorder	0	356	0	4,613	1	4,450	1	13,903
Cirrhosis of the liver	30	1,206	14	669	256	4,158	786	13,973
Lung cancer	1	34	1	35	353	3,226	1,243	11,228
Nephritis and nephrosis	22	997	15	745	315	3,133	677	8,393
Stomach cancer	0	14	2	57	326	3,016	850	8,094
Hypertensive heart disease	2	84	2	72	490	3,714	911	7,643
Liver cancer	2	83	4	139	188	1,981	618	7,135
Colon and rectum cancer	0	3	1	37	299	2,684	622	5,817
<b>III. Injuries</b>								
<b>Group III total</b>	535	34,507	547	33,890	1,268	33,267	5,168	181,685
Road traffic accidents	136	7,207	138	7,066	229	5,915	1,192	38,630
Violence	20	1,074	66	3,981	90	2,636	559	21,372
Self-inflicted injuries	2	149	83	3,700	286	6,373	873	20,765
Falls	30	4,342	19	3,376	137	2,834	392	16,158

\* Includes "causes arising in the perinatal period" as defined in the International Classification of Diseases and does not include all causes of deaths occurring in the perinatal period.

Source: World Health Organization (2004)

broader YLD age range. Results are presented using World Bank geographic regions to group low- and middle-income countries. High-income countries in all regions are separately grouped as a single “high-income” group. Definitions of these regions are given by Lopez et al. (2006).

## **Estimation of Mortality Levels and Causes of Death**

For the most recent GBD estimates at the WHO, life tables specifying mortality rates by age and sex for 192 WHO Member States were developed for 2002 from available death registration data (112 member states), sample registration systems (India, China), and data on child and adult mortality from censuses and surveys such as the Demography and Health Surveys (DHS) and UNICEF’s Multiple Indicator Cluster Surveys (MICS). Death registration data containing usable information on cause of death distributions were available for 107 countries, the majority of these in the high-income group, Latin America and the Caribbean, and Europe and central Asia. Population-based epidemiological studies, disease registers, and notification systems (in excess of 2,700 data sets) contributed to the estimation of mortality due to 21 specific communicable causes of death, including HIV/AIDS, malaria, tuberculosis, childhood immunizable diseases, schistosomiasis, trypanosomiasis, and Chagas disease. Almost one-third of these data sets related to sub-Saharan Africa. In order to address information gaps relating to other causes of death for populations without useable death registration data, models for estimating broad cause-of-death patterns based on GDP and overall mortality levels were used (Mathers et al. 2006).

## **Calculating Years Lived with Disability (YLD)**

Estimating YLD requires systematic assessments of the available evidence on incidence, prevalence, duration, and severity of a wide range of conditions, often based on inconsistent, fragmented, and partial

data available from different studies. Data sources included disease registers, epidemiological studies, health surveys, and health facility data (where relevant). Two key tools in dealing with limited or missing data were to carefully screen sources of health data for plausibility and completeness, drawing on expert opinion and on cross-population comparisons, and to explicitly ensure the internal consistency of estimates of incidence, prevalence, case fatality, and mortality for each specific disease cause. A software tool called DisMod was developed for the GBD study to help model the incidence and duration parameters needed for YLD calculations from available data, to incorporate expert knowledge, and to check the consistency of different epidemiological estimates and ensure that the estimates used were internally consistent (Barendregt et al. 2003).

Epidemiological estimates for incidence, prevalence, and YLD were first developed for 17 groupings of countries, and then imputed to country populations using available country-level information and methods to ensure consistency with the country-specific mortality estimates. The resulting country-level estimates were then used to prepare regional estimates for the World Bank country groups. Around 8,700 data sets were used to quantify the YLD estimates for GBD 2000–2002, of which more than 7,000 related to Group I causes. One-quarter of the data sets relate to populations in sub-Saharan Africa and around one-fifth to populations in high-income countries. Together with the more than 1,370 additional data sets used for the estimation of YLL, the 2000–2002 GBD Study incorporated information from over 10,000 data sets relating to population health and mortality. This almost certainly represents the largest synthesis of global information on population health ever carried out. Cause-specific data sources and methods are documented in more detail by Mathers et al. (2006).

## **Disease Burden from Risk Factors**

There are many published analyses of disease and mortality attributable to individual risk factors such as tobacco smoking or unsafe water and sanitation,

usually for specific populations. It is usually difficult to compare such estimates across risk factors due to different definitions and treatments of “hazardous exposure” and to differences in health outcome measures used. As part of the Global Burden of Disease project, a unified framework for Comparative Risk Assessment (CRA) was developed using a systematic and consistent approach to the assessment of the changes in population health (deaths or DALYs) which would result from modifying the population distribution of exposure to a risk factor or a group of risk factors (Ezzati et al. 2003). In the CRA framework, the burden of disease due to the observed exposure distribution in a population is compared with the burden from an alternative “theoretical minimum risk” distribution which is defined consistently for different risk factors.

The CRA project included 26 selected risk factors presented in Table 2.3. The criteria for selection of risk factors included that they were not too specific or broad, that the likelihood of causality was high based on scientific knowledge, that sufficient data on exposure levels and relative risks of health outcomes were available, and that they were potentially modifiable. For many of these risk factors, the counterfactual distribution is zero exposure (e.g., 100% of the population being never smokers). For some risk factors, where zero exposure is an inappropriate choice [e.g., body mass index (BMI), high blood pressure, or outdoor air pollution (where there is a physical lower limit to particulate matter concentration)], the lowest levels observed in specific low-risk populations and epidemiological studies were used to choose the theoretical minimum risk distribution. The counterfactual exposure distributions are specified elsewhere (Ezzati et al. 2002).

The proportional reduction in disease or death that would occur if exposure to a risk factor or group of risk factors were reduced to the counterfactual distribution is referred to as the population attributable fraction (PAF) and is given by the following relationship:

$$\text{PAF} = \frac{\int_{x=0}^m \text{RR}(x)P(x) dx - \int_{x=0}^m \text{RR}(x)P'(x) dx}{\int_{x=0}^m \text{RR}(x)P(x) dx}$$

$x$ : risk factor exposure level

$P(x)$ : population distribution of exposure

$P'(x)$ : counterfactual distribution of exposure

$\text{RR}(x)$ : relative risk of mortality from site-specific cancer at exposure level  $x$

$m$ : maximum exposure level

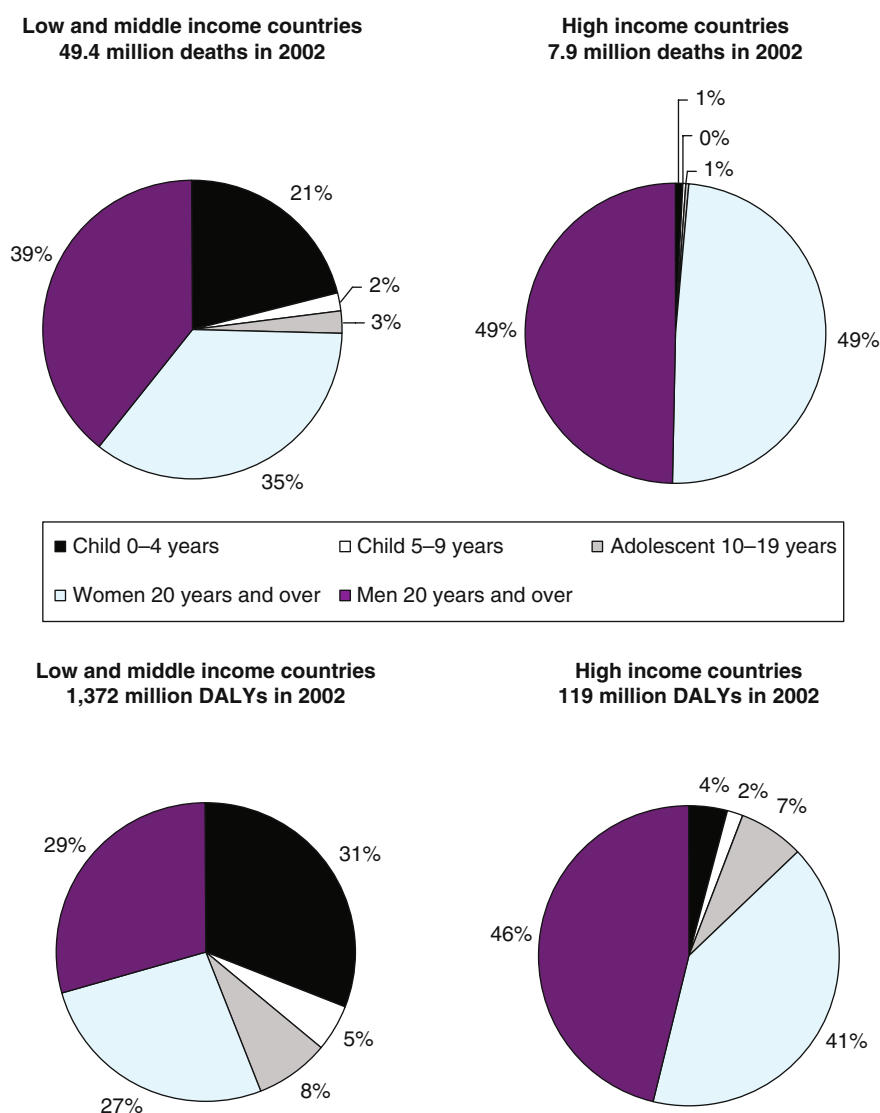
For risk factors with discrete exposure levels, a similar equation can be written with summation over the discrete levels, rather than integration. Because most diseases are caused by multiple risk factors acting together, and because some risk factors act through others, PAFs for multiple risk factors for the same disease can add to more than 100% (Murray and Lopez 1999). In other words, the joint attributable burden of several risk factors combined may be less than the sum of the individual attributable burdens. For this reason, attributable burden estimates for individual risk factors presented below should not be added across risk factors. For each risk factor, between 1999 and 2002, an expert group conducted a comprehensive review of published literature as well as sources such as government reports, international databases to obtain data on risk factor exposure and the magnitude of hazardous effects (relative risk, RR, or absolute hazard size when appropriate) (Ezzati et al. 2004). This chapter presents some summary results for the mortality and burden of disease in the year 2002 attributable to the 26 selected risk factors. This measures the reduction in the current (2002) disease or death if the current and *past* exposure to the risk factor had been equal to a counterfactual distribution. The results presented here are based on the analyses carried out for the year 2000 for the CRA project. Age–sex–cause-specific PAFs calculated for the year 2000 for 14 subregions of the 6 WHO regions were applied to country-specific estimates of mortality and burden of disease for the year 2002 for each country in each of the 14 subregions. The results were aggregated for high-, low-, and middle-income countries.

## Global Burden of Disease – An Overview

Just over 57 million people died in 2002, 10.4 million (or nearly 20%) of whom were children less than 5 years of age. Of these child deaths, 99%

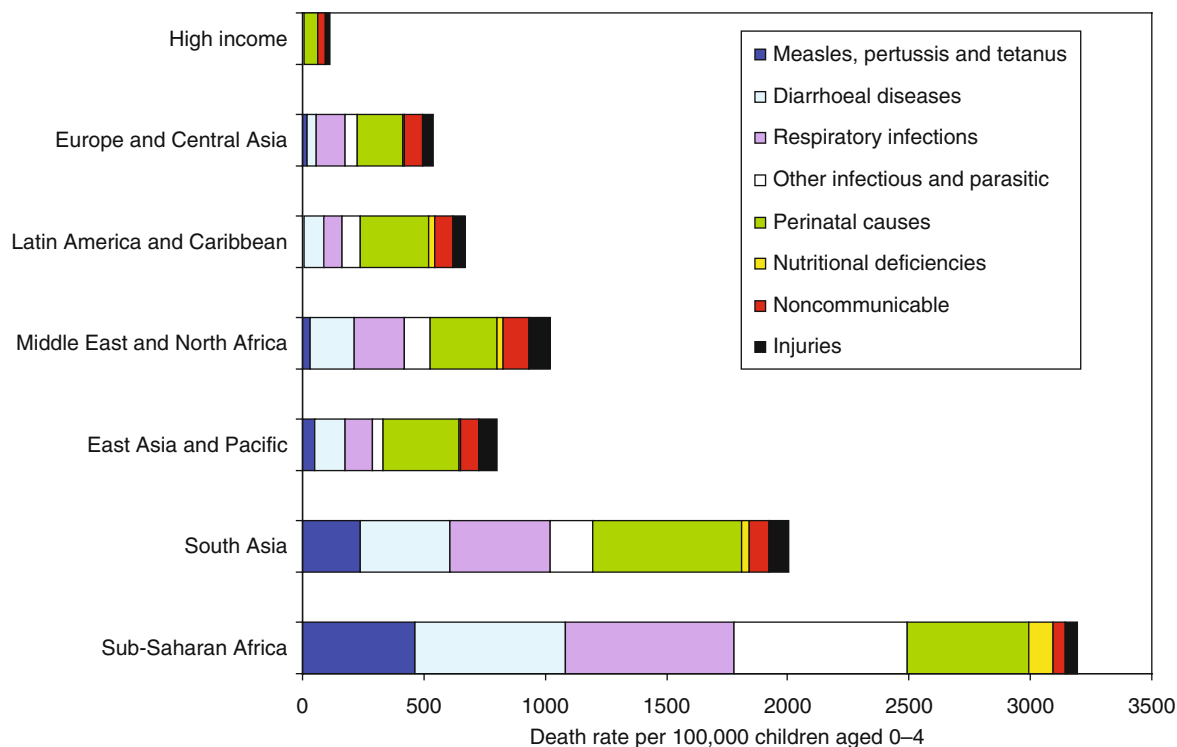
occurred in low- and middle-income countries. Child and adolescent deaths under age 20 comprise just 1.5% of deaths in high-income countries, but more than 25% in low- and middle-income countries (Fig. 2.1). About 70% of deaths in high-income countries occurred beyond 70 years of age, compared to 30% in other countries. A key point is the comparatively high number of deaths in low- and middle-income countries at young and middle adult ages. The causes of death at these ages, as well as in childhood, are thus important in assessing public health priorities. Measured in

DALYs, 21% of total disease and injury burden for the world in 2002 was in children aged less than 10 years, 7.5% in adolescents aged 10–19 years, and 34% in women aged 20 years and over. The global disease burden for children fell almost entirely in low- and middle-income countries (Fig. 2.2). Table 2.1 summarizes estimated numbers of deaths and DALYs in 2002 for diseases and injuries which caused more than 1% of global deaths or DALYs.



**Fig. 2.1** Age–sex distribution of total deaths in low- and middle-income countries and in high-income countries, 2002





**Fig. 2.2** Death rates by disease group and region for children aged 0–4 years, 2002. For all the World Bank geographical regions, high-income countries have been excluded and are

shown as a single group at the top of the graph. Source: World Health Organization (2004)

## The Burden of Disease in Children

Of the estimated 11.4 million deaths of children under age 10 in 2002, over 90% (or 10.4 million) were among children aged 0–4 years and 99% of these deaths occurred in low- and middle-income countries. The risk of a child dying before age 5 ranged from 17% in sub-Saharan Africa to 0.7% in high-income countries in 2002. Globally, conditions arising in the perinatal period such as prematurity, birth asphyxia, and severe neonatal infections were the leading cause of death under age 5, responsible for 2.5 million deaths (Table 2.1). Lower respiratory infections, principally pneumonia, diarrheal diseases, malaria, HIV/AIDS, and measles were the next leading causes. Collectively these five largely preventable causes were responsible for 70% of all child deaths.

Infectious and parasitic diseases remain the major killers of children in the developing world (Fig. 2.2 and Table 2.1). Although notable success has been

achieved in certain areas (e.g., polio), communicable diseases still represent 7 out of the top 10 causes and cause about 60% of all child deaths. Overall, the 10 leading causes represent 83% of all child deaths under age 5. In contrast, in high-income countries perinatal conditions and congenital anomalies are the leading causes of child death (Table 2.2).

About 90% of all HIV/AIDS and malaria deaths in children in developing countries occurred in sub-Saharan Africa, where 23% of the world's births and 43% of the world's child deaths are found. The immense surge of HIV/AIDS mortality in children in recent years means that HIV/AIDS is now responsible for around 300,000 child deaths annually in sub-Saharan Africa and nearly 7% of all child deaths in the region. Some progress has been observed against diarrheal diseases and measles. While incidence is thought to have remained stable, mortality from diarrheal diseases has fallen from 2.5 million deaths in 1990 to about 1.7 million deaths in 2002, accounting for 15% of all child deaths under age 10.

**Table 2.2** Leading causes of mortality by income group among children aged 0–4 years, 2002

Low- and middle-income countries				High-income countries			
	<i>Cause</i>	<i>Deaths (thousands)</i>	<i>Percent of total deaths</i>		<i>Cause</i>	<i>Deaths (thousands)</i>	<i>Percent of total deaths</i>
1	Perinatal conditions <sup>a</sup>	2,431	23.4	1	Perinatal conditions <sup>a</sup>	30.7	43.9
2	Lower respiratory infections	1,803	17.3	2	Congenital anomalies	16.9	24.2
3	Diarrheal diseases	1,681	16.2	3	Road traffic accidents	1.7	2.4
4	Malaria	822	7.9	4	Lower respiratory infections	1.5	2.2
5	Measles	537	5.2	5	Endocrine disorders	1.5	2.2
6	Congenital anomalies	408	3.9	6	Drownings	1.2	1.7
7	HIV/AIDS	340	3.3	7	Violence	1.0	1.5
8	Whooping cough	294	2.8	8	Meningitis	0.8	1.1
9	Tetanus	198	1.9	9	Leukemia	0.6	0.8
10	Protein-energy malnutrition	148	1.4	10	Inflammatory heart diseases	0.6	0.8

<sup>a</sup>Includes “causes arising in the perinatal period” as defined in the International Classification of Diseases and does not include all causes of deaths occurring in the perinatal period.

Source: World Health Organization (2004)

There has also been a significant decline in deaths from measles, although more than half a million children under 5 years were killed by measles in 2002. Malaria deaths are thought to have increased during the 1990s to around 820,000 deaths among children under 5 years of age in 2002, nearly 8% of all under-5 deaths.

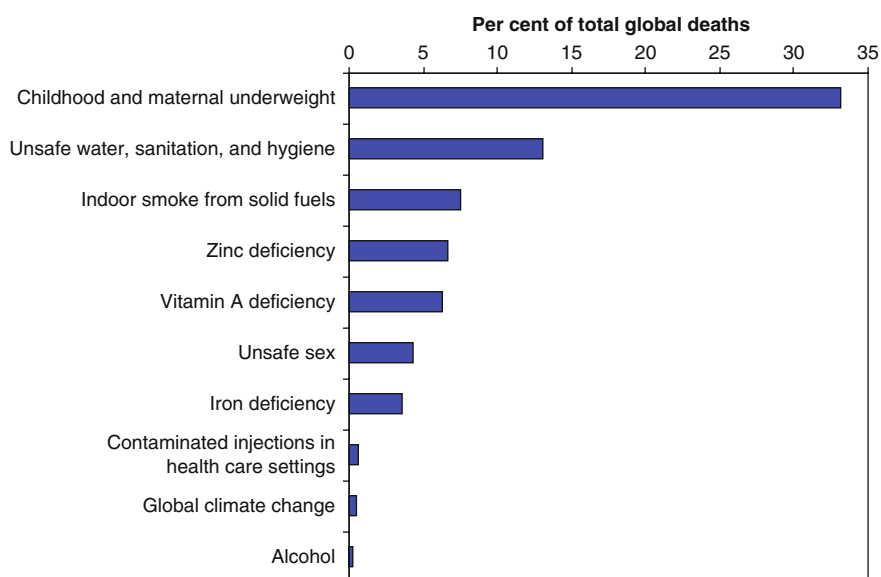
Many Latin American and some Asian and Middle-Eastern countries have partly shifted toward the cause-of-death pattern observed in high-income countries. Here, conditions arising in the perinatal period, including birth asphyxia, birth trauma, and low birth weight, have replaced infectious diseases as the leading causes of death and are now responsible for 21–36% of deaths. Such a shift in the cause-of-death pattern has not occurred in sub-Saharan Africa, where perinatal conditions rank in fourth place.

## The Burden of Diseases and Injuries in Children

The leading causes of burden of disease in children aged 0–9 years, as measured in DALYs, are almost the same as for mortality, except that protein-energy malnutrition ranks somewhat higher as the seventh

leading cause because of the considerable disability associated with lifelong stunting and, for many cases of severe stunting, associated cognitive impairment. Malnutrition (resulting in underweight) is also a risk factor for deaths from infectious causes as discussed in the following section. More than 85% of the burden of disease among children aged 0–9 is concentrated in children aged 0–4. Because DALYs are calculated using an incidence perspective, this means that 85% of lost years of healthy life are due to incident disease, injury, and mortality below age 5. However, there will be prevalent disability among children aged 5–9 years due to infectious diseases, nutritional deficiencies, congenital malformations, etc., present at birth or incident in the first 5 years. Almost 50% of the burden of disease in children aged 0–4 years is attributable to just seven infectious diseases: lower respiratory infections, diarrheal diseases, malaria, measles, whooping cough, HIV/AIDS, and tetanus. Injuries become relatively more important for children aged 5–9 years. Among the top 10 causes of DALYs for this age group are road traffic accidents, falls, and fires. Although injuries become more important for boys beyond infancy, the causes of burden of disease are broadly similar for boys and girls.

**Fig. 2.3** Mortality attributable to 10 leading global risk factors for children aged 0–9 years, as a percent of global deaths for children aged 0–9 years. The figure shows the estimated mortality and disease burden attributable to each risk factor considered individually. Source: World Health Organization (2004)



## Leading Risk Factors for Mortality and Burden of Disease in Children

One-third of child deaths under age 10 in 2002 were attributable to underweight (primarily due to protein-energy malnutrition). Micronutrient deficiencies were also among the leading risk factors for child mortality (e.g., vitamin A deficiency [6.3%], zinc deficiency [6.7%], and iron deficiency [3.6%]) (Fig. 2.3 and Table 2.3). Unsafe water, sanitation, and hygiene was the second leading risk factor responsible for child deaths through diarrheal diseases primarily [13.0%] followed by indoor smoke from household use of solid fuels [7.5%] and unsafe sex [4.3%]. The mortality and burden of disease attributable to all these risks was primarily concentrated in south Asia and sub-Saharan Africa.

## The Burden of Disease in Adolescents

While death rates and burden of disease rates are lower for adolescents than for children or adults aged 20 years and over, many of these deaths are preventable and strong regional differences remain (Fig. 2.4). The regional differentials are lower than for child deaths, and total death rates for

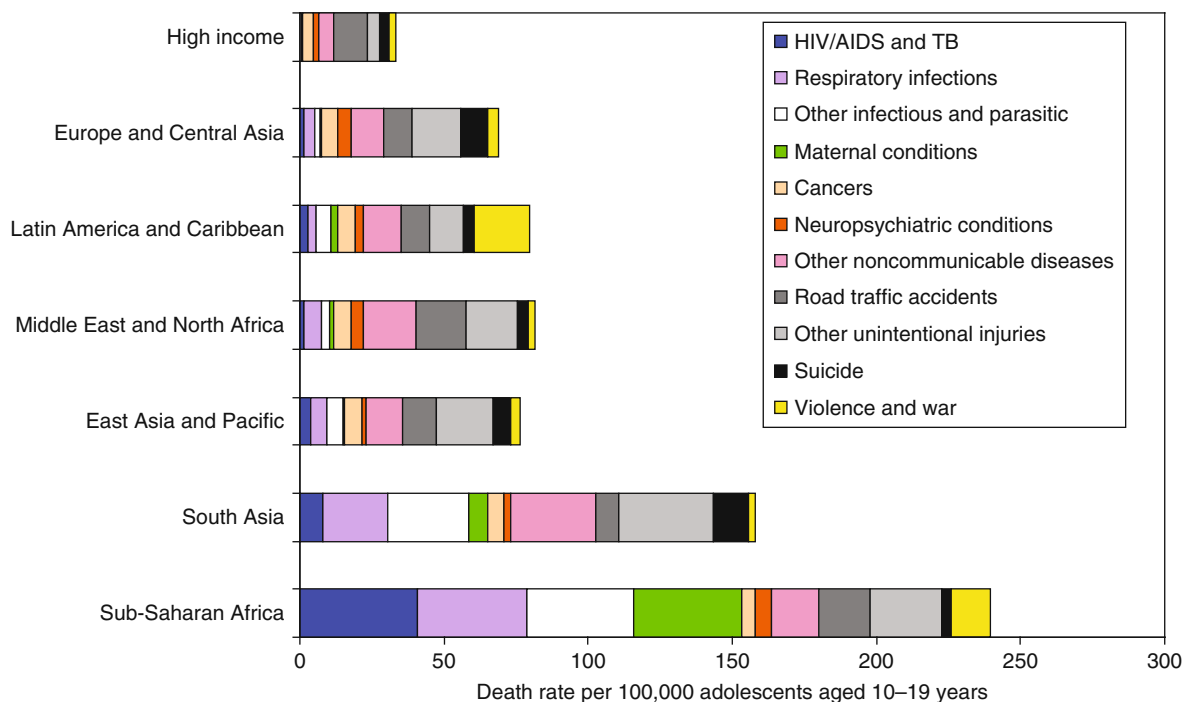
adolescents are very similar in all developing regions at just under 1 per 1,000 population except for south Asia, where the rate is twice as high, and sub-Saharan Africa, where it is almost three times as high. HIV/AIDS, tuberculosis, and maternal deaths explain much of the excess death rate in sub-Saharan Africa, along with higher rates from other infectious diseases and violence and war. For south Asia, the excess death rate is associated with high infectious disease death rates and with high injury death rates. Globally, lower respiratory infections and road traffic accidents were the leading causes of death in adolescents (Table 2.1). These were followed by suicide (6%), drownings (6%), and interpersonal violence (5%) (WHO 2004).

Road traffic accidents were the second leading cause of burden of disease in this age group, after unipolar major depression (Table 2.4). Injuries comprised four out of the ten leading causes of DALYs for adolescents as well. Several mental disorders also appear in the top 10 causes of burden including depression, schizophrenia, bipolar disorder, and alcohol use disorders (dependence and problem use of alcohol). Alcohol use disorders were the second leading cause of burden of disease in adolescents in high-income countries; in low- and middle-income countries they were only the 11th leading cause.

**Table 2.3** Attributable global deaths (000) and DALYs (000) by risk factor – for children, adolescents, and women, 2002. The combined effects of any group of risk factors in this table will often be less than the sum of their separate effects

All causes	Children aged 0–9		Adolescents aged 10–19		Women aged 20 and over		All ages, both sexes	
	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)	Deaths ('000)	DALYs ('000)
<b>Childhood and maternal under-nutrition</b>								
Childhood and maternal underweight	3,778	139,272	–	–	–	–	3,778	139,272
Iron deficiency	410	16,046	16	2,697	144	6,090	603	27,489
Vitamin A deficiency	718	25,018	15	551	90	2,599	823	28,177
Zinc deficiency	762	27,160	–	–	–	–	762	27,160
<b>Other diet-related risks and physical inactivity</b>								
High blood pressure	–	–	–	–	4,250	29,202	7,984	61,746
High cholesterol	–	–	–	–	2,077	16,200	4,018	36,495
Overweight and obesity	–	–	–	–	1,227	15,782	2,225	29,065
Low fruit and vegetable intake	–	–	5	241	1,165	10,434	2,526	24,855
Physical inactivity	–	–	3	188	980	8,942	1,981	19,560
<b>Sexual and reproductive health risks</b>								
Unsafe sex	492	18,217	55	4,014	1,380	39,367	3,162	95,005
Lack of contraception	–	–	13	1,551	149	7,501	162	9,052
<b>Addictive substances</b>								
Tobacco	–	–	–	–	1,029	11,545	5,039	61,284
Alcohol	25	1,338	85	7,600	379	8,410	2,199	61,557
Illicit drugs	0	87	6	1,740	50	2,410	247	12,336
<b>Environmental risks</b>								
Unsafe water, sanitation, and hygiene	1,483	52,213	4	992	76	1,547	1,643	56,554
Urban outdoor air pollution	22	735	–	–	359	2,339	769	6,079
Indoor smoke from solid fuels	851	29,948	–	–	549	4,522	1,592	36,430
Lead	2	9,793	2	85	80	1,058	246	13,172
Global climate change	62	2,494	1	105	3	111	70	2,808
<b>Occupational risks</b>								
Occupational airborne particulates	–	–	1	363	95	1,091	377	5,092
Occupational carcinogens	–	–	1	21	21	218	121	1,181
Occupational ergonomic stressors	–	–	0	96	0	312	1	854
Occupational noise	–	–	–	111	–	1,341	–	4,278
Occupational risk factors for injuries	–	–	27	1,518	17	636	315	10,767
<b>Other selected risks to health</b>								
Unsafe healthcare injections	66	2,356	12	506	153	2,789	543	10,908
Childhood sexual abuse	–	–	6	1,362	38	4,563	82	8,595

Source: World Health Organization (2004)

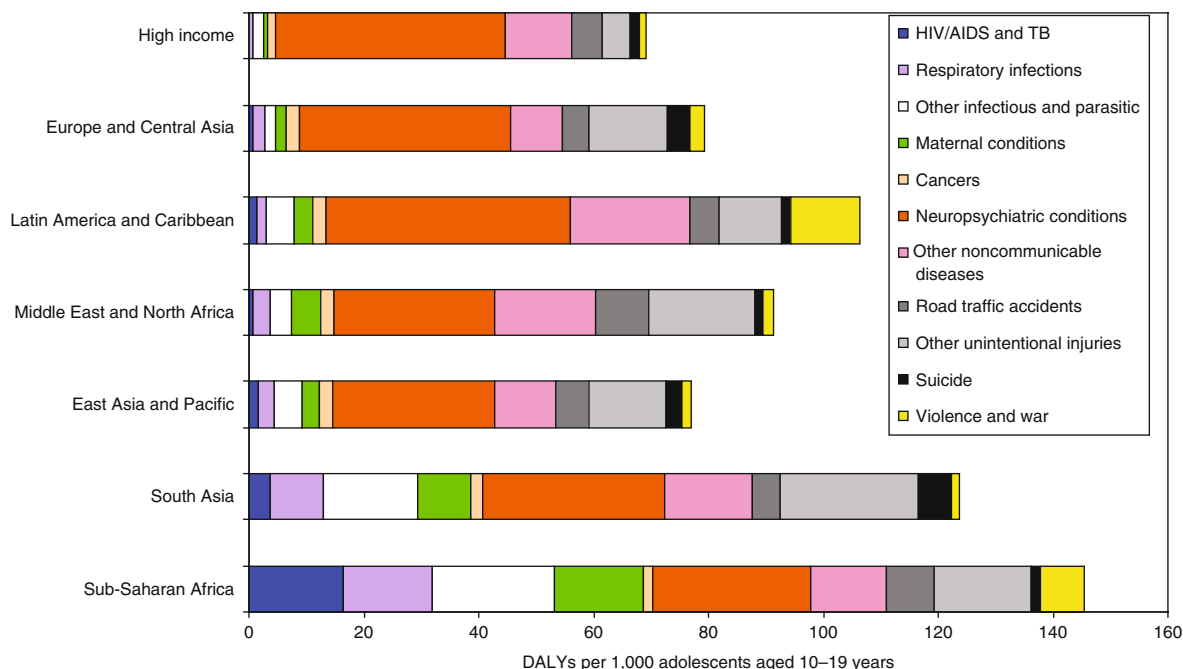


**Fig. 2.4** Death rates by disease group and region for adolescents aged 10–19 years, 2002. For all the World Bank geographical regions, high-income countries have been excluded and are shown as a single group at the top of the graph. Source: World Health Organization (2004)

**Table 2.4** Leading causes of disease burden by income group among adolescents aged 10–19 years, 2002

Low- and middle-income countries				High-income countries			
<i>Cause</i>	<i>DALYs (thousands)</i>	<i>Percent of total DALYs</i>		<i>Cause</i>	<i>DALYs (thousands)</i>	<i>Percent of total DALYs</i>	
1	Unipolar depressive disorders	10,316	9.6	1	Unipolar depressive disorders	1,458	17.4
2	Road traffic accidents	6,443	6.0	2	Alcohol use disorders	820	9.8
3	Lower respiratory infections	6,294	5.8	3	Road traffic accidents	623	7.4
4	Schizophrenia	4,766	4.4	4	Asthma	521	6.2
5	Bipolar disorder	4,193	3.9	5	Schizophrenia	474	5.7
6	Violence	3,856	3.6	6	Migraine	468	5.6
7	Asthma	3,587	3.3	7	Bipolar disorder	420	5.0
8	Self-inflicted injuries	3,489	3.2	8	Drug use disorders	295	3.5
9	Falls	3,226	3.0	9	Panic disorder	228	2.7
10	Drownings	2,977	2.8	10	Self-inflicted injuries	211	2.5

Source: World Health Organization (2004)



**Fig. 2.5** DALYs per 1,000 population, by region and cause group, adolescents aged 10–19 years, 2002. For all the World Bank geographical regions, high-income countries have been

excluded and are shown as a single group at the top of the graph. Source: World Health Organization (2004)

Interpersonal violence and war are disproportionately large contributors to adolescent burden of disease in Latin America and the Caribbean and in sub-Saharan Africa (Fig. 2.5). In sub-Saharan Africa, where there were significant conflict levels in a number of large countries, war and civil conflict were responsible for almost as much burden of disease as interpersonal violence. In Latin America, interpersonal violence is far more important, responsible for twice as many DALYs as road traffic accidents in the age group 10–19 years. Unintentional injuries other than road traffic accidents are also responsible for a much higher burden of disease in south Asia than in other regions.

### Leading Risk Factors for Mortality and Burden of Disease in Adolescents

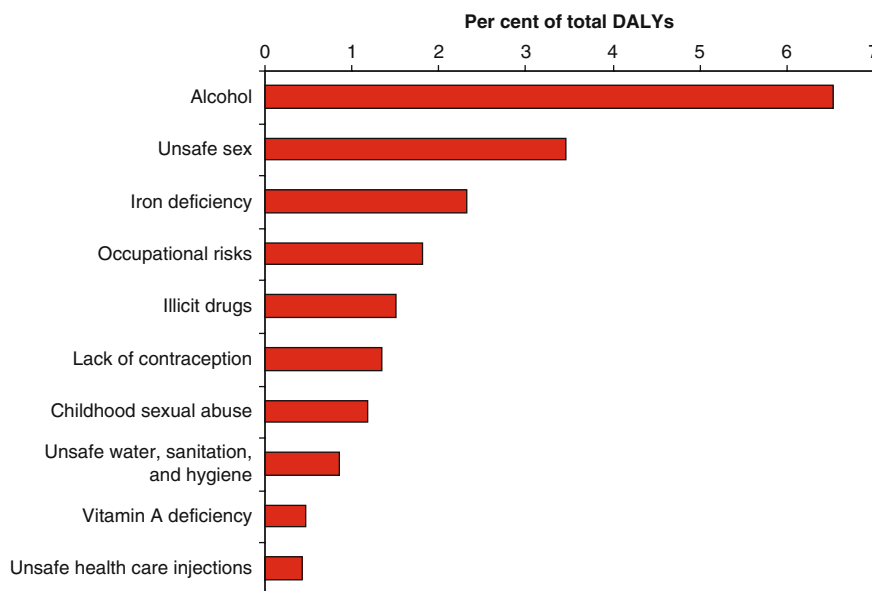
Among the selected 26 risk factors quantified in the CRA project, the leading attributable cause of mortality in adolescents was alcohol, responsible for around 6% of deaths in the age group 10–19 years.

This was followed by unsafe sex (4% of deaths) and selected occupational risks (totaling 2% of deaths). Alcohol was also the leading risk factor for burden of disease, responsible for an estimated 6.5% of DALYs in ages 10–19 (Fig. 2.6). These DALYs include the direct burden of alcohol dependence and problem use, as well as the attributable DALYs from causes such as road traffic accidents, which were estimated to already be responsible for increased burden of disease among this population group. Other important risk factors in this age range include unsafe sex, iron deficiency, occupational risks, illicit drugs, and lack of contraception.

### The Burden of Disease in Women

Table 2.5 shows the 20 leading causes of deaths and DALYs among women aged 20–59 years worldwide for 2002. Despite a global trend of declining communicable disease burden in adults, HIV/AIDS has become the leading cause of mortality and the single most important contributor to the burden of disease

**Fig. 2.6** DALYs attributable to 10 leading global risk factors for adolescents aged 10–19 years, as a percent of global DALYs for adolescents. The figure shows the estimated disease burden attributable to each risk factor considered individually. Source: World Health Organization (2004)



among women aged 20–59. Nearly 90% of the 1.1 million adult female deaths from HIV/AIDS globally in 2002 occurred in sub-Saharan Africa. In this region, HIV/AIDS accounted for almost half of deaths of adult women (aged 20–59). Owing to the impact of HIV/AIDS, there has been a reversal in mortality trends among women in this region and life expectancies for many countries have declined since 1990.

Injuries were also an important cause of death and burden of disease (Table 2.6). Road traffic accidents and self-inflicted injuries (suicide) were among the 10 leading causes of death, and fires and violence were also in the top 20 causes. Suicide was the fifth leading cause of death for women in this age group, after HIV/AIDS, ischemic heart disease, stroke, and tuberculosis. Other chronic diseases in the top 10 causes of death included breast cancer and chronic obstructive lung disease.

The overall death rate from all causes varied greatly across the regional groupings of low- and middle-income countries (Fig. 2.7) and between them and high-income countries. HIV/AIDS was largely responsible for the very high death rate in sub-Saharan Africa relative to other low-income countries, although other infectious diseases were

also a greater cause of death, as they were in south India. Maternal conditions, associated with pregnancy and childbirth, were also important in south Asia and Africa. Cardiovascular diseases were an important cause of death in all middle- and low-income regions of the world, but highest rates were in Europe and central Asia, reflecting the high rates of cardiovascular disease in former Soviet and Eastern European countries.

In developing countries, non-communicable diseases were responsible for more than 60% of deaths in women aged 20–59 in all regions except south Asia and sub-Saharan Africa, where Group I causes including HIV/AIDS remained responsible for two-fifths and three-quarters of deaths, respectively (Fig. 2.7). In other words, the epidemiologic transition is already well established in most developing countries. Maternal conditions were estimated to be responsible for 2.9% of deaths worldwide in females aged 20 and older in 2005 or 444,000 deaths. Among reproductive-age women aged 20–44, these conditions were responsible for 13.1% of deaths. The most common causes of maternal mortality include post-partum hemorrhage (25%), eclampsia (12%), unsafe abortions (13%), infections (15%), and obstructed labor (8%) (World Health Organization 2005).

**Table 2.5** Twenty leading causes of mortality and disease burden in the world among women aged 20–59 years, 2002

Mortality				Burden of disease			
<i>Cause</i>	<i>Deaths (thousands)</i>	<i>Percent of total deaths</i>		<i>Cause</i>	<i>DALYs (thousands)</i>	<i>Percent of total DALYs</i>	
1 HIV/AIDS	1,112	17.7	1	HIV/AIDS	32,871	10.8	
2 Ischemic heart disease	416	6.6	2	Unipolar depressive disorders	30,086	9.9	
3 Tuberculosis	325	5.2	3	Cataracts	9,295	3.1	
4 Cerebrovascular disease	321	5.1	4	Tuberculosis	9,163	3.0	
5 Self-inflicted injuries	214	3.4	5	Hearing loss, adult onset	9,028	3.0	
6 Breast cancer	205	3.3	6	Ischemic heart disease	8,508	2.8	
7 Lower respiratory infections	174	2.8	7	Cerebrovascular disease	7,812	2.6	
8 Road traffic accidents	163	2.6	8	Osteoarthritis	6,189	2.0	
9 COPD	145	2.3	9	Self-inflicted injuries	5,877	1.9	
10 Maternal hemorrhage	130	2.1	10	COPD	5,631	1.9	
11 Cirrhosis of the liver	112	1.8	11	Road traffic accidents	5,403	1.8	
12 Diabetes mellitus <sup>a</sup>	107	1.7	12	Schizophrenia	5,238	1.7	
13 Cervix uteri cancer	105	1.7	13	Maternal sepsis	5,120	1.7	
14 Fires	104	1.7	14	Vision disorders, age related	4,851	1.6	
15 Nephritis and nephrosis	90	1.4	15	Diabetes mellitus <sup>a</sup>	4,808	1.6	
16 Lung cancer	87	1.4	16	Bipolar disorder	4,444	1.5	
17 Stomach cancer	85	1.4	17	Lower respiratory infections	4,423	1.5	
18 Hypertensive heart disease	72	1.1	18	Breast cancer	4,278	1.4	
19 Violence	72	1.1	19	Maternal hemorrhage	3,907	1.3	
20 Rheumatic heart disease	71	1.1	20	Anemia	3,659	1.2	

<sup>a</sup>Does not include renal failure deaths attributable to diabetic nephropathy or cardiovascular disease deaths attributable to diabetes mellitus as a risk factor.

Source: World Health Organization (2004)

Diabetes caused around 550,000 deaths in women aged 20 years and over. Diabetes increases the risk of cardiovascular disease and the total attributable deaths are likely to be more than double the direct deaths. Together, cardiovascular disease and diabetes were responsible for more than two in five deaths among women aged 20 years and over. Just fewer than 1 million women aged 20–59 died of cancer in 2002. The most common cancers were breast cancer (22% of cancer deaths in women aged 20–59), cervical cancer (11%), lung cancers

(9%), and stomach cancers (9%), but there are significant regional variations in the prevalence of cancer by site.

## Disability and Burden of Disease

Among the 10 leading causes of burden of disease for adult women aged 20–59 are four non-fatal conditions: unipolar depressive disorders,

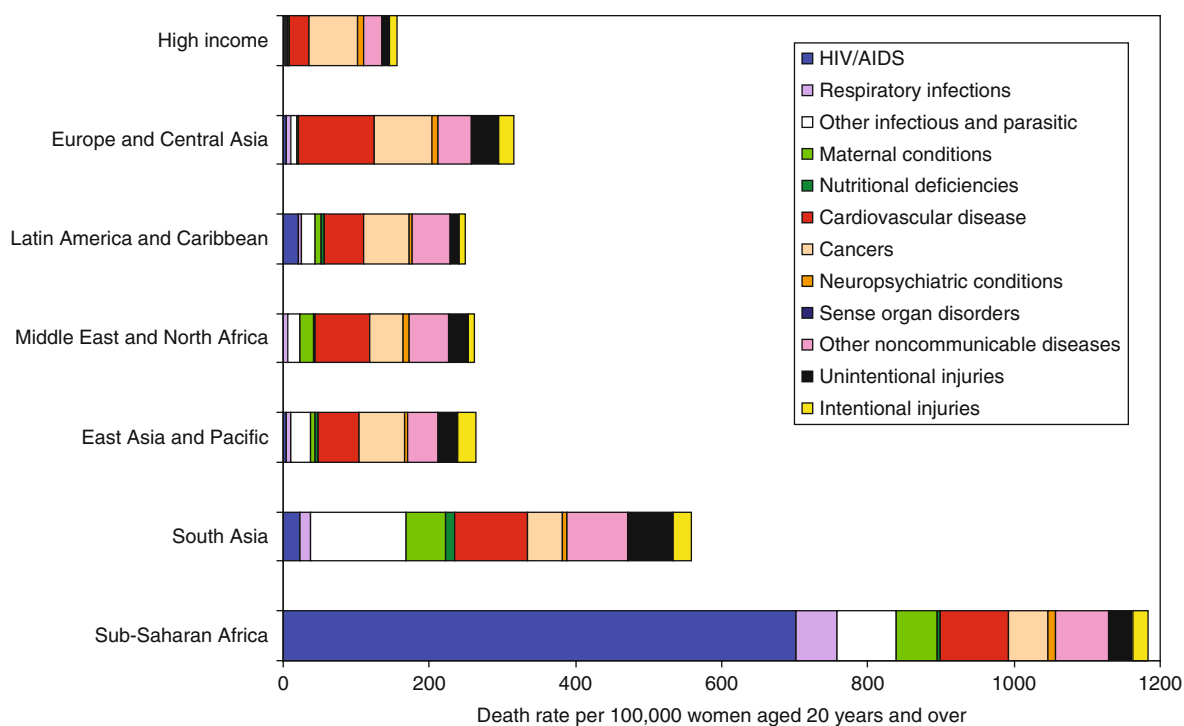


**Table 2.6** Leading causes of disease burden among women aged 60+ years in the world, 2002

Low- and middle-income countries				High-income countries		
<i>Cause</i>	<i>DALYs (thousands)</i>	<i>Percent of total DALYs</i>	<i>Cause</i>	<i>DALYs (thousands)</i>	<i>Percent of total DALYs</i>	
1 Ischemic heart disease	2,979	20.2	1 Cerebrovascular disease	15,486	14.0	
2 Cerebrovascular disease	2,625	17.8	2 Ischemic heart disease	15,183	13.7	
3 COPD	1,188	8.0	3 COPD	6,637	6.0	
4 Lower respiratory infections	744	5.0	4 Alzheimer and other dementias	5,468	4.9	
5 Diabetes mellitus <sup>a</sup>	436	3.0	5 Cataracts	4,456	4.0	
6 Hypertensive heart disease	418	2.8	6 Hearing loss, adult onset	3,437	3.1	
7 Breast cancer	270	1.8	7 Diabetes mellitus <sup>a</sup>	3,437	3.1	
8 Lung cancer	265	1.8	8 Lower respiratory infections	3,424	3.1	
9 Alzheimer and other dementias	244	1.7	9 Vision disorders, age related	2,835	2.6	
10 Stomach cancer	240	1.6	10 Osteoarthritis	2,541	2.3	

<sup>a</sup>Does not include renal failure deaths attributable to diabetic nephropathy or cardiovascular disease deaths attributable to diabetes mellitus as a risk factor.

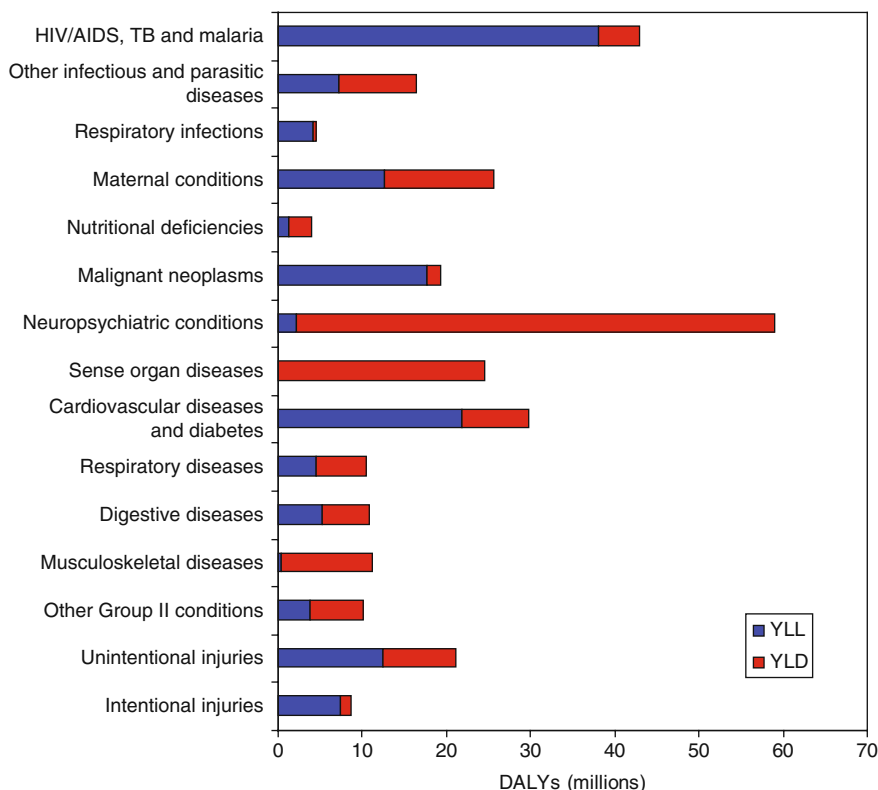
Source: World Health Organization (2004)



**Fig. 2.7** Death rates by disease group and region for women aged 20–59 years, 2002. For all the World Bank geographical regions, high-income countries have been excluded and are

shown as a single group at the top of the graph. Source: World Health Organization (2004)

**Fig. 2.8** Global YLD, YLL, and DALYs for major disease groups, women aged 20–59 years, 2002. DALYs are the sum of years of life lost due to premature mortality (YLL) and years lived with disability (YLD). Source: World Health Organization (2004)

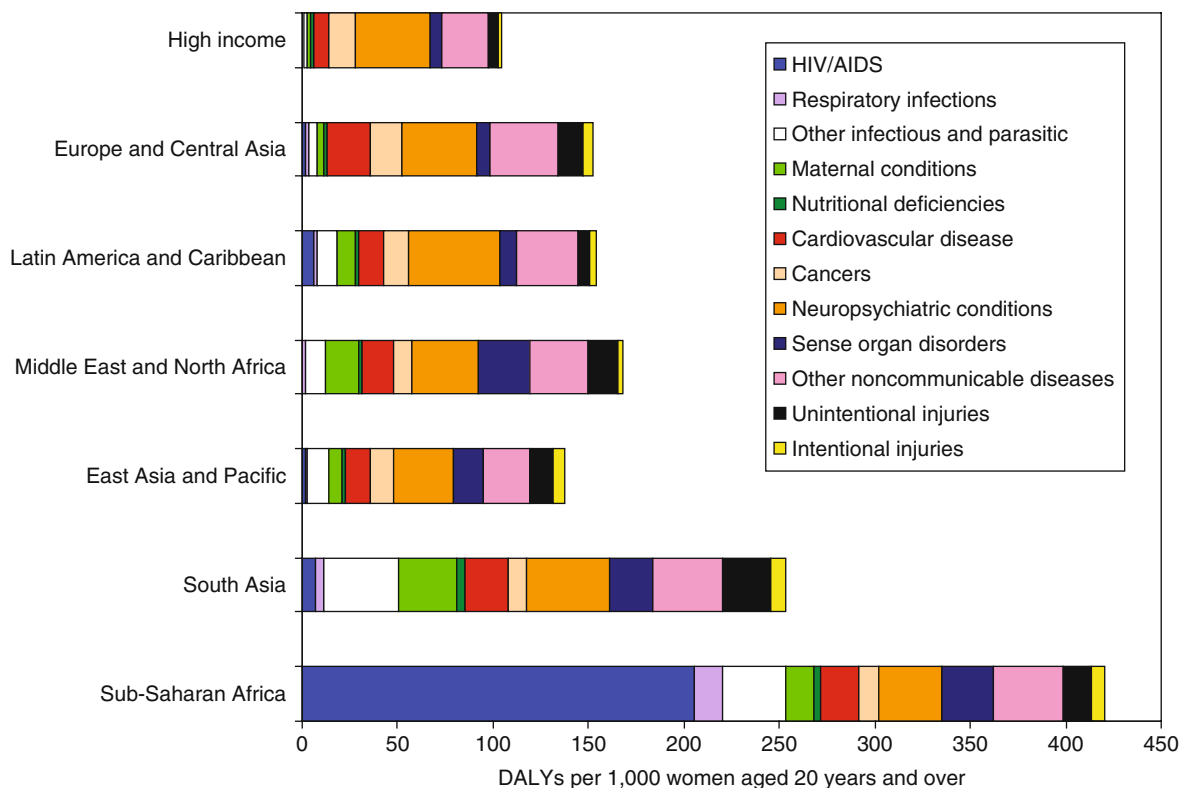


cataracts, adult-onset hearing loss, and osteoarthritis. Figure 2.8 summarizes the contributions of premature mortality (YLL) and disability (YLD) to the burden of disease for the various major cause groups. In all regions, neuropsychiatric conditions are the most important causes of disability, accounting for over 37% of YLDs among women aged 20–59 years. While depression is the leading cause of disability for both males and females, the burden of depression is 50% higher for females than males, and females also have higher burden from anxiety disorders, migraine, and senile dementias. In contrast, the male burden for alcohol and drug use disorders is nearly six times higher than that for females, and accounts for one-quarter of the male neuropsychiatric burden. Vision disorders, hearing loss, and musculoskeletal disorders are also important causes of YLD, particularly for women, in both developed and developing countries. The burden of non-communicable diseases accounted for just

over one-half of the global burden of disease for women aged 20–59 in 2002, and close to one-third of the non-communicable disease burden was due to neuropsychiatric conditions (Fig. 2.9).

### Mortality and Burden of Disease for Adult Women Aged 60 Years and Over

The risk of death rises rapidly with age among women aged 60 and over in all regions. Globally, 60-year-old women have an 18% chance of dying before their 70th birthday. Regional variations in risk of death at older ages are smaller than at younger ages, although death rates at older ages are significantly lower in high-income countries where a 60-year-old woman has on average, a 9% chance of dying before age 70. Historical data from countries such as Australia and Sweden show that life expectancy at age 60 changed slowly



**Fig. 2.9** DALYs per 1,000 population, by disease group and region for women aged 20–59 years, 2002. For all the World Bank geographical regions, high-income countries have been

excluded and are shown as a single group at the top of the graph. Source: World Health Organization 2004

during the first six to seven decades of the 20th century but since around 1970 has started to increase substantially. Life expectancy at age 60 has now reached 27 years in Japan. In Eastern Europe from 1990 onward, Poland and Hungary have started to experience similar improvements in mortality for older women, but Russia has not.

Female deaths at ages 60 years and over are predominantly due to chronic (non-communicable diseases) and globally the leading causes of death in 2002 were ischemic heart disease, cerebrovascular disease, and chronic respiratory disease. Together with diabetes mellitus, these causes were responsible for just under one-half of all female deaths at ages 60 and greater. Other leading causes of death included acute lower respiratory infections (pneumonia and influenza), breast cancer, lung cancer, stomach cancer, and senile dementia. Chronic obstructive pulmonary disease (COPD) was responsible for about 1.3 million female deaths in 2002.

The primary risk factor for COPD is tobacco use, and as more females smoke, the prevalence of COPD will increase.

While Alzheimer disease and other dementias were the leading cause of YLD for older females, sight and hearing loss disorders accounted for four of the ten leading causes of disability. Other important causes included cerebrovascular disease, diabetes, and chronic lung disease. YLD rates were higher in low- and middle-income countries than in high-income countries in 2002 although their variation across regions was much lower than for YLL rates. The prevalence of disabling conditions such as dementia and musculoskeletal disease was higher in high-income countries due to the higher proportions of older women in their populations and, for dementia, to higher age-specific prevalence rates than in low- and middle-income countries. This was offset by lower contributions to disability in high-income countries from conditions such as

cardiovascular and chronic respiratory diseases, and long-term sequelae of communicable diseases and nutritional deficiencies. In other words, women living in developing countries not only face shorter life expectancies than those in developed countries but also live a higher proportion of their lives in poor health.

In terms of overall DALYs for women aged 60 years and older, ischemic heart disease, cerebrovascular disease, and chronic obstructive pulmonary disease were the three leading causes (together responsible for one-third of all DALYs in this age group), followed by Alzheimer and other dementias, and cataracts. Vision disorders, including cataracts and age-related vision disorders, were responsible for 7% of the total DALYs, around double the burden of hearing loss.

### **Burden of Disease Attributable to Selected Risk Factors for Women Aged 20 Years and Over**

The leading global causes of mortality and disease burden for women aged 20 years and over included risk factors for communicable, maternal, perinatal, and nutritional conditions (e.g., unsafe sex; indoor smoke from household use of solid fuels; and iron deficiency), whose burden is primarily concentrated in the low-income and high-mortality regions of sub-Saharan Africa and east Asia, as well as risk factors for non-communicable diseases (e.g., high blood pressure and cholesterol, tobacco and alcohol use, and overweight and obesity) which affect most regions. High blood pressure was the single leading global cause of mortality for adult women, responsible for 20% of all deaths, although most of these are at older ages. In terms of DALYs, which measure lost years of full health, high blood pressure is second behind unsafe sex (Fig. 2.10a, b)

Leading causes of burden of disease in low- and middle-income countries were unsafe sex (10%), high blood pressure (7%), high serum cholesterol (3.8%), and high body mass index – or overweight and obesity (3.2%). The relative contribution of unsafe sex was disproportionately larger (40%) in sub-Saharan Africa where HIV/AIDS prevalence is

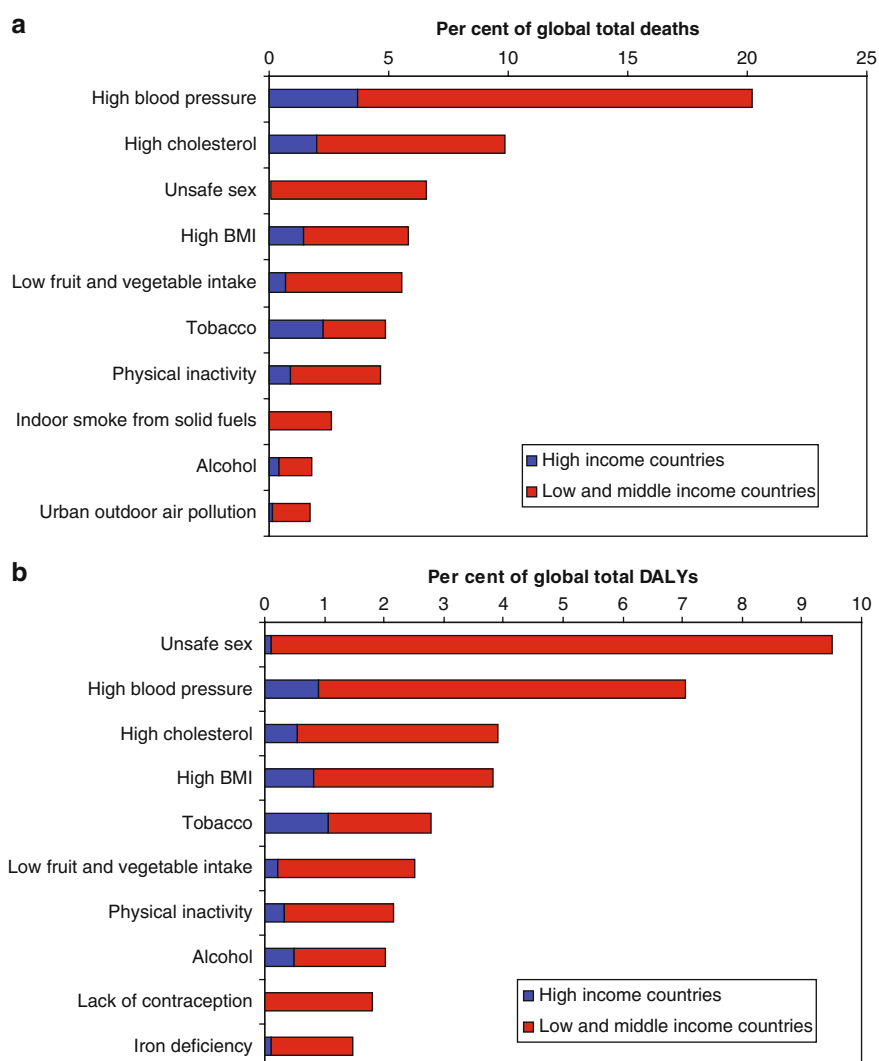
the highest, making it the leading cause of burden of disease in these countries. In high-income countries, smoking (9%), high blood pressure (8%), high BMI (7%), high cholesterol (4.6%), and alcohol use (4.2%) were consistently the leading causes of loss of healthy life, contributing mainly to non-communicable diseases and, to a lesser extent, injuries.

### **Discussion and Conclusions**

The analysis presented here has confirmed some of the conclusions of the original GBD study about the importance of including non-fatal outcomes in a comprehensive assessment of global population health and has confirmed the growing importance of non-communicable diseases for women in low- and middle-income countries, but has also documented some dramatic changes in women's health in some regions since 1990. Among the key findings are the following:

- The vast majority of child deaths are concentrated in middle- and low-income countries, particularly in south Asia and sub-Saharan Africa. Infectious diseases remain the principal killers of children under 5. Just five largely preventable conditions were responsible for 70% of all child deaths in 2002: lower respiratory infections, diarrheal diseases, malaria, HIV/AIDS, and measles.
- One-third of child deaths under age 10 in 2002 were attributable to underweight, and another 13% to unsafe water, sanitation, and hygiene.
- Mental disorders, particularly depression, schizophrenia, and bipolar disorders, and injuries, particularly road traffic accidents, violence, and suicide, were the leading causes of burden of disease in adolescents aged 10–19 in 2002. Alcohol use disorders were the second leading cause of burden of disease in adolescents in high-income countries.
- HIV/AIDS is now the leading cause of burden of disease among women aged 20–59 years globally, and responsible for one-half of deaths and DALYs in this group in sub-Saharan Africa.
- The epidemiological transition in low- and middle-income countries has resulted in a 20%

**Fig. 2.10a, b** Mortality attributable to 10 leading global risk factors for women aged 20 years and over, as a percent of global deaths for women aged 20 years and over. The figure shows the estimated mortality and disease burden attributable to each risk factor considered individually. Source: World Health Organization (2004)



reduction since 1990 in the per capita disease burden due to Group I causes (communicable, maternal, perinatal, and nutritional conditions). Without the HIV/AIDS epidemic, this reduction would have been substantially greater, at 30% over the last 11 years. Several of the “traditional” infectious diseases such as tuberculosis and malaria have not declined, in part because of weak public health services and the increased numbers of women with immune systems weakened by HIV/AIDS.

- The per capita disease burden in Europe and central Asian countries has increased since

1990, so that women in this region now have similar levels of health to other low- and middle-income countries of the world apart from those in south Asia and sub-Saharan Africa.

- Women aged 20–59 in low- and middle-income countries have substantially greater mortality risks and disease burden from non-communicable diseases than those in high-income countries.
- Injury deaths are noticeably higher for women in some parts of Asia and the Middle East and North Africa, in part due to high levels of suicide and violence. This higher burden of injury deaths

in combination with higher rates of infant and child mortality for girls result in the narrowest differential between male and female healthy life expectancy for any of the low- and middle-income regions.

- High blood pressure is the leading risk factor for attributable mortality for women aged 20 years and over, responsible for an estimated 20% of deaths in 2002. In terms of burden of disease, unsafe sex was the leading risk factor, responsible for 10% of DALYs.
- Sense organ disorders, principally hearing and sight loss, contribute significantly to disability among older women in all regions of the world. Levels of non-fatal health loss are proportionately greater in lower income countries than in high-income countries, contrary to the perception that disability is associated with older populations.

The GBD analyses have been criticised for making estimates of mortality and burden of disease for regions with limited, incomplete, and uncertain data (Cooper et al. 1998). Murray and colleagues have argued that health planning based on uncertain assessments of the available evidence, which attempt to synthesize it while ensuring consistency and adjustment for known biases, will almost always be more informed than planning based on ideology (Murray et al. 2003). The GBD analytic approach has been strongly influenced by demographic and economic traditions of making the best possible estimates of quantities of interest for populations from the available data, using a range

of techniques depending on the type and quality of evidence.

While methodological and data developments over the past decade have improved the empirical base for disease burden assessment, there are still very substantial data gaps and uncertainties, particularly for causes of death and levels of adult mortality in Africa and parts of Asia. Improving the population-level information on causes of death and on the incidence, prevalence, and health states associated with major disease and injury causes remains a major priority for national and international health and statistical agencies. At the time of writing, the Gates Foundation has decided to provide substantial funding for an international collaborative effort, led by Chris Murray and with the WHO collaboration, to carry out a complete revision and update of the Global Burden of Disease over the next 3 years, taking advantage of recent developments in data collection and analysis methods. Despite the uncertainties in the 2002 estimates, the results summarized here suggest that further gains in health for children, adolescents, and women in developing countries could be achieved. Intervention choices and priorities can be better guided by information about potential costs and gains, including a comprehensive understanding of disease burden. More rational application of the available information and knowledge in this area would accelerate progress toward millennium development goals and reduce the persistent differentials in health that show little tendency to narrow under current health policies.

## Key Terms

Age weighting	Global descriptive epidemiology	Observed exposure distribution
Alcohol	Hazardous exposure	Plausibility
Attributable mortality	High-income countries	Population attributable fraction (PAF)
Bipolar disorders	HIV/AIDS	Population distribution of exposure
Body mass index (BMI)	Hygiene	Potential years of life lost to premature death (PYLL)
Burden of disease	Incidence	Premature death
Causality	Individual attributable burden	Prevalence
Cause-of-death patterns	Infectious diseases	Quality of life
Central America	Injuries	Relative loss of health
Chronic diseases	Internally consistent estimates	Relative risk
Comparative Risk Assessment (CRA)	International Classification of Diseases (ICD)	Retinopathy
Counterfactual distribution	Latin America and the Caribbean	Risk factor exposure level
Death registration	Life expectancy	Risk factors
Demography and Health Surveys	Low-income countries	Sanitation
Depression	Lower respiratory tract infections	Schizophrenia
Diabetic neuropathy	Malaria	Sensitivity analysis
Diarrheal diseases	Maximum exposure level	Standard life table
Disability	Measles	Sub-Saharan Africa
Disability-adjusted life years (DALYs)	Mental disorders	Suicide
Disability weights	Middle-income countries	Theoretical minimum risk
Discounting	Multiple Indicator Cluster Survey	Theoretical minimum risk distribution
Discrete exposure levels	Musculoskeletal disorders	Underweight
Disease control priority	Non-fatal conditions	Unsafe water
Disease notification systems	Non-uniform age weights	Valuation
DisMod	North Africa and the Middle East	Violence
Epidemiological transition		Years of life lost to premature mortality (YLL)
Global Burden of Disease Study		

## Questions for Discussion

- Write short explanatory notes to summarize your understanding of the following terms:
  - Disability-adjusted life years
  - Epidemiological transition
  - Population attributable fraction (PAF)
  - Comparative Risk Assessment (CRA)
- In what ways can information on global burden of disease aid global health policy? What are the limitations of global burden of disease estimates?
- Identify the major causes of global burden of morbidity and mortality for the following age groups:
  - Children aged 0–9 years
  - Adolescents aged 10–19 years
  - Women aged 20 years and older

- 4 Discuss the major features of disease burden and risk factors in low-income countries compared to high-income countries.

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