



## Part 4

# Burden of disease: DALYs

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## 14. Broad cause composition

The measures of ill-health used so far (incidence, prevalence and YLL) do not give a good indication of the burden of disease borne by individuals in different communities. The summary measure used to give an indication of the burden of disease is the DALY (see Box 1, page 3). One DALY represents the loss of the equivalent of one year of full health. Using DALYs, the burden of diseases that cause early death but little disability (eg. drowning or measles) can be compared to that of diseases that do not cause death but do cause disability (e.g. cataract causing blindness).

### Globally, 60% of DALYs are due to premature mortality

As described in the Introduction, DALYs for 2004 combine the following:

- YLL for years of life lost due to deaths in 2004
- YLD for equivalent healthy years of life lost through living in states of less than full health for cases of disease and injury incident in 2004.

The global average burden of disease across all regions in 2004 was 237 DALYs per 1000 population, of which about 60% was due to premature death and 40% to non-fatal health outcomes.

### DALYs in Africa are at least two times higher than in any other region

The contribution of premature death varied dramatically across regions, with YLL rates seven times higher in Africa than in high-income countries (Figure 20). In contrast, the YLD rates were less varied, with Africa having 80% higher rates than high-income countries. South-East Asia and Africa together bore 54% of the total global burden of disease in 2004, although they account for only about 40% of the world's population. The Western Pacific

Region has the “healthiest” low- and middle-income countries, with countries such as China now having life expectancies similar to those of many Latin American countries, and higher than those in some European countries.

### The greatest variation between regions is for Group I conditions

The high levels of burden of disease for the WHO African, South-East Asia and Eastern Mediterranean regions compared to other regions are predominantly due to Group I conditions (communicable diseases, and maternal, perinatal and nutritional conditions), although injury DALY rates are also higher than in other regions (Figure 21). European low- and middle-income countries have a substantially higher noncommunicable disease burden than high-income countries (Figure 21). They also have a higher burden due to Group I causes and Group III causes (injuries). In fact, these countries have the highest proportion of burden due to injuries (16%) of all the regions, followed by the low- and middle-income countries of the Americas.

### Noncommunicable diseases now cause almost half of the burden of disease in low- and middle-income countries

Almost one half of the disease burden in low- and middle-income countries is now from noncommunicable diseases. Ischaemic heart disease and stroke are the largest sources of this burden, especially in the low- and middle-income countries of Europe, where cardiovascular diseases account for more than one quarter of the total disease burden. Injuries accounted for 17% of the disease burden in adults aged 15–59 years in 2004. In the low- and middle-income countries of the Americas, Europe and the Eastern Mediterranean Region, more than 30% of the entire disease and injury burden among men aged 15–44 years was from injuries.

Figure 20 : YLL, YLD and DALYs by region, 2004

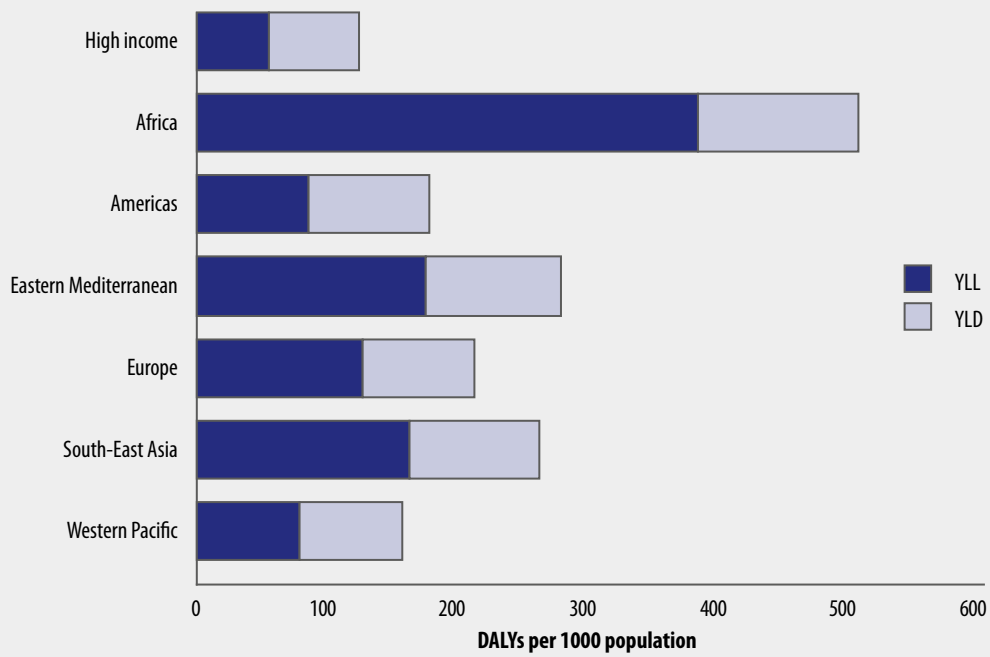
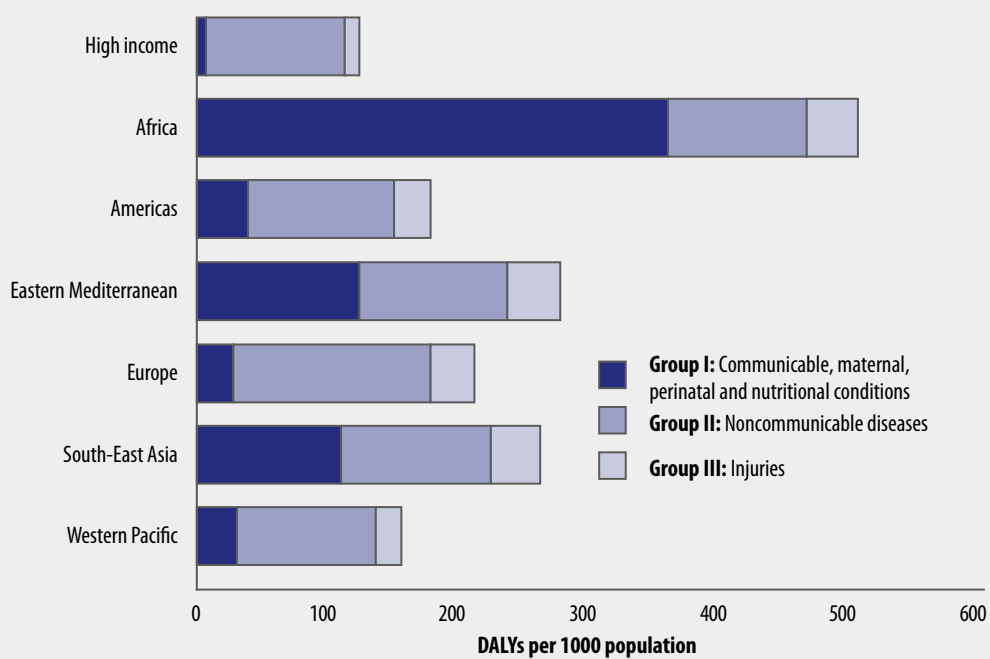


Figure 21: Burden of disease by broad cause group and region, 2004



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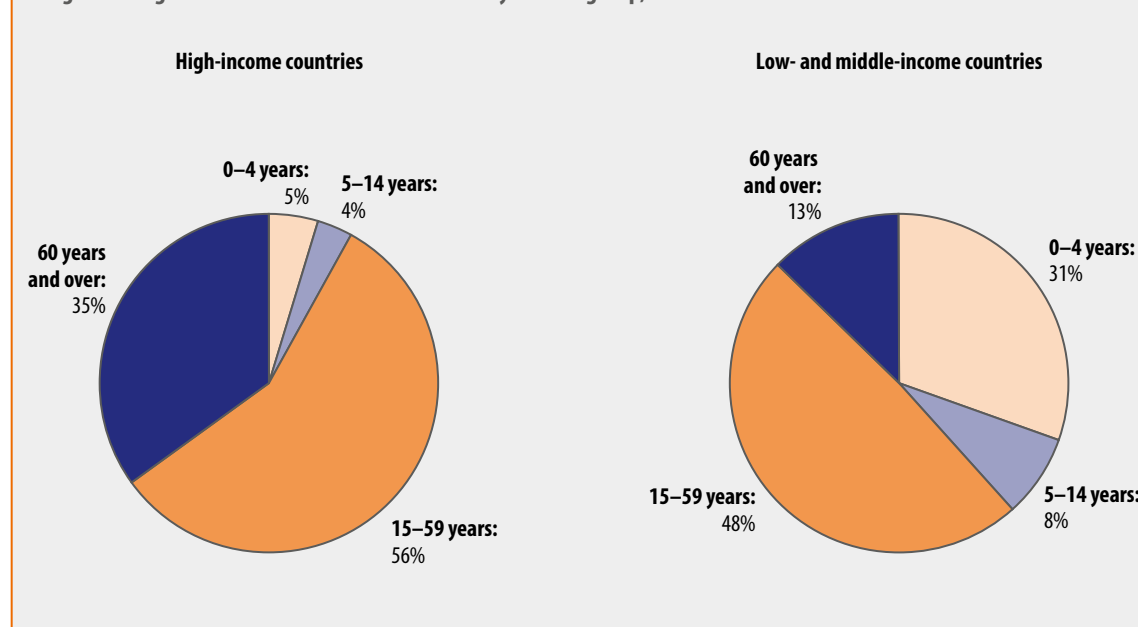
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Figure 22: Age distribution of burden of disease by income group, 2004



## 15. The age distribution of burden of disease

### Children bear more than half of the disease burden in low-income countries

Measured in DALYs, 36% of the total disease and injury burden for the world in 2004 involved children aged less than 15 years, and almost 50% involved adults aged 15–59 years. The disease burden for children falls almost entirely in low- and middle-income countries (Figure 22). While the proportion of the total burden of disease borne by adults aged 15–59 years is similar in both groups of countries, the remaining burden is predominantly among those aged 60 years and older in high-income countries.

DALYs are attributed to the age at which the disease, injury or death occurred. Some of the YLD associated with DALYs for children will be lived at older ages.

## 16. Leading causes of burden of disease

### Four non-fatal conditions are in the 20 leading causes of burden of disease

While the two leading causes of death – ischaemic heart disease and cerebrovascular disease – remain among the top six causes of burden of disease (Table 12), four primarily non-fatal conditions are also among the 20 leading causes of burden of disease; these are unipolar depressive disorders, adult-onset hearing loss, refractive errors and alcohol use disorders. This again illustrates the importance of taking non-fatal conditions into account, as well as deaths, when assessing the causes of loss of health in populations.

### Income levels are associated with major differences in burden of disease

The two leading causes of burden of disease in the world are infectious diseases – lower respiratory infections and diarrhoeal diseases. HIV/AIDS is

**Table 12: Leading causes of burden of disease (DALYs), all ages, 2004**

	Disease or injury	DALYs (millions)	Per cent of total DALYs
1	Lower respiratory infections	94.5	6.2
2	Diarrhoeal diseases	72.8	4.8
3	Unipolar depressive disorders	65.5	4.3
4	Ischaemic heart disease	62.6	4.1
5	HIV/AIDS	58.5	3.8
6	Cerebrovascular disease	46.6	3.1
7	Prematurity and low birth weight	44.3	2.9
8	Birth asphyxia and birth trauma	41.7	2.7
9	Road traffic accidents	41.2	2.7
10	Neonatal infections and other <sup>a</sup>	40.4	2.7
11	Tuberculosis	34.2	2.2
12	Malaria	34.0	2.2
13	COPD	30.2	2.0
14	Refractive errors	27.7	1.8
15	Hearing loss, adult onset	27.4	1.8
16	Congenital anomalies	25.3	1.7
17	Alcohol use disorders	23.7	1.6
18	Violence	21.7	1.4
19	Diabetes mellitus	19.7	1.3
20	Self-inflicted injuries	19.6	1.3

COPD, chronic obstructive pulmonary disease.

<sup>a</sup> This category also includes other non-infectious causes arising in the perinatal period apart from prematurity, low birth weight, birth trauma and asphyxia. These non-infectious causes are responsible for about 20% of DALYs shown in this category.

now the fifth cause of burden of disease globally, and three other infectious diseases also appear in the top 15 causes (Table 12).

The leading causes of burden of disease in low-income countries were broadly similar to those for the world in 2004, apart from malaria and TB (Table 13). Of the top 10 causes, 8 were Group I, but the leading causes in high-income countries were all noncommunicable diseases, with the exception of road traffic accidents (tenth leading cause). The leading causes in high-income countries included

three diseases (unipolar major depression, adult-onset hearing loss and alcohol use disorders) for which direct mortality is low.

Unipolar depression makes a large contribution to the burden of disease, being at third place worldwide and eighth place in low-income countries, but at first place in middle- and high-income countries. Effective treatments for depression are available, suggesting that this burden could be reduced.

Cigarette smoking is a major and entirely preventable cause of burden of disease in middle- and high-income countries. Chronic obstructive pulmonary disease is in fifth place in middle-income countries and seventh place in high-income countries, and lung cancer is in ninth place in high-income countries. Cigarette smoking also contributes to the burden of disease from ischaemic heart disease and cerebrovascular disease, and affects communities in low-income countries as well. Alcohol use disorders are another important preventable contributor to burden of disease in middle- and high-income countries.

### Considerable variation between regions in the burden of disease

The WHO regions fall into two groups – those in which the burden of disease is dominated by infectious disease, and those in which the burden of disease is dominated by vascular disease and depression (Table 14).

In Africa, HIV/AIDS, lower respiratory infections and diarrhoeal disease are the leading causes of burden of disease, whereas in the Eastern Mediterranean and in South-East Asia, lower respiratory infections and diarrhoeal disease are the two leading causes. In all three of these regions, problems during pregnancy and childbirth are important and preventable causes of burden of disease. The role of road traffic accidents in these regions, and of war and conflict in the Eastern Mediterranean, should also be noted.

Unipolar depression is one of the three leading causes of burden of disease in the WHO regions of the Americas, Europe and the Western Pacific. Ischaemic heart disease or cerebrovascular disease are also consistently leading causes of death in these

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regions. The role of violence in the Americas as the second leading cause of burden of disease, and the role of chronic obstructive pulmonary disease in the Western Pacific as the third leading cause, are also notable. Alcohol use and road traffic accidents, consistently causing about 6% of DALYs, are also important in these regions.

The leading 10 causes of the burden of disease in 2004 included 4 communicable diseases. HIV/AIDS was the fifth leading cause of the burden of disease globally in 2004 and the leading cause in the WHO

African Region, where it was followed by lower respiratory infections, diarrhoeal diseases and malaria. The WHO regions of South-East Asia, the Eastern Mediterranean and Africa are affected by a dual burden of disease (Table 14). These WHO regions are much more heavily burdened by infectious disease and conditions related to pregnancy and childbirth than other regions, but they also suffer severely from the problems that affect people in high-income countries – cardiovascular disease, depression and injury.

**Table 13: Leading causes of burden of disease (DALYs), countries grouped by income, 2004**

Disease or injury		DALYs (millions)	Per cent of total DALYs	Disease or injury		DALYs (millions)	Per cent of total DALYs
<b>World</b>				<b>Low-income countries<sup>a</sup></b>			
1	Lower respiratory infections	94.5	6.2	1	Lower respiratory infections	76.9	9.3
2	Diarrhoeal diseases	72.8	4.8	2	Diarrhoeal diseases	59.2	7.2
3	Unipolar depressive disorders	65.5	4.3	3	HIV/AIDS	42.9	5.2
4	Ischaemic heart disease	62.6	4.1	4	Malaria	32.8	4.0
5	HIV/AIDS	58.5	3.8	5	Prematurity and low birth weight	32.1	3.9
6	Cerebrovascular disease	46.6	3.1	6	Neonatal infections and other <sup>b</sup>	31.4	3.8
7	Prematurity and low birth weight	44.3	2.9	7	Birth asphyxia and birth trauma	29.8	3.6
8	Birth asphyxia and birth trauma	41.7	2.7	8	Unipolar depressive disorders	26.5	3.2
9	Road traffic accidents	41.2	2.7	9	Ischaemic heart disease	26.0	3.1
10	Neonatal infections and other <sup>b</sup>	40.4	2.7	10	Tuberculosis	22.4	2.7
<b>Middle-income countries</b>				<b>High-income countries</b>			
1	Unipolar depressive disorders	29.0	5.1	1	Unipolar depressive disorders	10.0	8.2
2	Ischaemic heart disease	28.9	5.0	2	Ischaemic heart disease	7.7	6.3
3	Cerebrovascular disease	27.5	4.8	3	Cerebrovascular disease	4.8	3.9
4	Road traffic accidents	21.4	3.7	4	Alzheimer and other dementias	4.4	3.6
5	Lower respiratory infections	16.3	2.8	5	Alcohol use disorders	4.2	3.4
6	COPD	16.1	2.8	6	Hearing loss, adult onset	4.2	3.4
7	HIV/AIDS	15.0	2.6	7	COPD	3.7	3.0
8	Alcohol use disorders	14.9	2.6	8	Diabetes mellitus	3.6	3.0
9	Refractive errors	13.7	2.4	9	Trachea, bronchus, lung cancers	3.6	3.0
10	Diarrhoeal diseases	13.1	2.3	10	Road traffic accidents	3.1	2.6

COPD, chronic obstructive pulmonary disease.

<sup>a</sup> Countries grouped by gross national income per capita (see Annex C, Table C2).

<sup>b</sup> This category also includes other non-infectious causes arising in the perinatal period apart from prematurity, low birth weight, birth trauma and asphyxia. These non-infectious causes are responsible for about 20% of DALYs shown in this category.

Table 14: Leading causes of burden of disease (DALYs) by WHO region, 2004

Disease or injury		DALYs (millions)	Per cent of total DALYs	Disease or injury		DALYs (millions)	Per cent of total DALYs
<b>African Region</b>				<b>Region of the Americas</b>			
1	HIV/AIDS	46.7	12.4	1	Unipolar depressive disorders	10.8	7.5
2	Lower respiratory infections	42.2	11.2	2	Violence	6.6	4.6
3	Diarrhoeal diseases	32.2	8.6	3	Ischaemic heart disease	6.5	4.6
4	Malaria	30.9	8.2	4	Alcohol use disorders	4.8	3.4
5	Neonatal infections and other <sup>a</sup>	13.4	3.6	5	Road traffic accidents	4.6	3.2
6	Birth asphyxia and birth trauma	13.4	3.6	6	Diabetes mellitus	4.1	2.9
7	Prematurity and low birth weight	11.3	3.0	7	Cerebrovascular disease	4.0	2.8
8	Tuberculosis	10.8	2.9	8	Lower respiratory infections	3.6	2.5
9	Road traffic accidents	7.2	1.9	9	COPD	3.1	2.2
10	Protein-energy malnutrition	7.1	1.9	10	Congenital anomalies	2.9	2.1
<b>Eastern Mediterranean Region</b>				<b>European Region</b>			
1	Lower respiratory infections	12.1	8.5	1	Ischaemic heart disease	16.8	11.1
2	Diarrhoeal diseases	8.3	5.9	2	Cerebrovascular disease	9.5	6.3
3	Ischaemic heart disease	6.2	4.3	3	Unipolar depressive disorders	8.4	5.6
4	Neonatal infections and other <sup>a</sup>	6.1	4.3	4	Alcohol use disorders	5.0	3.3
5	Birth asphyxia and birth trauma	5.5	3.9	5	Hearing loss, adult onset	3.9	2.6
6	Prematurity and low birth weight	5.3	3.8	6	Road traffic accidents	3.7	2.4
7	Unipolar depressive disorders	5.2	3.7	7	Trachea, bronchus, lung cancers	3.3	2.2
8	Road traffic accidents	5.1	3.6	8	Osteoarthritis	3.1	2.1
9	War and conflict	3.8	2.7	9	Cirrhosis of the liver	3.1	2.0
10	Congenital anomalies	3.7	2.6	10	Self-inflicted injuries	3.1	2.0
<b>South-East Asia Region</b>				<b>Western Pacific Region</b>			
1	Lower respiratory infections	28.3	6.4	1	Cerebrovascular disease	15.8	6.0
2	Diarrhoeal diseases	23.0	5.2	2	Unipolar depressive disorders	15.2	5.7
3	Ischaemic heart disease	21.6	4.9	3	COPD	11.9	4.5
4	Unipolar depressive disorders	21.1	4.8	4	Refractive errors	10.6	4.0
5	Prematurity and low birth weight	18.3	4.1	5	Road traffic accidents	9.6	3.6
6	Neonatal infections and other <sup>a</sup>	14.3	3.2	6	Alcohol use disorders	8.6	3.2
7	Birth asphyxia and birth trauma	13.9	3.1	7	Ischaemic heart disease	7.9	3.0
8	Tuberculosis	12.4	2.8	8	Hearing loss, adult onset	7.0	2.6
9	Road traffic accidents	11.0	2.5	9	Birth asphyxia and birth trauma	5.7	2.1
10	Cerebrovascular disease	9.6	2.2	10	Tuberculosis	5.6	2.1

COPD, chronic obstructive pulmonary disease.

<sup>a</sup> This category also includes other non-infectious causes arising in the perinatal period apart from prematurity, low birth weight, birth trauma and asphyxia. These non-infectious causes are responsible for about 20% of DALYs shown in this category.

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References

## 17. The disease and injury burden for women

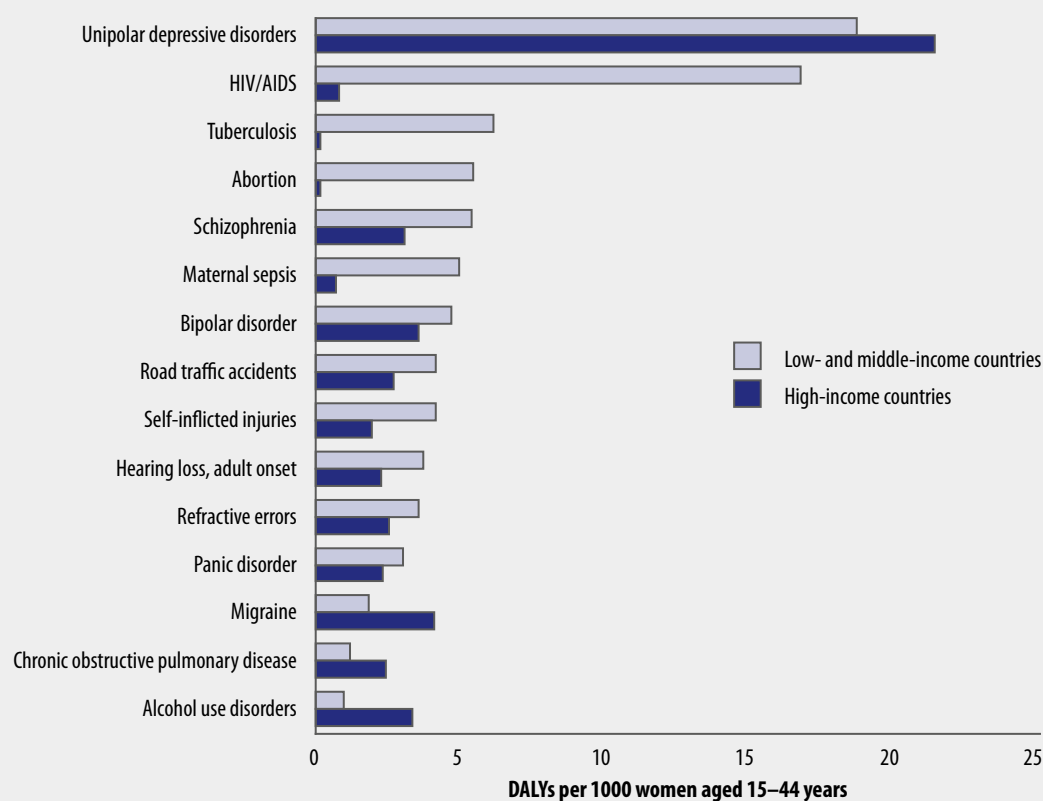
### Depression is the leading cause among young adult women

Mental disorders are an important source of lost years of healthy life for women aged 15–44 years. They make up 3 of the 10 leading causes of disease burden in low- and middle-income countries, and 4 of the leading 10 in high-income countries; self-inflicted injuries are also in the leading 10 causes for low- and middle-income countries (Figure 23). Depression is the leading cause of disease burden for women in both high-income and low- and middle-income countries. Injuries are also important for women aged 15–44 years, although road traffic accidents are the eighth leading cause globally, followed by self-inflicted injuries in ninth place.

### Maternal conditions are important causes of disease and injury for women of reproductive age

Although injuries become more important for boys beyond infancy, the causes of burden of disease are broadly similar for boys and girls. However, striking sex differences emerge in adulthood (ages 15–59 years). The burden of reproductive problems is almost entirely confined to low- and middle-income countries, but it is so great that maternal conditions make up 2 out of the 10 leading causes of disease burden in women aged 15–44 years. Together with HIV/AIDS, maternal conditions are a major contributor to the high burden of disease for women in Africa relative to other regions. The burden of maternal conditions in the African and South-East Asia regions is responsible for 8% of the total global burden of disease for women aged 15–59 years. Almost all of this loss of healthy years of life is avoidable.

Figure 23: Leading causes of disease burden for women aged 15–44 years, high-income countries, and low- and middle-income countries, 2004





Worldwide, and particularly in low-income countries, better care for women in pregnancy and childbirth could make a large contribution to reducing the burden of disease. The Millennium Development Goal of giving all women access to a skilled birth attendant when they give birth is directed at substantially reducing the burden of disease by avoiding preventable maternal and neonatal deaths.

**HIV/AIDS, neuropsychiatric conditions and sense organ disorders are the three main causes of burden of disease in women**

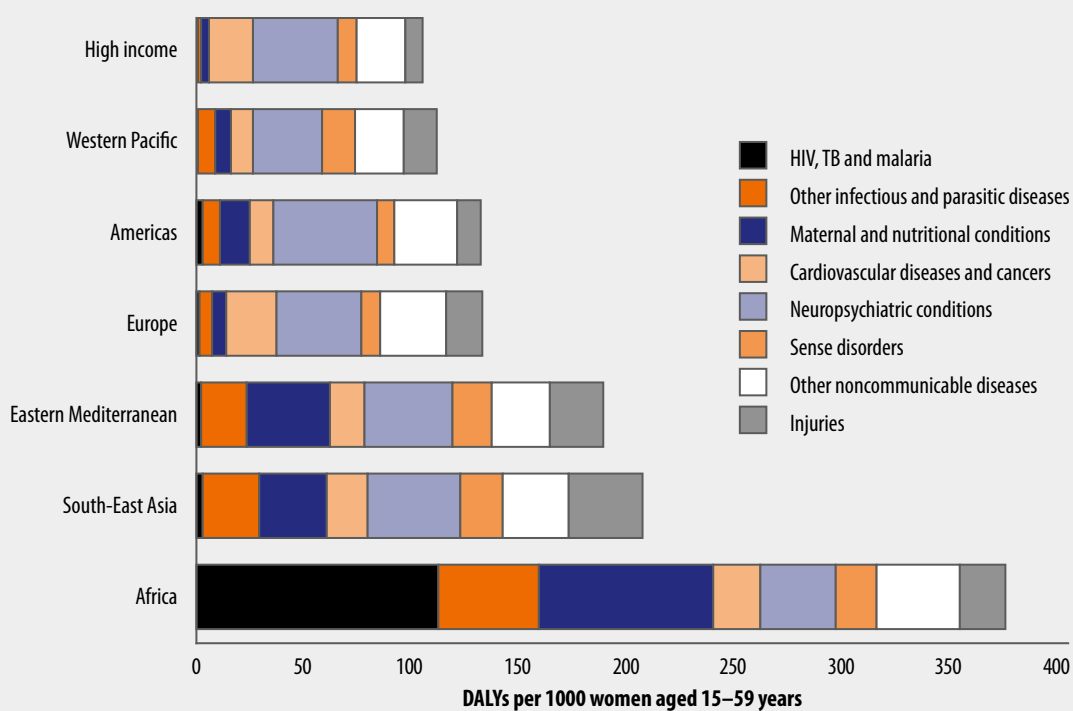
HIV/AIDS is the most important single cause of burden of disease for women aged 15–59 years in Africa (Figure 24), and the per capita burden of HIV is 40% higher for women than for men. Neuropsychiatric conditions are responsible for 22% of global DALYs for women aged 15–59 years, the largest cause group in all regions outside Africa. Sense organ disorders

are another important cause group, responsible for 8% of global DALYs for women aged 15–59 years. Causes of vision loss are responsible for more than two thirds of the DALYs for sense organ disorders in women; causes of hearing loss account for most of the rest.

**18. The growing burden of noncommunicable disease**

The burden of noncommunicable diseases now accounts for nearly half of the global burden of disease (all ages). Surprisingly, almost 45% of the adult disease burden in low- and middle-income countries globally is now attributable to noncommunicable disease. Population ageing and changes in the distribution of risk factors have accelerated the non-communicable disease share of total disease burden in many developing countries.

**Figure 24: Major causes of disease burden for women aged 15–59 years, high-income countries, and low- and middle-income countries by WHO region, 2004**



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### Noncommunicable disease risks are higher in low- and middle-income countries

Noncommunicable diseases dominate the disease burden of high-income countries, and in the past they have often been seen as a health priority mainly for high-income countries. In part this reflects the older population structure of the high-income countries, because noncommunicable disease risks generally increase with age. If the effects of different age distributions of populations are controlled for through age-standardization of DALY rates, it becomes apparent that noncommunicable disease risks, as measured by age-standardized DALY rates, are higher in low- and middle-income countries than in high-income countries (Figure 25). This is mainly due to cardiovascular diseases, principally ischaemic heart disease and stroke, whose age-standardized burden is substantially higher in low- and middle-income countries than in high-income countries. The burden of sense disorders, principally

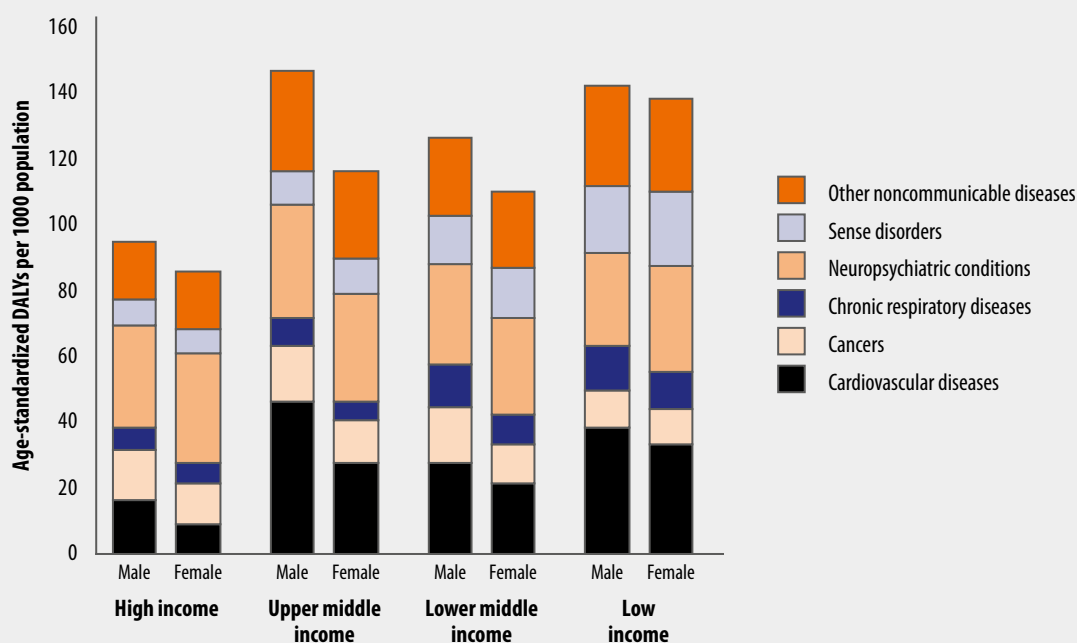
vision impairment and hearing loss, is also greater in low- and middle-income countries than in high-income countries.

## 19. The unequal burden of injury

### One sixth of the disease burden in adults is caused by injuries

Injuries accounted for 17% of the disease burden in adults aged 15–59 years in 2004. In the low- and middle-income countries of the Americas, Europe and the Eastern Mediterranean Region, more than 30% of the entire disease and injury burden among men aged 15–44 years was from injuries. Globally for both sexes, road traffic accidents are the third leading cause of burden in that age–sex group, preceded only by HIV/AIDS and unipolar depression. The burden of road traffic accidents is increasing – especially in the developing countries of sub-Saharan

Figure 25: Age-standardized DALYs for noncommunicable diseases by major cause group, sex and country income group, 2004



Africa, southern Asia and South-East Asia – and particularly affects males. Violence and self-inflicted injuries are also in the leading 10 causes of burden of disease for people aged 15–44 years, at sixth and eighth position respectively.

**Relative importance of intentional injuries varies between regions**

The category of intentional injuries includes self-inflicted injuries and suicide, violence and war. This type of injury accounts for an increasing share of the burden, especially among economically productive young adults. In developed countries, suicides are the largest source of intentional injury burden, whereas in developing regions violence and war are the larger source. Countries of the former Soviet Union and other high-mortality countries of Eastern Europe have rates of injury, death and disability among males that are similar to those in sub-Saharan Africa (Figure 26). The death rate due to poisoning is much

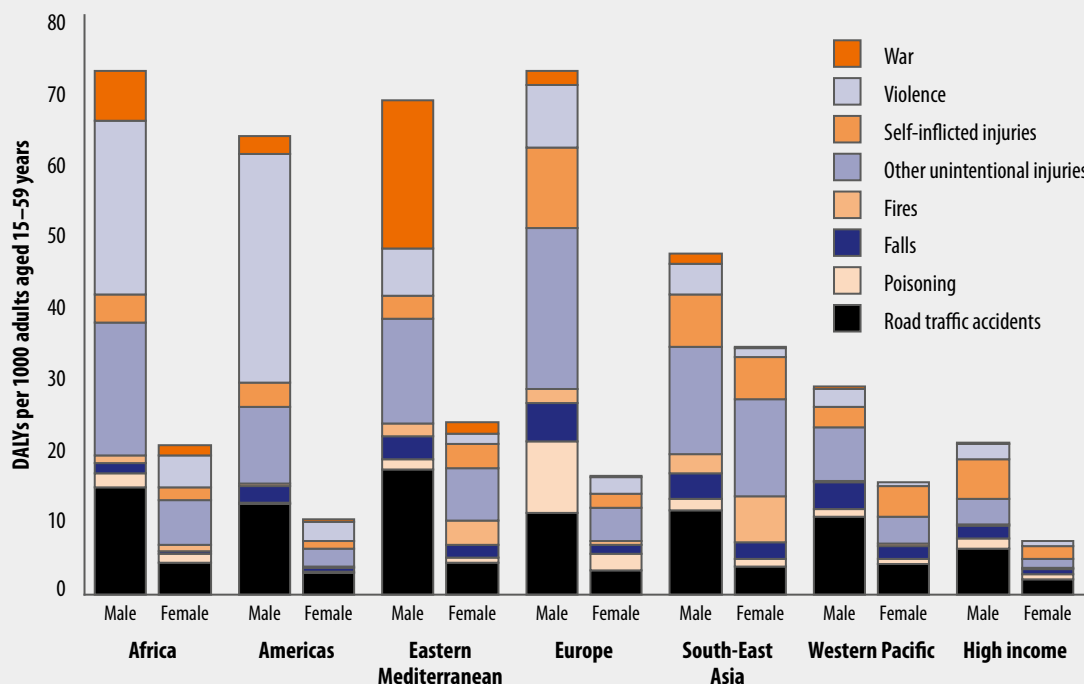
higher in the low- and middle-income countries of Europe than in any other region of the world. Alcohol overdose deaths are likely to be a primary contributor to this situation. The death rate for injuries due to fire is much higher for women in South-East Asia than for men or women in any other region of the world.

**20. Projected burden of disease in 2030**

**Global burden of disease per capita is projected to decrease**

Global DALYs are projected to decrease from 1.53 billion in 2004 to 1.36 billion in 2030, an overall decline of about 10%. Since the population increase is projected to be 25% over the same period, this represents a significant reduction in the global per capita burden. The DALY rate decreases at a faster rate than the overall death rate because of the shift

Figure 26: Burden of injuries (DALYs) by external cause, sex and WHO region, 2004



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in age at death to older ages, associated with fewer YLL. Even assuming that the age-specific burden for most non-fatal causes remains constant into the future, and hence that the overall burden for these conditions increases with the ageing of the population, there is still an overall projected decrease in the global burden of disease per capita of 30% from 2004 to 2030. This decrease is largely driven by projected levels of economic growth in the projection model. If economic growth is slower than in recent World Bank projections, or risk factor trends in low- and middle-income regions are adverse, then the global burden of disease will fall more slowly than projected.

### Halving the contribution of Group I causes

The proportional contribution of the three major cause groups to the total disease burden is projected to change substantially. Group I causes are projected to account for 20% of total DALYs lost in 2030, compared with just under 40% in 2004. The noncommunicable disease (Group II) burden is projected to increase to 66% in 2030, and to represent a greater burden of disease than Group I conditions in all income groups, including low-income countries.

**Figure 27** shows the changes in the leading causes of DALYs globally from 2004 to 2030. The three leading causes of DALYs in 2030 are projected to be unipolar depressive disorders, ischaemic heart disease and road traffic accidents. Lower respiratory infections drop from leading cause in 2004 to sixth leading cause, and HIV/AIDS drops from fifth leading

cause in 2004 to ninth leading cause in 2030.

Lower respiratory infections, perinatal conditions and diarrhoeal diseases are all projected to decline substantially in importance. On the other hand, diabetes mellitus, road traffic accidents, chronic obstructive pulmonary disease, hearing loss and refractive errors are all projected to move up three or more places in the rankings. Ischaemic heart disease, cerebrovascular disease and unipolar depressive disorders move up two places in the rankings to become three of the four leading causes of disease and injury burden in 2030.

These projections represent a vision of an improving future for population health under:

- an explicit set of assumptions
- specific projections of income and human capital
- specific projections of future trends in tobacco smoking, HIV/AIDS transmission and survival, and overweight and obesity.

Under these projections, people in all regions of the world will live longer and with lower levels of disability, particularly from infectious, maternal, perinatal and nutritional conditions. But if there is no sustained and additional effort to address Millennium Development Goals, neglected tropical diseases, tobacco smoking and other chronic disease risks, or if economic growth in low-income countries is lower than the forecasts used here, then the world may achieve slower progress and experience widening of health inequalities.

Figure 27: Ten leading causes of burden of disease, world, 2004 and 2030

2004 Disease or injury	As % of total DALYs	Rank	Rank	As % of total DALYs	2030 Disease or injury
Lower respiratory infections	6.2	1	1	6.2	Unipolar depressive disorders
Diarrhoeal diseases	4.8	2	2	5.5	Ischaemic heart disease
Unipolar depressive disorders	4.3	3	3	4.9	Road traffic accidents
Ischaemic heart disease	4.1	4	4	4.3	Cerebrovascular disease
HIV/AIDS	3.8	5	5	3.8	COPD
Cerebrovascular disease	3.1	6	6	3.2	Lower respiratory infections
Prematurity and low birth weight	2.9	7	7	2.9	Hearing loss, adult onset
Birth asphyxia and birth trauma	2.7	8	8	2.7	Refractive errors
Road traffic accidents	2.7	9	9	2.5	HIV/AIDS
Neonatal infections and other <sup>a</sup>	2.7	10	10	2.3	Diabetes mellitus
COPD	2.0	13	11	1.9	Neonatal infections and other <sup>a</sup>
Refractive errors	1.8	14	12	1.9	Prematurity and low birth weight
Hearing loss, adult onset	1.8	15	15	1.9	Birth asphyxia and birth trauma
Diabetes mellitus	1.3	19	18	1.6	Diarrhoeal diseases

COPD, chronic obstructive pulmonary disease.

<sup>a</sup> This category also includes other non-infectious causes arising in the perinatal period apart from prematurity, low birth weight, birth trauma and asphyxia. These non-infectious causes are responsible for about 20% of DALYs shown in this category.

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