specific rates remained at 1990 levels; and, (2) a population growth and population ageing scenario computed as the number of deaths expected in 2010, using 1990 age-sex specific rates and 2010 age-specific and sex-specific population numbers. The difference between 1990 numbers and the population growth scenario is the change in death numbers due strictly to the growth in total population. The change from the population growth scenario to the population growth and ageing scenario is the number of deaths due to ageing of the population. The difference between 2010 deaths and the population growth and ageing scenario is the difference in death numbers due to epidemiological change in age-specific and sex-specific death rates. Each of these three differences is also presented as a percentage change with reference to the 1990 death number.

We calculated change in the risk of death, by cause, directly using age standardised death rates, based on the WHO world population standard age structure.[62] Further details on the data and methods used for specific causes of death are available on request.

Role of the funding source

The sponsor of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all of the data in the study and the final responsibility to submit for publication.

Results

The GBD 2010 cause list divides causes into three broad groups. At the most aggregate level, communicable, maternal, neonatal, and nutritional causes account for 13·2 million (24·9%) of 52·8 million total deaths at all ages in 2010. Non-communicable causes account for 34·5 million or 65·5%. The third category, injuries, accounts for 5·1 million or 9·6%. The continued decrease in deaths from communicable, maternal, neonatal, and nutritional disorders is striking, if not surprising. The number of deaths from these disorders decreased by 2·7 million from 15·9 million in 1990 to 13·2 million in 2010, representing a 17% decrease from 1990 to 2010. The annual number of deaths from non-communicable diseases, by contrast, rose by just under 8 million, to 34·5 million, or two of every three deaths in 2010. The global fraction of deaths due to injuries increased slightly between 1990 and 2010 (from 8·8% to 9·6%), but this masks some important trends in mortality from these causes.

Table 1 decomposes these global trends into the contribution of total increase in population size, ageing of the population, and changes in age-specific and sex-specific rates. Global population growth alone would have been expected to increase deaths from all causes by 31·8% from 1990 to 2010. Because of the correlation between population growth rates and mortality rates from communicable, maternal, neonatal, and nutritional causes, population growth alone would have increased this category by 46·9%, non-communicable diseases by 22·9%, and injuries by 31·1% (table 1). Ageing of the world's population such that the mean age of the world increased from 26·1 years to 29·5 years contributed to an 11·2% decrease in communicable, maternal, neonatal, and nutritional disorders, a 39·2% increase in non-communicable disease deaths, and a 9·2% increase in injuries (table 1). Declines in age-specific and sex-specific death rates have contributed to a 52·7% decrease in communicable, maternal, neonatal, and nutritional deaths, a 32·1% decrease in non-communicable disease deaths, and a 16·3% decrease in injury deaths. With decreasing age-specific death rates from all three groups of causes, including non-communicable diseases, the global shift towards non-communicable diseases and injuries as leading causes of death is being driven by population growth and ageing, and not by increases in age-sex-cause specific death rates.

At the second level of the GBD 2010 cause hierarchy, there are 21 major cause groups. Figure 1 (A–D) summarises the composition of causes of death for every age-sex group for male and female individuals separately in 1990 and 2010 at this second level of cause disaggregation. The structure of causes of death changed systematically with age. In the neonatal age groups, disorders arising during the neonatal period dominated, but with important contributions from the category of diarrhoeal disease, lower respiratory infections, and other infectious and non-communicable diseases, including congenital causes. By the post-neonatal period, causes of death were dominated by diarrhoea, lower respiratory infections, and other infectious diseases such as measles, among others. At ages 1–4 years, the category neglected tropical diseases and malaria were also an important contributor to global mortality. In the age group 5–14 years, infectious diseases, HIV/tuberculosis (HIV/TB), injuries, and some cancers predominated, although overall mortality at these ages was low. Important sex differences were evident from ages 15–34 years; among male individuals, injuries, HIV/TB, and some non-communicable diseases predominate. Among female individuals of the same age group, injuries were a smaller cause of death with maternal causes making an important contribution. In 2010, maternal causes accounted for 10·7% of deaths of women in this age group. By age 40 years, more than 50% of global deaths in 1990 were from non-communicable diseases—this transition age shifts to 45 years in 2010 because of the HIV epidemic. Beginning at age 50 years, circulatory causes begin a steady rise to become the largest cause of death.

The comparison of the 1990 and 2010 plots shows various shifts in the cause structure by age and sex (figure 1). At younger age groups, neonatal disorders and other non-communicable causes, including congenital anomalies, predominate. The unfolding HIV/AIDS epidemic at the global level is clearly evident from the huge increase in the contribution of HIV/TB to cause of death patterns among young adult men and women. By 2010, for example, HIV/TB and injuries accounted for more than half of all

deaths in the age group 20–39 years in men. Other important shifts, with age, are evident—namely, a rising fraction of deaths in many age groups from diabetes, chronic kidney diseases, blood and endocrine disorders, and cancers, along with a decrease in the fraction due to chronic respiratory deaths in the middle-aged and older groups. For women, the share of deaths at ages 20–39 years due to maternal causes notably decreased.

At a more disaggregated cause level, there is interest in a broad global overview of who dies of what, and how this is

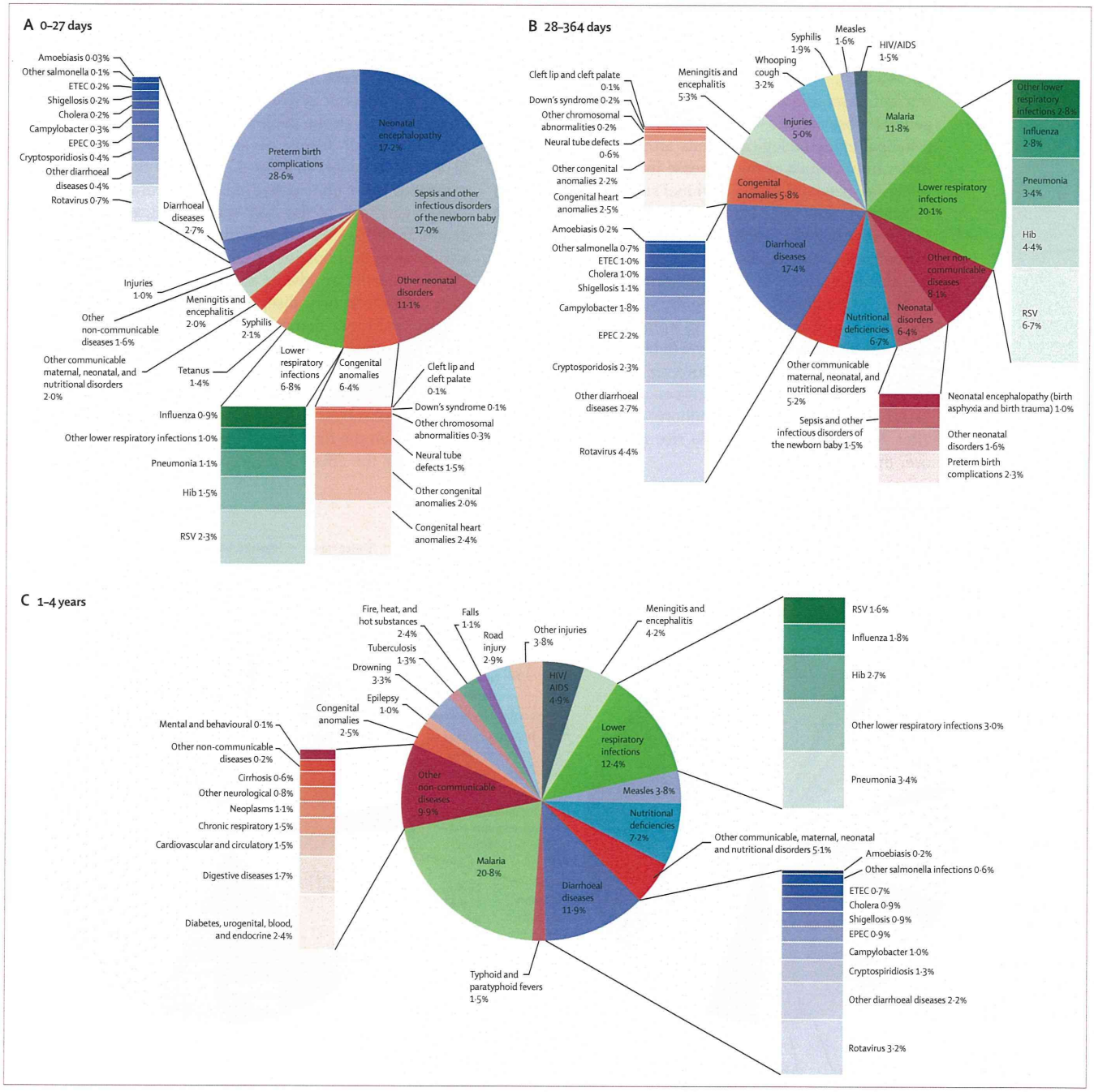

Figure 2: **Pie chart of global neonatal, post-neonatal, and child deaths in 2010 for children of both sexes combined by cause**
(A) Age 0–27 days (neonatal); 2 840 157 total deaths. (B) Age 28–364 days (post-neonatal); 2 031 474 total deaths. (C) Age 1–4 years; 1 969 567 total deaths. ETEC=enterotoxigenic *Escherichia coli*. EPEC=enteropathogenic *E coli*. Hib=*Haemophilus influenzae* type B. RSV=respiratory syncytial virus.

changing. Table 2 provides total numbers of deaths and age-standardised death rates for each cause in 1990 and 2010. Because there is substantial interest in causes of death for different age groups, we provide global deaths for the 20 GBD age groups, by sex, and including 95% UI for 2010 and 1990 (appendix pp 149–340). In addition to the numbers of deaths, we present the death rates by age for 2010 and 1990 in for those readers interested in comparing change in age-sex-specific death rates (appendix pp 341–533). There are many features of the tables that warrant discussion: we limit ourselves here to some general observations that we believe characterise the principal epidemiological trends around the turn of the millennium. Much of the decrease in the communicable, maternal, neonatal, and nutritional causes was due to the substantial reductions in diarrhoeal disease (from 2·5 to 1·4 million), lower respiratory infections (from 3·4 to 2·8 million), neonatal disorders (from 3·1 to 2·2 million), measles (from 0·63 to 0·13 million), and tetanus (from 0·27 to 0·06 million), reflecting the scaling up of effective treatments and technologies to combat these disorders generally associated with poverty (table 2). Not all diseases in this category decreased, however. Table 2 shows the massive increase in deaths between 1990 and 2010 from HIV/AIDS (from 0·3 to 1·5 million), despite the decrease after 2006, as well as a 19·9% rise in malaria mortality over the two decades.

Cancers claimed 8·0 million lives in 2010, 15·1% of all deaths worldwide, with large increases in deaths from trachea, bronchus, and lung cancers, twice the number of deaths from the next two most common sites for mortality (liver and stomach). Roughly half of the total liver cancer mortality was attributed to hepatitis B infection, with smaller fractions due to hepatitis C and alcohol (table 2). The largest cause fraction (13·3%) among all causes of death in 2010 was due to ischaemic heart disease, closely followed by stroke (11·1%), being roughly split equally between ischaemic stroke and haemorrhagic and other non-ischaemic stroke (table 2). Together, ischaemic heart disease and all forms of stroke killed an estimated 12·9 million people in 2010, a quarter of the global total, compared with one in five deaths worldwide 20 years earlier. Cirrhosis of the liver was the cause of a million deaths in 2010, 33% more than in 1990, roughly equally attributable to hepatitis B, hepatitis C, and alcohol. Diabetes deaths worldwide almost doubled, as did deaths from chronic kidney disease. Deaths from Alzheimer's disease and other dementias rose more than three-fold, and deaths from Parkinson's disease doubled. One of the few causes in this group to decrease was COPD, falling from 3·1 to 2·9 million. This is consistent with the decreases observed with development in countries such as the UK in the first part of the 20th century, only to be reversed as the effect of tobacco use becomes evident.[63,64]

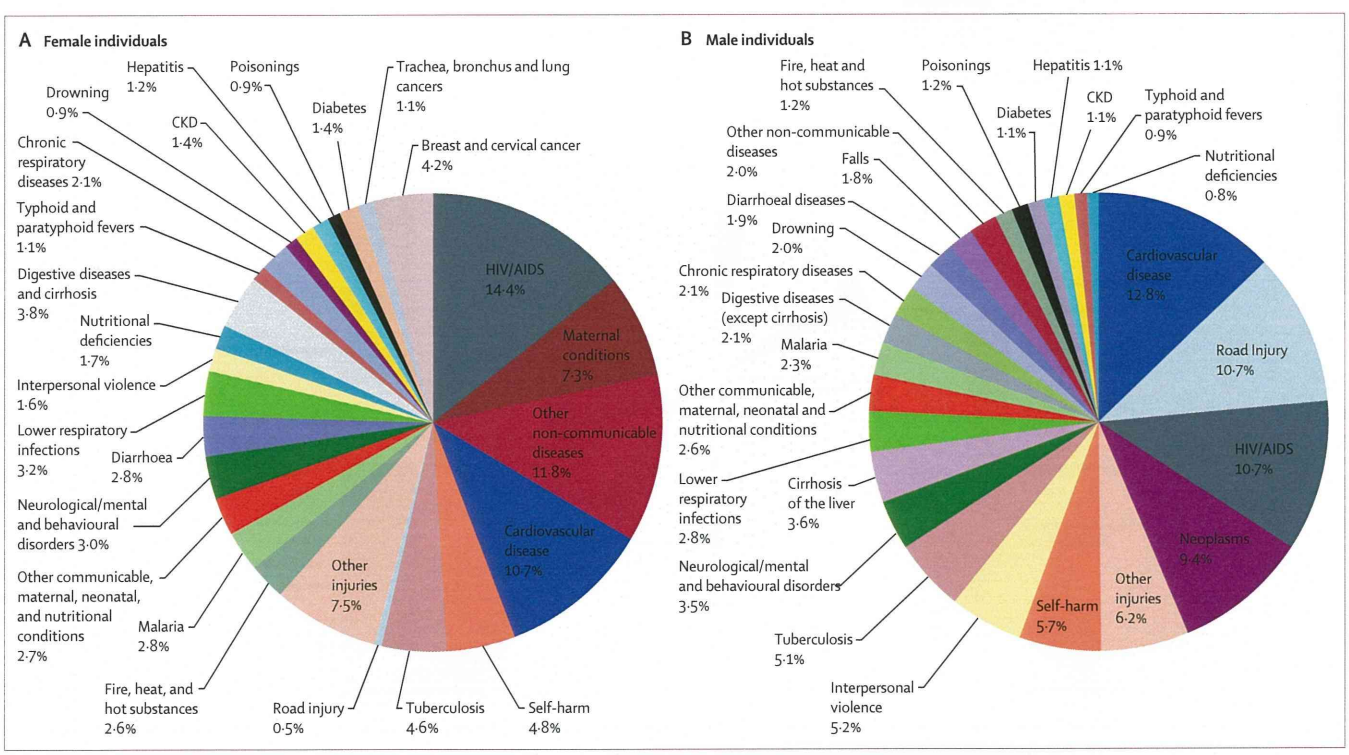

Figure 3: **Global deaths in 2010 for individuals aged 15–49 years**
(A) Female individuals, 3 496 480 total deaths. (B) Male individuals, 5 741 344 total deaths. CKD=chronic kidney disease.

The massive increases in tobacco use since the 1970s, especially in men in less developed countries, might reverse this trend over the next decade or so.[65]

One million more deaths from injuries occurred in 2010 (5·1 million) than two decades earlier, a 24% increase (table 2). This was driven primarily by a 420 600 increase in road traffic deaths, which claimed 1·3 million lives in 2010. Falls also claimed an additional 191 900 lives compared with 1990, with most other accidental causes being relatively constant, or decreasing, especially drowning. Deaths from intentional injuries increased for both self-harm and interpersonal violence. Deaths from forces of nature, war, and legal intervention were more than twice as common than two decades earlier. Given the huge annual fluctuation in deaths from forces of nature and war, trends must be interpreted with caution. The fact that deaths from injuries are rising, and account for one in ten deaths worldwide, argues for far greater policy action to prevent them.

Trends in numbers of deaths are of interest and importance for health services and health policies that are designed to reduce premature mortality from various causes. Yet numbers of deaths alone do not provide a clear indication of whether disease control strategies are working since they are heavily dependent on changes in population size and age structure. By computing age-standardised mortality rates, we effectively controlled for demographic changes across populations over time; however, age-standardised death rates are sensitive to the population standard used. Changes in age-standardised mortality rates between 1990 and 2010 are shown in the right hand panels of table 2. Death rates from all communicable, maternal, neonatal, and nutritional disorders have decreased by 30% since 1990, a much greater reduction than suggested from numbers of deaths alone (table 2). The age-standardised death rate from diarrhoeal diseases fell by 49%, whereas lower respiratory infections decreased by 34%. Interestingly, age-standardised death rates from trachea, bronchus, and lung cancers fell by 8% between 1990 and 2010, despite a 47% increase in numbers of deaths, due to continued decreases in mortality in developed countries and more modest increases in less developed countries where the full impact of smoking, especially in men, has yet to occur. Breast cancer mortality

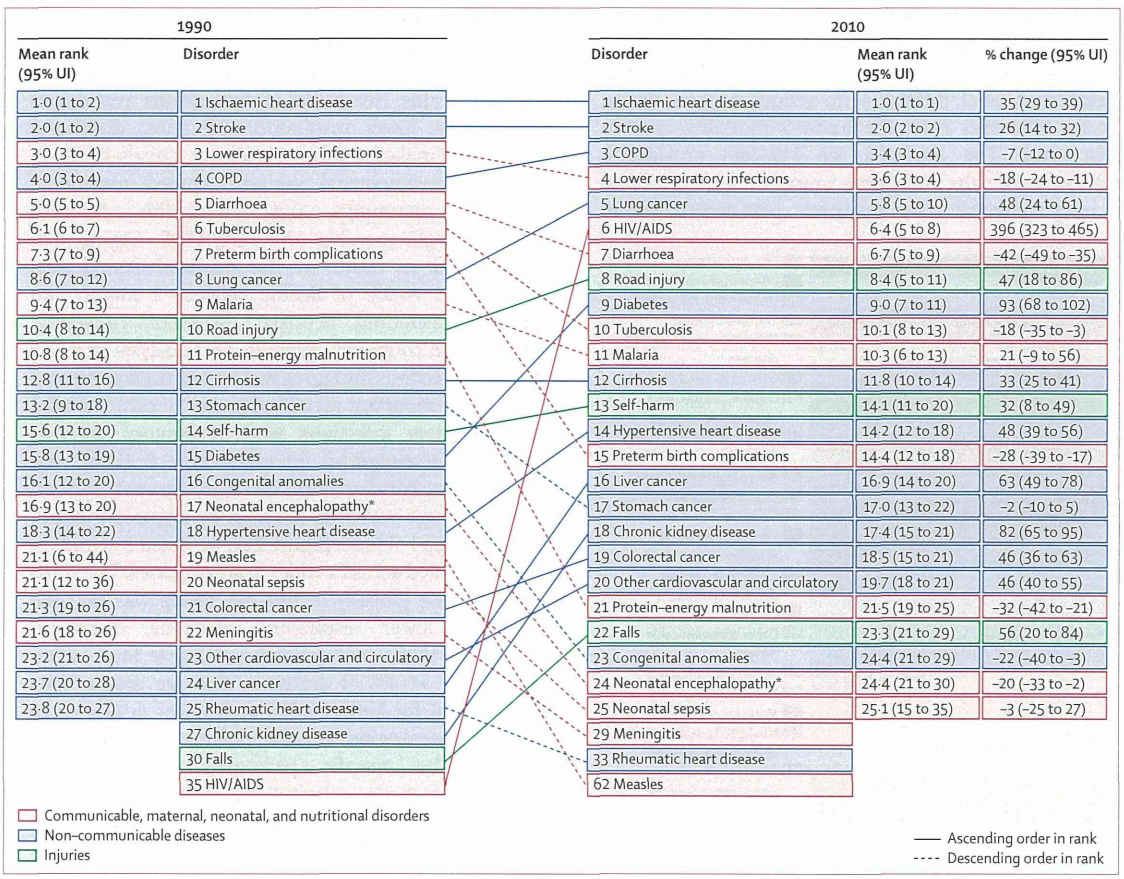

Figure 4: **Global death ranks with 95% UIs for the top 25 causes in 1990 and 2010, and the percentage change with 95% UIs between 1990 and 2010**
UI=uncertainty interval. COPD=chronic obstructive pulmonary disease. *Includes birth asphyxia/trauma. An interactive version of this figure is available online at http://healthmetricsandevaluation.org/gbd/visualizations/regional.

rates fell by 15%, even though numbers of deaths from the disease increased by more than a third.

Our findings suggest important decreases (20% or more) in age-standardised death rates from major vascular diseases, especially heart disease and strokes, for the world as whole, even though numbers of vascular disease deaths increased by a third to 15·6 million in 2010 (table 2). Death rates for COPD and liver cirrhosis also decreased, but almost doubled for Alzheimer's disease, and rose for diabetes and chronic kidney disease. These represent important global health challenges that might, or might not, be evident from an assessment of trends in numbers of deaths alone. Globally, although the number of deaths from injury rose by 24% since 1990, death rates decreased modestly, although this masks variable trends for different injuries, with death rates from drownings and poisonings falling by about a third, less dramatically for self-harm and violence, and rising for transport injuries and, interestingly, from adverse effects of medical treatment. Death rates from forces of nature also massively increased (by 336%) comparing 1990 to 2010 because of the earthquake in Haiti in 2010.

Causes of death in children younger than 5 years are of particular interest because of the global focus on improving child survival over the past few decades that has been reinforced by the push to achieve Millennium Development Goal (MDG) 4 (to reduce by two thirds, between 1990 and 2015, the under-5 mortality rate) in recent years. The appendix (pp 149–340) provides a breakdown of deaths in children younger than 5 years into the early neonatal, late neonatal, post-neonatal, and 1–4 years age groups in 2010 and 1990. To facilitate an understanding of the leading causes at different ages under 5 years, we show in figure 2A, B, and C the distribution of deaths in the neonatal periods, the post-neonatal period, and ages 1–4 years, respectively. Of 2·8 million early and late neonatal deaths, we estimate that 2·1 million were from neonatal disorders including preterm birth complications, neonatal sepsis, and neonatal encephalopathy, among others. A further 137 000 deaths were also due to disorders that arise in the neonatal period but which lead to death after the first month of life. Among the important neonatal disorders, preterm events accounted for 29% of global neonatal deaths, with nearly equal shares for neonatal sepsis and neonatal encephalopathy—17% each. Of the remaining 741 000 neonatal deaths, congenital anomalies accounted for 183 000 deaths, although most congenital deaths occured after the first month of life. Injuries accounted for 28 000 neonatal deaths; other non-communicable causes including haemoglobinopathies and haemolytic anaemias, some rare cancers, sudden infant death syndrome (SIDS), and other rare causes accounted for 45 000 deaths. Among communicable diseases, notably lower respiratory infections (194 000), diarrhoea (77 000), and meningitis (46 000) accounted for the remaining neonatal deaths.

In the post-neonatal period (figure 2B), we estimated 2·0 million deaths. Nearly half of these deaths were due to three diseases: lower respiratory infections, diarrhoeal diseases, and malaria. Other important causes of death during the post-neonatal period included nutritional deficiencies, meningitis and encephalitis, injuries, whooping cough, measles, and HIV/AIDS. Causes that primarily lead to death in the neonatal period also contributed to 14·0% of deaths between 1 month and 11 months including neonatal disorders, congenital anomalies, and congenital syphilis. Our analysis of lower respiratory infections disaggregated by pathogen suggested that the most important identified causes of post-neonatal lower respiratory infections were respiratory syncytial virus (RSV), *Haemophilus influenzae* type B (Hib), and pneumococcus. For diarrhoeal diseases, the most important pathogen was rotavirus followed by cryptosporidium. In the age group 1–4 years (figure 2C), we noted 2·0 million deaths distributed across a wider array of causes. The most important cause globally in this age group was malaria, followed by lower respiratory infections, diarrhoeal diseases, and nutritional deficiencies. These four causes accounted for 52·4% of deaths in this age group. Four causes account for between 3% and 5% of deaths each: HIV/AIDS, meningitis or encephalitis, measles, and drowning. The specific pathogens causing lower respiratory infections substantially shifted in this age group compared with the age groups of under 1 year with a much more substantial part played by pneumococcal deaths. Just under 14% of deaths in this age group were from a long list of non-communicable causes, each of which accounted for a relatively small number of deaths.

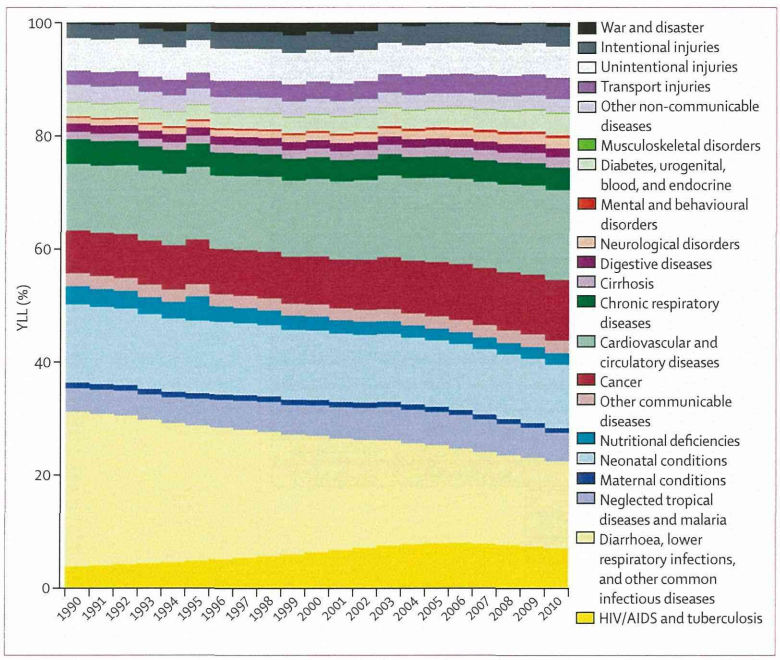

Figure 5: Percentage of global years of life lost (YLLs) from 1990 to 2010 for all ages and both sexes combined by cause and year

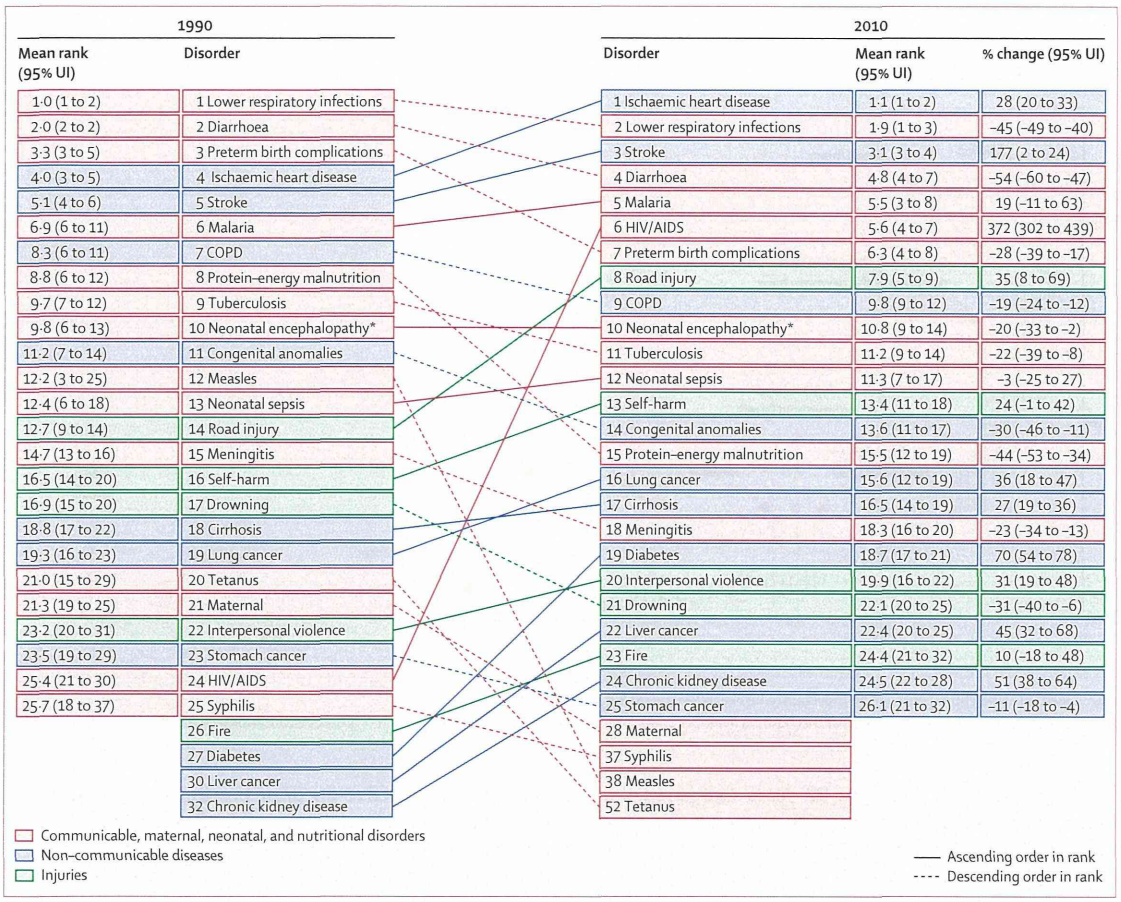

Figure 6: **Global years of life lost (YLLs) ranks with 95% UIs for the top 25 causes in 1990 and 2010, and the percentage change with 95% UIs between 1990 and 2010**

YLLs=years of life lost. UI=uncertainty interval. COPD=chronic obstructive pulmonary disease. *Includes birth asphyxia/trauma. An interactive version of this figure is available online at http://healthmetricsandevaluation.org/gbd/visualizations/regional.

Because of the focus of MDG 5 on maternal mortality, the composition of causes of death in women and men of reproductive age is of particular interest. Although deaths related to pregnancy and childbirth have been given special priority in the MDGs, any death in these young adult age groups is a major cause for concern. For women aged 15–49 years, we estimated 3·5 million deaths from all causes in 2010. Figure 3A shows that the leading cause was HIV/AIDS, followed by cardiovascular disease, maternal disorders, suicide, tuberculosis, breast and cervical cancer, and digestive diseases and cirrhosis. The top seven causes accounted for half of the deaths of women in these age groups. Although there is no MDG related specifically to male deaths in the reproductive age groups, disorders targeted by MDG 6 take an important toll on men in the age groups 15–49 years. The leading causes of death for men in this age group, however, were cardiovascular diseases, road traffic injuries, and HIV/AIDS, with other major causes including suicide and interpersonal violence.

Identification of more detailed causes is perhaps more important for priority setting and planning, since interventions are generally cause-specific. Figure 4 shows the top 25 causes of death in the world ranked in 1990 and 2010 with arrows connecting the causes between the two periods. Although the top four causes of death in 1990 remain the top four in 2010, the change in numbers of deaths is noteworthy, with ischaemic heart disease and stroke increasing by 26–35% over the interval, but lower respiratory infections and COPD declining by 7–18%. Lung cancer increased from the 8th cause to the 5th cause in the two decades because of a 48% increase in absolute number of deaths. The largest change was for HIV/AIDS, rising from the 35th cause to the 6th leading cause of death. Diarrhoea, tuberculosis, and malaria all dropped in the global league table. Large increases in absolute number of deaths and their relative importance can be seen for diabetes, liver cancer, falls, and chronic kidney disease. Each of these causes has increased by more than 50% over the two decades.

Whereas the number of deaths from a given cause is a widely understood measure, its utility as a metric for informing public health priorities is limited since it gives

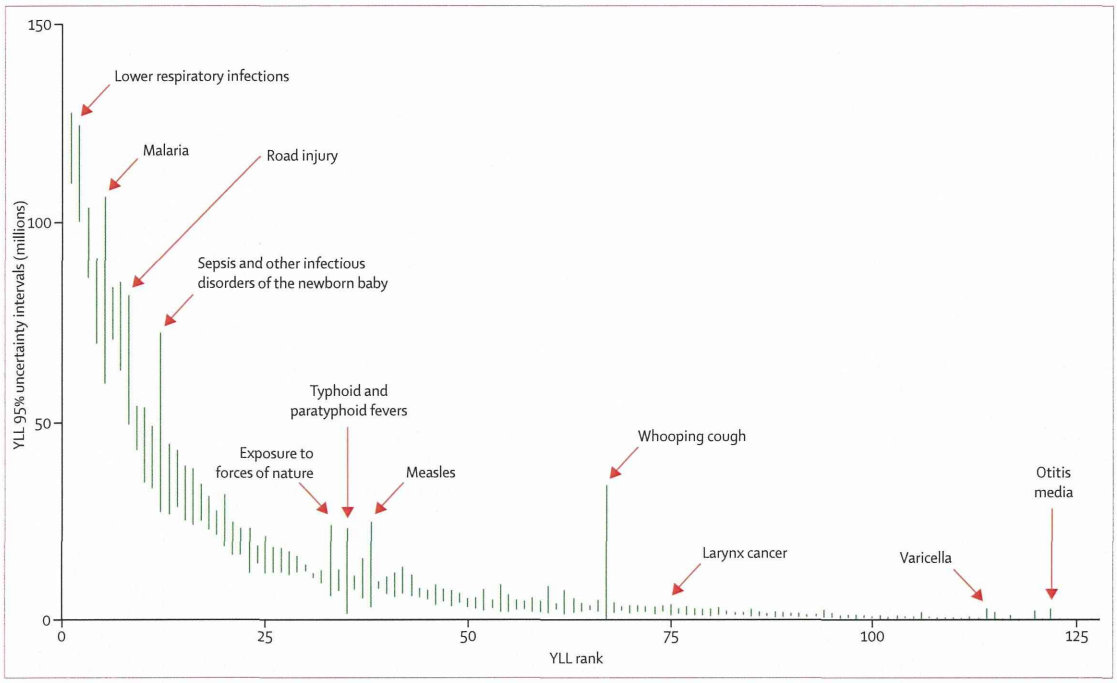

Figure 7: **Global YLLs (millions) with 95 % uncertainty intervals versus rank by cause in 2010**
YLLs=years of life lost. An interactive version of this figure is available online at http://healthmetricsandevaluation.org/gbd/visualizations/regional.

equal weight to a death at age 90 years compared, for example, with a death at age 25 years or 5 years. Consequently, the predominance of non-communicable causes might be misleading. In the Global Burden of Disease studies, the computation of years of life lost based on the standard expectation of life at the age of each death quantified the amount of life lost due to premature mortality (YLLs) from each cause. By computing YLLs, we could aggregate information on deaths across all ages to summarise overall patterns of premature mortality. Figure 5 shows the demographic and epidemiological transition, with the change in the composition of YLLs by single year from 1990 to 2010 for both sexes combined. The effect of major mortality shocks such as the Rwanda genocide (1994) and the famine in North Korea (covering most of the 1990s with a peak in 1995), were evident even at the global scale. The fraction of YLLs due to diarrhoea, lower respiratory infections, meningitis, and other common infectious diseases decreased substantially from 27·3% in 1990 to 15·4% in 2010. The percentage due to HIV/TB has increased due to the HIV epidemic. There is a concomitant expansion of YLLs due to non-communicable diseases, particularly cardiovascular diseases. The share of YLLs from non-communicable diseases increased from 33·3% in 1990 to 42·8% in 2010. The appendix (pp 534–725) shows the global YLLs with 95% UIs for 2010 and 1990.

Figure 6 provides a comparison of the top 25 causes of YLLs for both sexes combined, which gives an even more meaningful perspective on priorities for disease control than a simple ranking of causes of death according to the numbers of deaths from each cause. The leading cause of YLLs globally was lower respiratory infections in 1990 and ischaemic heart disease in 2010; in this period, the total number of YLLs from lower respiratory infections decreased by 45% but increased 28% for ischaemic heart disease. More generally, a number of communicable, maternal, neonatal, and nutritional causes declined in both absolute terms and in relative importance as causes of YLLs—most notably measles, tetanus, preterm birth complications, tuberculosis, meningitis, and protein-energy malnutrition. Conversely, several non-communicable diseases increased in importance over the two decades: ischaemic heart disease, stroke, lung cancer, cirrhosis, diabetes, liver cancer, and chronic kidney disease particularly, although COPD and congenital causes have declined in rankings of YLLs. Among injuries, road traffic, self-harm, and interpersonal violence increased substantially in both absolute and relative terms, whereas drowning decreased.

An important innovation in this study was the quantification of uncertainty by cause. UIs varied widely across causes. Figure 7 shows the 95% UIs for YLLs for each cause in 2010, ordered by the mean rank of every cause. The two leading causes—ischaemic heart disease and lower respiratory infections—have nearly overlapping UIs. These two causes are separated by a substantial gap with the next highest ranked cause, stroke. The 12th ranked

cause, neonatal sepsis, has a UI that is nearly three times wider than the 11th ranked cause, COPD. Several causes have much larger UIs than adjacent causes in the rank list. Natural history models for whooping cough, measles, and syphilis have large UIs. This originates from considerable empirical uncertainty on the estimation of incidence and case-fatality rates. By contrast, the HIV/AIDS natural history model developed by UNAIDS has remarkably narrow uncertainty in many countries with large epidemics. Across the causes analysed with CODEm, where the validity of UIs were evaluated using out-of-sample performance, there was also substantial variation across causes reflecting both the coherence of the underlying data, and whether powerful explanatory covariates were identified.

Figure 8 shows the composition of causes of death at the second level of aggregation (21 cause groups) for the 21 GBD regions in 1990 and 2010 for both sexes combined. The regions were ordered by the mean age at death, a crude but informative measure of the demographic and epidemiological transition.[40] At both time periods, there was substantial variation across regions in the relative importance of different causes, with communicable diseases and related causes being much more important in parts of sub-Saharan Africa and parts of Asia than in north Africa, and vascular diseases and cancer predominating in most other regions. By 2010, substantial progress was achieved, even in Africa, in reducing YLLs from communicable, maternal, neonatal, and nutritional causes particularly, although these still accounted for three out of four premature deaths in Africa. The predominance of vascular diseases as a cause of premature mortality in eastern Europe is clear from figure 8, especially compared with other developed regions, where cancer causes as much, if not more, premature death. The impact of the civil violence in Papua New Guinea in 1990 and the 2010 earthquake in Haiti led to notable shifts due to war and disaster. The combination of road injuries, other unintentional injuries, and intentional injuries ranges from a high of 23% of YLLs in 2010 in central Latin America to a low of 6% in the Caribbean, nearly a four-fold variation.

Figure 9 shows the rank for every cause that was either in the global top 25 causes of YLLs in 2010 or appeared in the top 25 causes of YLLs for any region. The appendix (p 726) presents the same information for 1990. Different colours represent different bands of ranks (figure 9). Such heat maps help to visualise important variations in ranking of YLLs across regions. In both 1990 and 2010, a similar number of causes (60 or so) appeared in the rankings, but with very substantial regional variations. At the top of figure 9, causes highest in global rankings of YLLs, such as lower respiratory diseases, ischaemic heart

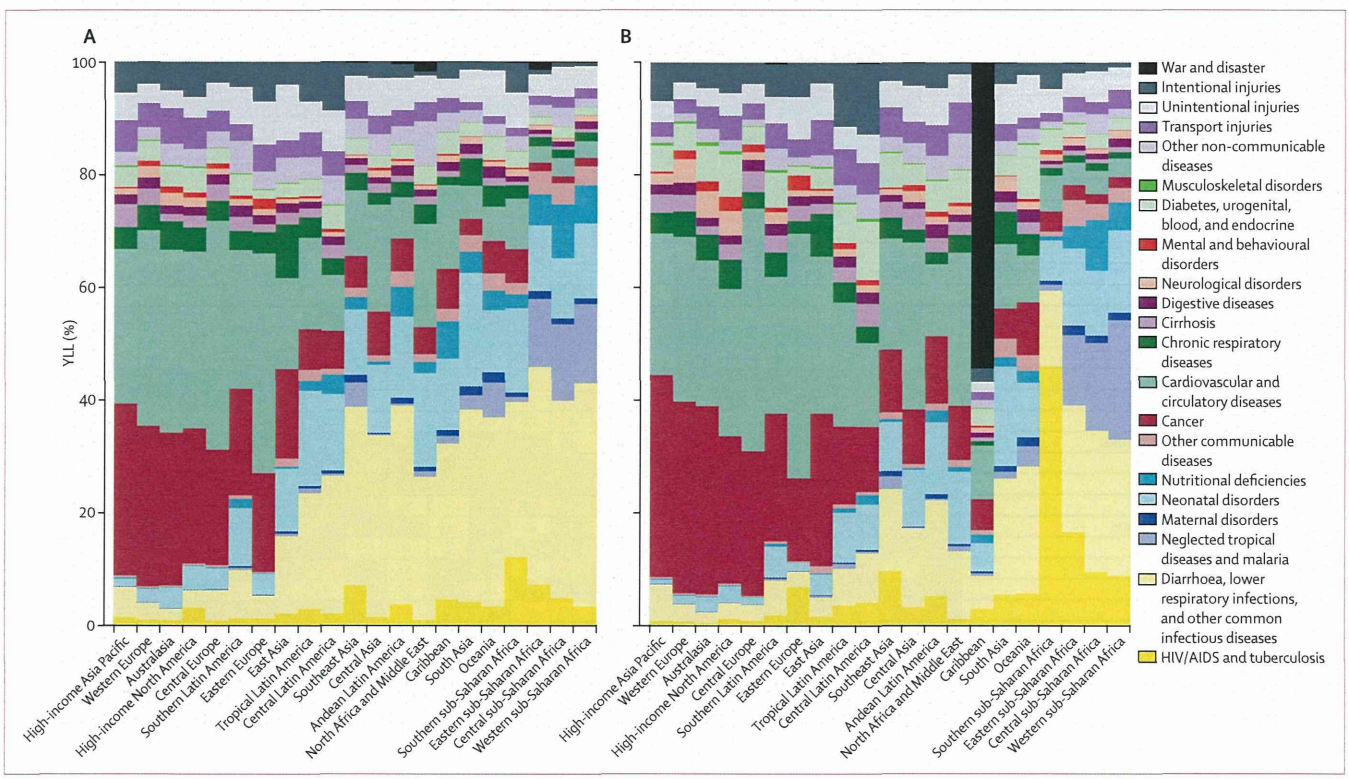

Figure 8: **Percentage of YLLs for all ages and both sexes combined by cause and region in 1990 and 2010**
YLLs=years of life lost. (A) 1990. (B) 2010. An interactive version of this figure is available online at http://healthmetricsandevaluation.org/gbd/visualizations/regional.

Ranking Legend: 1–10 | 11–20 | 21–30 | 31–50 | 51–90 | 91–176

Cause	Global	High-income Asia Pacific	Western Europe	Australasia	High-income North America	Central Europe	Southern Latin America	Eastern Europe	East Asia	Tropical Latin America	Central Latin America	Southeast Asia	Central Asia	Andean Latin America	North Africa and Middle East	Caribbean	South Asia	Oceania	Southern sub-Saharan Africa	Eastern sub-Saharan Africa	Central sub-Saharan Africa	Western sub-Saharan Africa
Ischaemic heart disease	1	2	1	1	1	1	1	1	2	2	2	4	1	3	1	2	4	5	11	17	16	17
Lower respiratory infections	2	5	9	14	11	8	3	9	9	5	4	3	2	1	3	4	1	1	2	3	4	2
Cerebrovascular disease	3	1	2	3	3	2	2	2	1	3	10	1	3	5	2	3	9	8	7	14	13	12
Diarrhoeal diseases	4	57	61	76	54	80	55	44	61	23	12	6	14	8	7	7	3	3	3	4	2	3
Malaria	5	119	120	117	120	119	122	119	119	109	108	19	116	98	41	39	36	4	14	2	1	1
HIV/AIDS	6	65	40	56	26	44	20	3	23	8	11	9	20	9	38	5	13	10	1	1	5	4
Preterm birth complications	7	38	30	17	14	24	6	26	18	6	7	7	5	4	4	6	2	7	6	5	6	7
Road injury	8	10	11	6	5	7	4	5	4	4	3	5	7	2	6	11	11	19	12	11	11	9
Chronic obstructive pulmonary disease	9	12	5	7	4	10	11	13	3	11	14	17	11	23	17	27	5	27	27	29	25	32
Neonatal encephalopathy*	10	63	51	32	41	54	28	29	20	12	13	10	4	7	12	13	7	17	9	9	10	10
Tuberculosis	11	32	73	82	82	40	47	15	29	33	31	2	10	14	34	14	8	6	5	8	8	11
Sepsis	12	71	74	68	62	68	29	55	79	13	16	24	35	11	10	10	6	20	18	7	12	5
Self-harm	13	3	6	5	6	5	5	4	8	15	15	20	9	18	22	21	10	22	16	24	30	50
Congenital anomalies	14	24	23	13	19	20	8	17	11	9	9	12	8	6	5	12	12	14	13	15	7	15
Protein–energy malnutrition	15	67	76	79	73	82	52	84	59	38	19	38	50	19	25	19	16	16	29	6	3	6
Trachea, bronchus, and lung cancers	16	4	3	2	2	3	7	6	5	17	21	15	15	27	14	16	34	45	33	66	54	64
Cirrhosis of the liver	17	9	7	18	9	4	9	7	14	10	8	11	6	12	9	20	15	12	28	23	21	20
Meningitis	18	69	69	67	67	61	39	61	51	36	30	26	23	24	19	18	17	9	19	10	9	8
Diabetes mellitus	19	14	13	10	7	14	10	33	15	7	5	8	17	16	11	9	19	2	8	26	26	24
Interpersonal violence	20	49	50	38	12	31	12	8	31	1	1	16	13	10	20	8	27	24	4	18	17	23
Drowning	21	25	54	34	40	29	26	18	12	19	17	22	12	17	24	31	18	28	26	22	18	29
Liver cancer	22	7	20	28	30	21	33	37	6	34	26	18	29	31	29	30	57	21	41	45	47	30
Fire, heat, and hot substances	23	47	66	63	46	53	36	25	52	51	44	40	30	39	28	33	14	26	23	16	19	13
Chronic kidney diseases	24	13	22	21	16	22	16	31	22	16	6	14	16	13	16	22	25	11	17	32	36	31
Stomach cancer	25	6	15	25	34	13	18	12	7	24	18	33	19	15	27	34	43	31	50	52	56	60
Falls	26	21	21	29	29	17	40	21	16	28	27	29	33	33	32	36	23	42	55	27	31	19
Hypertensive heart disease	27	20	18	40	21	9	17	24	17	14	22	21	21	25	13	17	30	52	15	38	39	46
Maternal disorders	28	85	89	88	78	85	61	75	55	48	41	27	51	26	39	29	24	18	20	13	15	14
Colon and rectum cancers	29	8	4	4	10	6	13	14	13	21	28	31	31	34	33	25	55	50	40	56	63	63
Other cardiovascular and circulatory diseases	30	17	10	19	17	11	15	52	21	20	24	23	26	21	8	23	45	39	30	37	35	39
Breast cancer	31	16	8	8	13	12	14	19	24	22	25	30	28	32	26	28	47	35	38	46	55	59
Cardiomyopathy and myocarditis	32	28	24	26	20	15	19	16	34	18	38	37	22	28	15	32	38	40	22	35	32	38
Exposure to forces of nature	33	122	120	117	120	119	58	119	124	125	90	123	124	123	124	1	125	120	126	127	126	124
Exposure to mechanical forces	34	50	64	53	48	50	38	11	35	50	35	36	18	29	21	41	28	32	10	28	22	40
Typhoid and paratyphoid fevers	35	95	110	102	102	113	49	111	39	62	50	13	119	53	36	69	21	76	21	25	37	27
Leukaemia	36	19	19	15	22	23	22	28	19	29	20	32	27	20	23	38	48	23	49	68	62	66
Syphilis	37	102	101	83	101	87	82	98	74	61	57	48	66	30	47	24	41	41	31	12	14	18
Measles	38	106	105	101	108	105	103	110	103	106	93	34	83	58	94	106	20	54	35	19	38	22
Oesophageal cancer	39	18	28	30	33	39	30	41	10	35	61	52	32	66	58	55	46	61	36	44	57	78
Rheumatic heart disease	40	36	41	49	60	36	34	36	28	41	51	28	24	48	18	48	32	36	37	43	44	49
Epilepsy	41	56	48	43	63	48	57	49	43	44	33	39	25	36	42	46	53	30	25	20	24	16
Asthma	42	42	60	50	57	59	65	50	49	54	46	25	41	62	30	45	26	13	32	40	34	33
Poisonings	43	64	65	42	25	47	68	20	25	95	58	57	34	60	40	85	31	15	43	30	28	43
Encephalitis	44	82	96	103	90	84	109	66	99	75	97	69	48	105	45	96	22	91	46	41	42	42
Cervical cancer	46	34	44	48	45	25	24	34	38	27	23	35	40	22	67	35	52	29	34	31	43	41
Pancreatic cancer	47	11	14	12	18	16	21	22	27	37	39	50	43	47	50	40	73	78	53	83	80	87
Brain and nervous system cancers	48	30	17	20	28	19	37	32	26	26	32	42	38	43	31	44	64	88	54	87	70	104
Non-Hodgkin lymphoma	49	23	26	16	24	33	31	51	37	40	40	43	45	35	46	42	51	47	45	48	58	54
Alzheimer's disease and other dementias	50	26	12	9	8	43	27	53	41	45	66	82	79	76	68	37	81	66	58	80	86	75
Tetanus	52	112	113	113	114	110	118	114	86	108	109	64	121	103	79	59	40	51	104	33	45	25
Acute hepatitis A	54	100	103	104	104	99	108	92	78	101	94	91	91	92	54	104	33	25	98	53	64	44
Alcohol use disorders	55	55	31	47	32	18	41	10	73	25	29	59	39	49	108	54	76	72	61	103	99	117
Kidney and other urinary organ cancers	57	29	25	24	23	27	32	27	36	57	47	75	49	63	57	58	85	80	76	84	85	79
Drug use disorders	58	72	34	22	15	57	69	23	64	71	52	70	37	40	35	52	93	56	24	59	72	69
Prostate cancer	63	31	16	11	27	26	23	42	72	30	34	77	59	42	56	26	100	68	47	75	79	74
Whooping cough	67	99	95	84	87	94	87	95	93	105	65	44	63	37	59	43	37	33	56	21	29	21
Gallbladder and biliary tract cancer	68	15	39	51	58	37	25	59	40	49	45	60	60	44	71	67	63	67	89	113	98	84
Iron-deficiency anaemia	72	77	83	90	81	90	74	89	90	63	43	85	73	38	114	15	75	55	44	54	27	26
Interstitial lung disease and pulmonary sarcoidosis	78	22	47	46	38	70	54	76	71	72	59	100	75	46	65	101	62	81	70	77	77	85
Sickle-cell disorders	80	109	94	107	86	104	105	107	120	80	88	122	117	102	64	51	108	115	100	67	20	28
Malignant melanoma of skin	91	73	38	23	44	45	71	56	77	70	77	106	72	84	103	94	117	48	88	116	113	111
African trypanosomiasis	106	122	120	117	120	119	125	119	124	125	127	123	124	123	124	123	125	120	124	76	23	68

Figure 9: **Regional ranking of leading causes of years of life lost (YLLs), 2010**

Causes in the figure are ordered according to global ranks for causes. The figure shows all causes that are in the 25 leading causes in at least one region. Ranks are also colour-shaded to indicate rank intervals. *Includes birth asphyxia/trauma. An interactive version of this figure is available online at http://healthmetricsandevaluation.org/gbd/visualizations/regional.

disease, and stroke were the top ten causes of premature death in almost all regions in 2010, as were complications of preterm birth in all regions except Europe, high-income Asia Pacific, and east Asia. The massive effect of HIV/AIDS on mortality in most developing regions by 2010 was also clear, with north Africa and Middle East, east Asia, central Asia, and southern Latin America being notable exceptions. Malaria was a leading global cause but a minor cause in most regions outside sub-Saharan Africa and Oceania. Road injury was a remarkably consistent cause of YLLs; its lowest regional ranking is 19th in Oceania and it was in the top five causes in eight regions. All the neonatal causes and tuberculosis were important causes in some developing regions but minor causes in the more epidemiologically and demographically advanced regions. Figure 9 also highlights causes that were not in the top 25 global rankings but were important in selected regions. In some cases, these regional patterns gave a glimpse of future patterns and trends. Suicide was a top ten cause in the eight regions with the most advanced health transition. Other causes that seemed to be strongly related to the epidemiological and demographic transition included colon and rectum cancer, breast cancer, pancreatic cancer, brain cancer, non-Hodgkin lymphoma, Alzheimer's disease, kidney cancer, and prostate cancer. Other diseases had a more focal regional pattern that was not directly related to the broad health transition. More notable examples highlighted by multicoloured rows include: cirrhosis, diabetes, interpersonal violence, sickle-cell disease, whooping cough, poisonings, oesophageal cancer, drug use, gallbladder cancer, malignant melanoma, and African trypanosomiasis. Generally, the distribution of ranks by cause for YLLs was much more heterogeneous than for YLDs.[52] This was true for both time periods and suggests marked regional variation in disease and injury control priorities to improve survival.

Marked variation was noted in cancer rates by site and overall across regions in 2010 (figure 10). Figure 10 shows crude death rates to highlight the mixture of cancers recorded in health systems of every region but to remove the effect of variation in population size across regions. Crude rates are affected both by variation in age-specific and site-specific death rates and by population age-structure. In general, crude cancer death rates were higher in the regions with a more advanced demographic transition. But regions such as high-income Asia Pacific had a substantially different cancer profile from that in western Europe due to breast cancer, liver cancer, and stomach cancer along with a number of smaller cancers. At the other end of the epidemiological spectrum, crude cancer rates in three of the sub-Saharan African regions were the lowest. Central Latin America, tropical Latin America, and Andean Latin America have low cancer rates overall, whereas the Caribbean had higher rates than expected for its demographic transition.

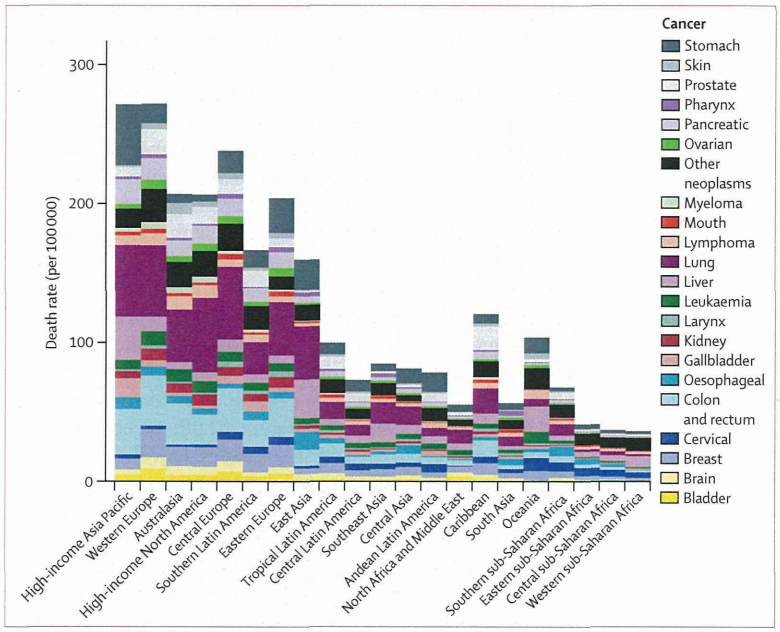

Figure 10: **Cancer death rates in 2010 for all ages and both sexes combined by cause and region**

Discussion

The GBD 2010 is the most comprehensive and systematic analysis of causes of death undertaken to date. The addition of time trends over 1980–2010 and quantification of uncertainty increases both the utility and the methodological rigour of the results. The global health community can now draw on annual estimates of mortality, by age and sex, for 21 regions of the world, for each year from 1980 to 2010, for 235 separate causes, each with 95% UIs to aid interpretation. These estimates of cause of death at the regional level are constructed from separate estimates of cause of death at the country level for 187 countries. No such resource for policy makers, donors, or scholars currently exists. At the most aggregate level, we have documented great changes in cause of death structure in regions such as central Latin America and tropical Latin America. We have also identified regions, such as eastern Europe and central Asia, where mortality has increased profoundly over the past two decades but the cause of death structure has not changed dramatically, at least for leading causes.

The shifting pattern of the number of deaths by cause across time, regions, and age groups is consistent with the three key drivers of change: rising total population, rising average age of the world's population, and the broad epidemiological transition. For communicable, maternal, neonatal, and nutritional causes, the increase expected because of population growth alone is reversed by population ageing and decreases in age-sex-specific death rates. By contrast, both population growth and ageing are driving up the number of deaths from non-communicable diseases and injuries more than the decreases expected