

***Updated projections of global mortality
and burden of disease, 2002-2030:
data sources, methods and results.***

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Evidence and Information for Policy Working Paper

**Evidence and Information for Policy
World Health Organization
October 2005**

Executive summary

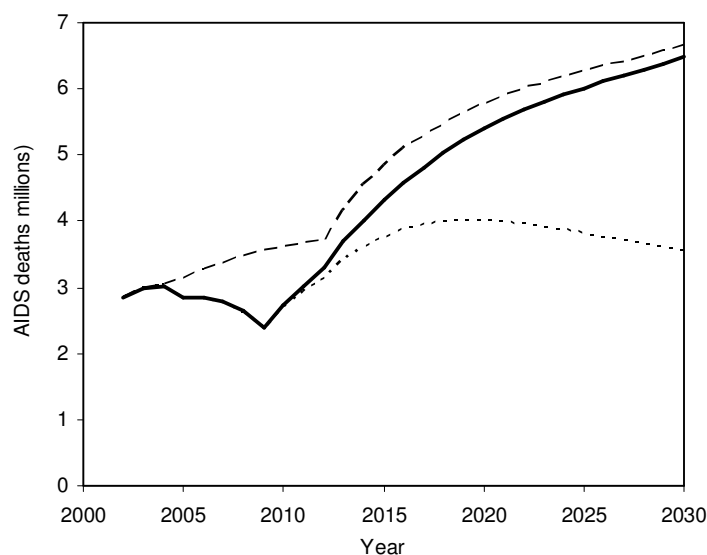
In order to address the need for updated projections of mortality and burden of disease by region and cause, we have prepared updated projections of future trends for mortality and burden of disease between 2002 and 2015 using methods similar to those used in the original Global Burden of Disease (GBD) study (Murray and Lopez 1997). A set of relatively simple models were used to project future health trends under various scenarios, based largely on projections of economic and social development, and using the historically observed relationships of these with cause-specific mortality rates. The data inputs for the projections models have been updated to take account of the greater number of countries reporting death registration data to WHO, particularly from developing regions, and to take into account the latest available projections for HIV/AIDS, income, human capital and other inputs.

Rather than attempt to model the effects of the many separate direct determinants or risk factors for diseases from the limited data that are available, the GBD methodology considered a limited number of socio-economic variables: (1) average income per capita, measured as gross domestic product (GDP) per capita; (2) the average number of years of schooling in adults, referred to as “human capital”; and (3) time, a proxy measure for the impact of technological change on health status. This latter variable captures the effects of accumulating knowledge and technological development, allowing the implementation of more cost-effective health interventions, both preventive and curative, at constant levels of income and human capital. These socio-economic variables show clear historical relationships with mortality rates, and may be regarded as indirect, or distal, determinants of health. In addition, a fourth variable, tobacco use, was included in the projections for cancers, cardiovascular diseases and chronic respiratory diseases, because of its overwhelming importance in determining trends for these causes.

Separate projections for HIV/AIDS mortality were prepared by UNAIDS and WHO, under a scenario in which coverage with anti-retroviral (ARV) drugs reaches 80% by 2012, remaining constant beyond that year, and that there are no changes to current transmission rates due to increased prevention efforts. Projected tuberculosis mortality rates were modified in regions with high HIV prevalence, due to the expected interaction of tuberculosis and HIV. Since a substantial proportion of diabetes mortality is attributable to overweight and obesity, a separate projection model for diabetes mortality was developed using WHO projection of trends in body mass index distributions from 2000 to 2010. Similarly, projections of mortality for chronic respiratory diseases were adjusted for projected changes in tobacco smoking.

Global HIV/AIDS deaths are projected to rise from 2.8 million in 2002 to 6.5 million in 2030 under the baseline scenario. A pessimistic scenario assumed slower achievement of ARV drug coverage (60% by 2012) and an optimistic scenario assumed a mixed treatment-prevention scale-up resulting in reductions in projected HIV incidence beyond 2008. Figure S1 shows the projected global deaths due to HIV/AIDS under the three scenarios. The declining death rates for years 2005 to 2010 in the baseline and pessimistic scenario, followed by increasing death rates, reflect the effects of the assumed treatment scale-up scenarios. Rapidly increasing levels of ART coverage result in postponement of deaths for a number of years, but once the ART coverage plateaus at its final level, death rates continue to rise reflecting underlying trends in incidence rates. Under the optimistic scenario HIV/AIDS deaths start declining around 2018 and are projected to drop to 3.7 million in 2030.

Figure S1: Projections of global AIDS deaths (millions) from 2002 to 2030, for three scenarios: baseline (solid lines), optimistic (dotted lines) and pessimistic (dashed lines).



The projections of global and regional cause-specific mortality under the baseline, optimistic and pessimistic scenarios represent the numerical consequences of the assumptions and methods described in this Working Paper, applied to the Global Burden of Disease estimates for the year 2002. These starting estimates involve considerable uncertainty for certain regions and for certain causes, as do the projections of the covariates used to generate the mortality projections. The uncertainties and limitations of the projections are discussed in greater detail in Section 11 of this paper. The reader should bear in mind that these projections do not necessarily represent reliable predictions of the future, but rather a set of visions of the future resulting from explicit assumptions, covariate projections, and starting estimates.

Figure S2 shows projected life expectancies at birth in 2020 under the three scenarios, by WHO region. Life expectancy at birth is projected to increase in all WHO regions, with the largest increases in the African region, the Eastern Mediterranean and the South-East Asian regions. In all regions except the European region, life expectancy increases are greater for females than for males. Life expectancy at birth is projected to increase to 85 years in 2030 for females in high income countries.

Global numbers of deaths are projected to rise from 57 million in 2002 to 64.3 million in 2015 and 74.3 million in 2030 under the baseline scenario. In all three scenarios there is a dramatic shift in the distribution of deaths from younger to older ages and from communicable, maternal, perinatal and nutritional (Group I) causes to non-communicable disease (Group II) causes. The risk of death for children aged under 5 is projected to fall substantially in the baseline scenario, by almost 30% between 2005 and 2015, and by over 40% between 2005 and 2030. These rates of decline are similar to those projected between 2005 and 2015 in the original GBD projections. The proportion of deaths due to non-communicable disease is projected to rise from 59 per cent in 2002 to 66 per cent in 2030.

Figure S2: Projected life expectancy at birth in 2020 by WHO region: baseline, optimistic and pessimistic scenarios compared with 2002 estimates

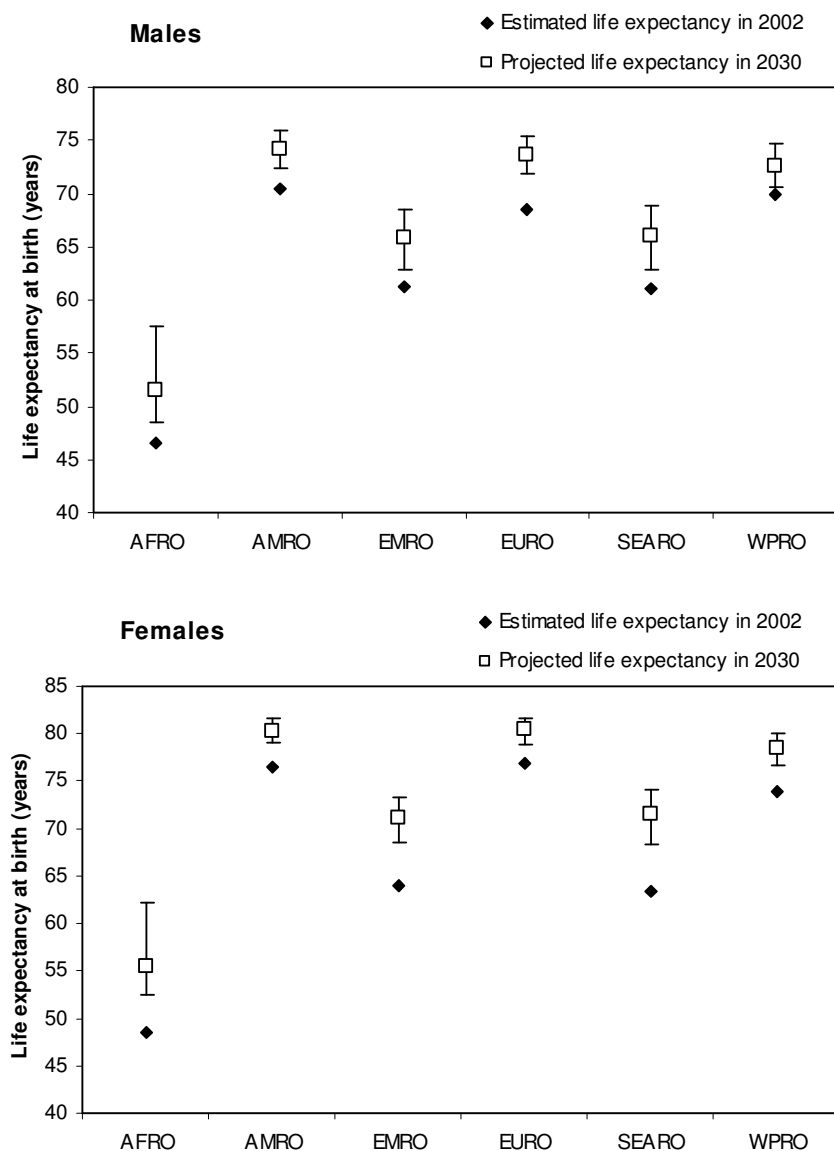
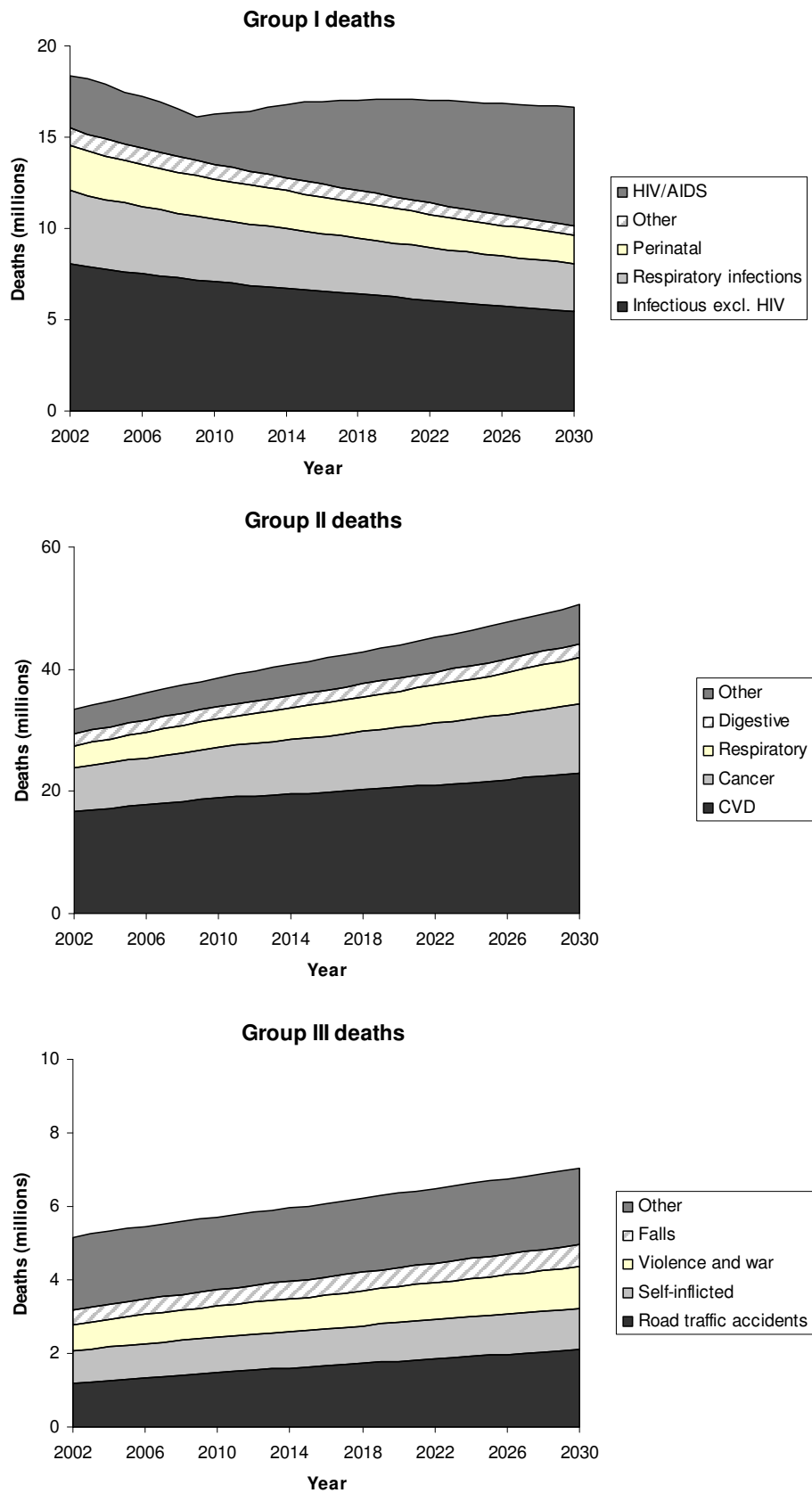


Figure S3 summarizes the contributions of major causes to global trends in numbers of deaths for the three major cause groups. Large declines in mortality between 2002 and 2030 are projected for all of the principal Group I causes with the exception of HIV/AIDS. Total deaths due to Group I causes other than HIV/AIDS are projected to decline from 15.5 million in 2002 to 10.2 million in 2030 under the baseline scenario. Unfortunately, this is substantially offset by the projected rise in HIV/AIDS deaths.

Although age-specific death rates for most Group II conditions are projected to decline (at an average rate of just under 1% per annum), ageing of the population will result in significantly increasing total deaths due to most Group II conditions over the next thirty years. Global cancer deaths are projected to increase from 7.1 million in 2002 to 11.4 million in 2030, and global cardiovascular deaths from 16.7 million in 2002 to 23.0 million in 2030.

Figure S3: Baseline projections of deaths from Group I, Group II and Group III causes, world, 2002-2030



The projected 40 per cent increase in global deaths due to injury (Group III) causes between 2002 and 2030 is predominantly due to the increasing numbers of road traffic accident deaths, together with increases in population numbers more than offsetting small declines in age-specific death rates for other causes of injury. Road traffic accident deaths are projected to increase from 1.2 million in 2002 to 1.9 million in 2030, primarily due increased motor vehicle fatalities associated with economic growth in low and middle income countries.

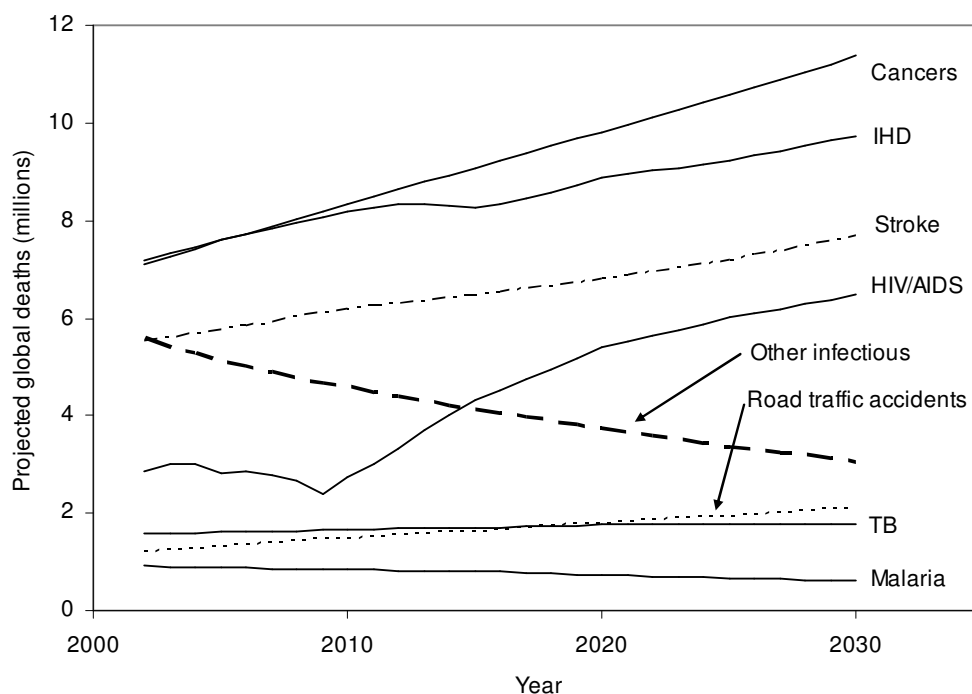
Figure S4 illustrates the changes in rank order of deaths between 2002 and 2030 for the 20 leading causes of death globally. The four leading causes of death in all scenarios are projected to be ischaemic heart disease, cerebrovascular disease (stroke), HIV/AIDS and chronic obstructive pulmonary disease (COPD), although HIV/AIDS moves from third to fourth position in the optimistic scenario. Lower respiratory infections, perinatal conditions, diarrhoeal diseases, malaria and measles are all projected to decline substantially in importance. On the other hand, diabetes mellitus, stomach cancer and oesophagus cancer are all projected to move up three or more places in the rankings.

Figure S4: Change in rank order of deaths for the 20 leading causes, world, 2002-2030

2002			2030		
Disease or injury	% total deaths	Rank	Rank	% total deaths	Disease or injury
Ischaemic heart disease	12.6%	1	1	13.1%	Ischaemic heart disease
Cerebrovascular disease	9.7%	2	2	10.3%	Cerebrovascular disease
Lower respiratory infections	6.9%	3	3	8.7%	HIV/AIDS
HIV/AIDS	4.8%	4	4	7.9%	Chronic obstructive pulmonary disease
Chronic obstructive pulmonary disease	4.8%	5	5	3.5%	Lower respiratory infections
Perinatal conditions	4.3%	6	6	3.1%	Diabetes mellitus
Diarrhoeal diseases	3.3%	7	7	3.0%	Trachea, bronchus, lung cancers
Tuberculosis	2.7%	8	8	2.8%	Road traffic accidents
Trachea, bronchus, lung cancers	2.2%	9	9	2.4%	Tuberculosis
Road traffic accidents	2.1%	10	10	2.1%	Perinatal conditions
Diabetes mellitus	1.7%	11	11	1.8%	Stomach cancer
Malaria	1.6%	12	12	1.8%	Hypertensive heart disease
Hypertensive heart disease	1.6%	13	13	1.5%	Self-inflicted injuries
Self-inflicted injuries	1.5%	14	14	1.3%	Nephritis and nephrosis
Stomach cancer	1.5%	15	15	1.3%	Liver cancer
Cirrhosis of the liver	1.4%	16	16	1.2%	Diarrhoeal diseases
Nephritis and nephrosis	1.2%	17	17	1.2%	Colon and rectum cancers
Colon and rectum cancers	1.1%	18	18	1.1%	Cirrhosis of the liver
Liver cancer	1.1%	19	19	1.1%	Violence
Measles	1.1%	20	20	1.0%	Oesophagus cancer
Violence	1.0%	21	23	0.80%	Malaria
Oesophagus cancer	0.8%	24	42	0.40%	Measles

Figure S5 summarizes projected global trends under the baseline scenario for HIV/AIDS, tuberculosis, malaria, for other infectious diseases, and also includes the major Group II causes (cancers, ischaemic heart disease and stroke) and a Group III cause (road traffic accidents) for which global deaths are projected to increase, not only because of population ageing, but also because of some increases in age-specific mortality rates associated with increasing levels of development.

Figure S5: Projected trends in total deaths for selected causes, baseline scenario, world, 2002-2030

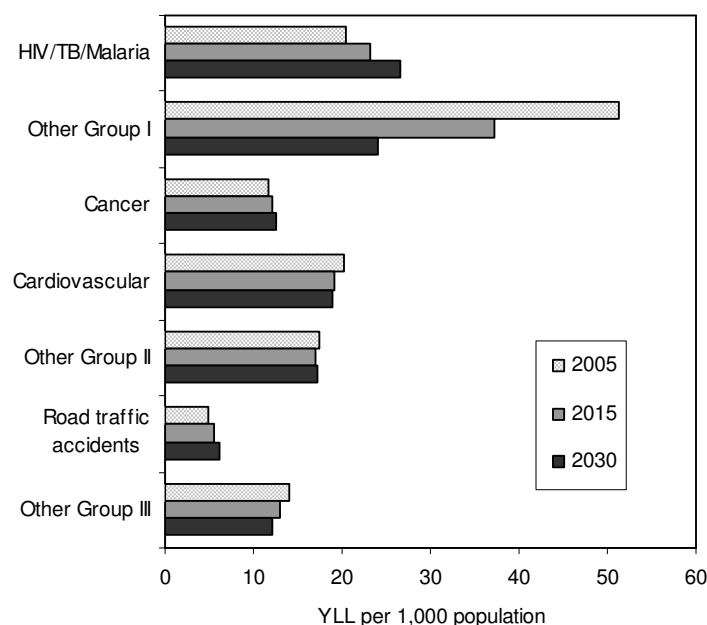


The mortality projections were also used to calculate years of life lost due to mortality (YLL). Figure S6 summarizes the projected trends in global YLL per capita for broad disease groups from 2002 to 2030. YLL give greater weight to deaths at younger age and lower weight to deaths at older ages, so the impact of population growth and ageing on YLL rates is different to that on numbers of deaths. Thus, whereas total deaths and crude death rates for cancers and cardiovascular diseases are projected to increase, YLL rates are projected to increase slightly for cancers, but to decline for cardiovascular diseases.

The mortality projections were used to project the burden of disease as measured by disability-adjusted life years (DALYs), with age-sex specific DALY rates for non-fatal causes largely assumed to remain constant. Global DALYs are projected to increase from 1.48 billion in 2002 to 1.65 billion in 2030, an overall increase of only 11 per cent. Since the population increase is projected to be 22 per cent over the same period, there is actually a decrease in the global per capita burden of 9 per cent. The DALY rate decreases because the increasing number of deaths is offset by the shift in age at death to older ages, associated with fewer lost years of life.

The proportional contribution of the three major cause groups to the total disease burden is projected to change substantially however. Group I causes are projected to account for 30 per cent of total DALYs in 2030, compared with over 40 per cent in 2002. In low income countries, the decline is even greater, from 56 per cent in 2002 to 41 per cent in 2030, even including the more than doubling of the HIV/AIDS burden. In 2030, the non-communicable disease (Group II) burden is projected to increase to 57 per cent, and to represent a greater burden of disease than Group I conditions in all income groups, including low income countries.

Figure S6: Trends in global years of life lost (YLL) per 1,000 population, by broad cause group and income group, 2002-2030



The three leading causes of DALYs in all scenarios are projected to be HIV/AIDS, unipolar depressive disorders and ischaemic heart disease. Road traffic accidents become the fourth leading cause under the optimistic scenario, though perinatal conditions remain the fourth leading cause under the pessimistic scenario. HIV/AIDS becomes the leading cause of burden of disease in middle income countries, as well as low income countries, by 2015. Figure S7 illustrates the changes in rank order of DALYs between 2002 and 2030 for the 20 leading causes globally. Lower respiratory infections, perinatal conditions, diarrhoeal diseases, malaria, measles, protein-energy malnutrition and congenital anomalies are all projected to decline substantially in importance. On the other hand, ischaemic heart disease, diabetes mellitus, lung cancer, COPD, age-related vision disorders and cataracts are all projected to move up three or more places in the rankings. Hearing loss disorders are projected to be among the top ten causes of burden of disease in high and middle income countries, and Alzheimer disease and other dementias and alcohol use disorders among the top ten causes in high income countries in 2030. In low income countries in 2030, malaria and tuberculosis are projected to remain among the top ten causes of burden of disease, as are diarrhoeal diseases and lower respiratory infections.

The uncertainty in regional and global assessments of mortality and disease burden for 2002 must be kept in mind when using the projections of mortality and burden of disease to 2030. The projections are not intended as forecasts of what will happen in the future but as projections of current and past trends, based on certain explicit assumptions. The results depend strongly on the assumption that future mortality and risk factor trends in poor countries will have a similar relationship to economic and social development as has occurred in the higher income countries over the last 50 years. Additionally, no attempt has been made to forecast possible global influenza epidemics or major natural disasters or conflicts. With these caveats, the global burden of disease projections provide a useful indication of what are the likely overall results of economic growth, the continuation of the epidemiological

transition, the future course of epidemics such as the HIV/AIDS epidemic, and the impact of population ageing in developing regions.

Figure S7: Change in rank order of DALYs for the 20 leading causes, world, 2002-2030

2002			2030		
Disease or injury	% total deaths	Rank	Rank	% total deaths	Disease or injury
Perinatal conditions	6.6%	1	→	10.3%	HIV/AIDS
Lower respiratory infections	6.3%	2	→	5.3%	Unipolar depressive disorders
HIV/AIDS	5.7%	3	→	4.4%	Ischaemic heart disease
Unipolar depressive disorders	4.5%	4	→	3.8%	Chronic obstructive pulmonary disease
Diarrhoeal diseases	4.3%	5	→	3.8%	Perinatal conditions
Ischaemic heart disease	4.0%	6	→	3.7%	Cerebrovascular disease
Cerebrovascular disease	3.3%	7	→	3.6%	Road traffic accidents
Road traffic accidents	2.6%	8	→	2.9%	Cataracts
Malaria	2.3%	9	→	2.8%	Lower respiratory infections
Tuberculosis	2.3%	10	→	2.5%	Tuberculosis
Chronic obstructive pulmonary disease	1.9%	11	→	2.5%	Hearing loss, adult onset
Congenital anomalies	1.8%	12	→	2.5%	Diabetes mellitus
Hearing loss, adult onset	1.7%	13	→	2.0%	Diarrhoeal diseases
Cataracts	1.7%	14	→	1.8%	Violence
Violence	1.4%	15	→	1.4%	Malaria
Measles	1.4%	16	→	1.4%	Vision disorders, age-related
Self-inflicted injuries	1.4%	17	→	1.4%	Self-inflicted injuries
Alcohol use disorders	1.4%	18	→	1.4%	Osteoarthritis
Protein-energy malnutrition	1.1%	19	→	1.3%	Alcohol use disorders
Diabetes mellitus	1.1%	20	→	1.2%	Trachea, bronchus, lung cancers
Osteoarthritis	1.0%	24	→	1.2%	Congenital anomalies
Vision disorders, age-related	0.9%	25	→	0.6%	Measles
Trachea, bronchus, lung cancers	0.8%	31	→	0.5%	Protein-energy malnutrition

Contents

Executive Summary	1
1. Introduction	10
2. Overview of methods: major analytic components	12
3. Major cause regressions	15
4. Projections of GDP per capita, human capital, smoking intensity and technological change	24
5. Regression equations for detailed causes	35
6. Projections for HIV/AIDS and TB	38
7. Projecting years lived with disability	48
8. Projection scenarios.....	52
9. Population projections.....	54
10. Results.	60
11. Discussion and conclusions.....	92
Acknowledgements	95
References	96
Annex Tables.....	101

1. Introduction

As part of the original Global Burden of Disease study for the year 1990, Murray and Lopez prepared projections of mortality and burden of disease by cause forward to 2000, 2010 and 2020 under three alternate scenarios (Murray and Lopez A.D. 1996; Murray and Lopez 1997). These projections have been widely used and continue to be quoted by WHO programs seeking to provide information on likely future trends in global health, see for example (Mackay and Mesah 2004). However, these projections were based on the GBD 1990 estimates and on projections of HIV/AIDS, smoking, income and human capital from 1990 to 2020. The HIV/AIDS projections in particular have proven to substantially underestimate to spread of the HIV epidemic and the level of HIV/AIDS mortality around 2000.

In order to address the need for updated projections of mortality and burden of disease by region and cause, we have prepared updated projections of future trends for mortality and burden of disease between 2002 and 2015 using methods similar to those used in the original Global Burden of Disease (GBD) study, but based on the latest available GBD estimates for 2002, and using the latest available projections for HIV/AIDS, income, human capital and other inputs. Funding support was provided for this work by two WHO programs requiring up-to-date mortality and burden of disease projections: the WHO Department of Chronic Diseases and Health Promotion (NMH/CHP), and the WHO Commission on Intellectual Property Rights, Innovation and Public Health (CIPIH).

The objectives of this update were to prepare updated projections of mortality and burden of disease for the years 2002 to 2030 with revisions to all inputs, but using essentially the same methods as the projections carried out in the original Global Burden of Disease study. Given the relatively short time frame available for the revision, and limitations on available resources, it was not intended to undertake major new methodological developments, but rather to provide up-to-date projections for the first thirty years of the 21st century, using as much relevant new information as is available. Detailed results are presented here, and available on the WHO website, for the years 2005, 2015 (the target year for the Millennium Development Goals), and for 2030. The updated projection results have also been extensively used in the recently released WHO global report *Preventing chronic diseases: a vital investment* (World Health Organization 2005b).

A set of relatively simple models were used to project future health trends under various scenarios, based largely on projections of economic and social development, and using the historically observed relationships of these with cause-specific mortality rates (see Section 2 for a more detailed overview). The data inputs for the projections models have been updated to take account of the greater number of countries reporting death registration data to WHO, particularly from developing regions, and to take into account other recently developed projection models on HIV/AIDS and other conditions where appropriate, and smoking epidemics.

There is an extensive literature on the projection or forecasting of all-cause mortality rates and mortality rates for specific diseases. The methods used fall into two broad groups. First are those methods based on time-series analysis of historical trends in mortality rates. By their data requirements, such methods are generally limited to high income countries with good death registration data, see for example Lee and Carter (Lee 2000; Lee and Carter 1992) and AIHW (Vos et al. 2005). Second, are those methods based on relationships between mortality and a set of independent variables, and necessarily projections of those independent variables. The Global Burden of Disease projections fall into this class, as do a number of more

sophisticated and data-demanding risk-factor based models for specific causes (Bronnum-Hansen 1999; Stover et al. 2002; Weinstein et al. 1987; Wolfson 1994). Methods also vary as to whether mortality is projected for all age groups simultaneously, or separate models developed for each age-sex group, and as to whether separate cause-specific projections are carried out. To our knowledge, the original Global Burden of Disease projections are the only attempt to date to project cause-specific mortality, rather than all-cause mortality, for a complete set of causes at global and regional level.

Recently, both types of projection model have been extended to use a Bayesian framework allowing incorporation of prior knowledge and enforcing coherence in the resulting mortality estimates across age groups, causes and regions. Czado et al (Czado, Delwarde, and Denuit 2005) have extended the Lee-Carter Poisson log-bilinear model into a Bayesian model. Girosi and King have developed a Bayesian forecasting model which models future values of log-mortality as functions of current values of covariates known to affect risk of death, such as GDP, total fertility rates, cigarette consumption, fat consumption and human capital (Girosi and King 2003). The Bayesian framework allows different country-age-group cross-sections to “borrow strength” from each other in order to overcome the serious data limitations faced for many countries. It also constrains the projections to vary smoothly over time, and across age groups in accordance with known age profiles for specific causes of death. The detailed application of this model incorporating major known risk factors for specific causes of public health importance should result in substantially improved forecasts of global mortality and burden of disease trends in the next few years.

In the meantime, these updated projections provide a comprehensive update of the original Global Burden of Disease projections, and include up-dated projections for income and human capital, an updated base set of estimates, and updated analyses of the associations between mortality trends and income, human capital, time and tobacco smoking. This working paper summarizes the methods, assumptions, input data and results for the updated projections and discusses some of the limitations and issues in their interpretation.

2. Overview of methods: major analytic components

Rather than attempt to model the effects of the many separate direct determinants or risk factors for disease from the limited data that are available, the GBD methodology considered a limited number of socio-economic variables: (1) average income per capita, measured as gross domestic product (GDP) per capita; (2) the average number of years of schooling in adults, referred to as “human capital”; and (3) time, a proxy measure for the impact of technological change on health status. This latter variable captures the effects of accumulating knowledge and technological development, allowing the implementation of more cost-effective health interventions, both preventive and curative, at constant levels of income and human capital (Murray and Lopez A.D. 1996).

These socio-economic variables show clear historical relationships with mortality rates, and may be regarded as indirect, or distal, determinants of health. In addition, a fourth variable, tobacco use, was included in the projections for cancers, cardiovascular diseases and chronic respiratory diseases, because of its overwhelming importance in determining trends for these causes. Tobacco use was measured in terms of “smoking intensity” - that component of observed lung cancer mortality that is attributable to tobacco smoking (Peto et al. 1992).

For the projections reported here, death rates for all major causes excluding HIV/AIDS were related to these four variables using historical death registration data for 107 countries between 1950 and 2002 (Mathers et al. 2005). Death rates were then projected using World Bank projections of GDP per capita, WHO projections of human capital, and smoking intensity projections based on historical patterns of tobacco use and further adjusted for recent regional trends in tobacco consumption where appropriate.

Separate projections for HIV/AIDS mortality were prepared by UNAIDS and WHO, under a scenario in which coverage with anti-retroviral drugs reaches 80% by 2012, remaining constant beyond that year, and that there are no changes to current transmission rates due to increased prevention efforts. Projected tuberculosis mortality rates were modified in regions with high HIV prevalence, due to the expected interaction of tuberculosis and HIV. Since a substantial proportion of diabetes mortality is attributable to overweight and obesity (James et al. 2004), a separate projection model for diabetes mortality was developed using WHO projection of trends in body mass index distributions from 2000 to 2010. Similarly, projections of mortality for chronic respiratory diseases were adjusted for projected changes in smoking intensity.

Whereas the original GBD projections assumed that the changes in death rates associated with income growth and time in countries with death registration data, mostly medium and high income countries, would also apply in low income countries, the new projections for low income countries (income less than \$3000 per capita in 2002) were based on the observed relationships for a data set consisting of 3,468 country-years of observation where income per capita was less than \$10,000 per year. Additionally, observed regional trends in child mortality from 1990 to 2002 were compared with those predicted by the projection model for low income countries. As a result, the regression coefficient for time was set to zero for sub-Saharan Africa, and to 25% of its original value for other low income countries.

The WHO projections of mortality rates to 2015, together with UN medium variant assumptions for fertility rates and migration rates (United Nations Population Division 2003), were also used to prepare consistent population projections for all regions. The projected

global population in 2015 was 7.1 billion compared to the UN medium variant projection of 7.2 billion, reflecting somewhat higher adult death rates in the WHO mortality projections.

2.1 Overview of the steps in the projection procedure

The projection method which we have used involves thirteen separate analytical or computational steps. Below, a brief outline of the overall approach is presented. In subsequent sections, more complete detail is provided. The steps in the projection procedure were as follows:

1. Parsimonious regression equations for ten major cause-clusters, for 14 different age-sex groups, were estimated from a panel of 5,210 country-years of vital registration data from 107 countries for years in the range 1950-2002. The regression equations relate age- sex- and cause-specific mortality rates to four distal determinants of mortality: income per capita, human capital (measured by average years of education for adults), smoking intensity and time. Separate regression equations were developed for low income countries.
2. For each cause-cluster in each age-sex group, a choice was made between using the final parsimonious regression equation, an alternative assumption such as stable (constant) rates, or a separate prediction model based on projections for the major relevant risk factor (diabetes mellitus and chronic respiratory diseases).
3. Model predictions of age-, sex- and cause-specific mortality rates in 2002 for each of the ten clusters of causes were compared for each country with the results of the Global Burden of Disease Study for that year. A series of scalars were then derived so that projected values for 2002 were identical to the 2002 GBD results. It is then assumed that these scalars would remain constant over the period 2002-2030.
4. Baseline, pessimistic and optimistic projections of income per capita, human capital and smoking intensity were developed.
5. Regression equations were developed relating age- and sex-specific mortality rates for 132 detailed causes to the age- and sex-specific mortality rates from corresponding cause-clusters, based on ICD-9 coded vital registration data from 98 countries.
6. For countries with good death registration data and populations of 5 million or more, trends in mortality rates were estimated for ischaemic heart disease, cerebrovascular disease, tuberculosis, suicide and homicide. These were used to adjust the initial years of relevant country-specific projections to match the recent observed trends.
7. Separate projection models were developed for diabetes mellitus and chronic respiratory diseases, based on projections of body mass index distributions and smoking intensity, respectively.
8. Separate projections for HIV/AIDS incidence, prevalence and mortality were developed based on projection models prepared by UNAIDS and WHO under different assumptions about trends in coverage of anti-retroviral drugs, and for an optimistic scenario involving increased prevention efforts.
9. Projected tuberculosis mortality rates were modified in middle and low income countries, to reflect the expected interaction of tuberculosis and HIV.

10. Age-, sex- and cause-specific mortality rates were projected for years from 2003 to 2030 for 192 WHO Member States. The resulting country projections were added back into regional groups for presentation of results.
11. Projections of Years of Life lived with Disability (YLDs) were developed based on the ratio of YLDs to Years of Life Lost due to premature mortality (YLLs) in the GBD results for 2002. For those conditions where there is little or no mortality, alternative assumptions were used. For ischaemic heart disease and stroke, future case fatality rates were assumed to decline with improvements in income per capita.
12. Population projections for each country were developed based on UN Population Division projections of fertility and net migration and our projected mortality rates.
13. Baseline, optimistic and pessimistic projections of the numbers of deaths and DALYs for each condition were made using the projected rates and population projections.

2.2 Projections for countries

Projections were carried out at country level, but aggregated into regional or income groups for presentation of results, apart from the projections for nine selected countries included in the WHO Global Report on chronic diseases (World Health Organization 2005b). Baseline estimates at country level for 2002 were derived from the GBD analyses published in the World Health Report 2004 (World Health Organization 2004). Mortality estimates were based on analysis of latest available national information on levels of mortality and cause distributions as at late 2003. Incidence, prevalence, duration and severity estimates for conditions were based on the GBD analyses for the relevant epidemiological subregion, together with national and sub-national level information available to WHO. These baseline estimates represent the best estimates of WHO, based on the evidence available to it in mid-2004, rather than the official estimates of Member States, and have been computed using standard categories and methods to maximize cross-national comparability.

Initial WHO estimates and technical explanations were sent to member states for comment in 2003 and comments or additional information incorporated where possible. Country-specific projections were shared with relevant WHO country offices and member states in advance of publication.

2.3 Regional categories

Projections of mortality and burden of disease to 2015 and 2030 have been summarized according to two groupings of countries:

- WHO regions. Countries in each WHO region are shown in Annex Table A-1.
- Income categories based on GNI per capita in 2001 (see Annex Table A-2).

The income categories were based on World Bank estimates of gross national income (GNI) per capita in 2001 (World Bank 2003). Each country is classified as low income, middle income (subdivided into lower middle and upper middle), or high income. GNI per capita is calculated using the World Bank Atlas method (converting national currency to US dollars based on a three year average of exchange rates). The groups are: low income, \$745 or less; lower middle income, \$746 - \$2,975; upper middle income, \$2,976 - \$9,205; and high income, \$9,206 or more.

3. Major cause regressions

The original GBD study used a set of relatively simple models to project future health trends, based largely on projections of economic and social development, and using the historically observed relationships of these with cause-specific mortality rates. Rather than attempt to model the effects of the many separate direct determinants or risk factors for disease from the limited data that are available, the GBD methodology considered a limited number of socio-economic variables: average national income per capita, average years of schooling in adults, and time. In addition, a fourth variable, tobacco use, was included in the projections for cancers, cardiovascular diseases and chronic respiratory diseases, because of its overwhelming importance in determining trends for these causes.

The updated projections have essentially used the same approach, with separate projection models for males and females and for seven age groups: 0-4 years, 5-14, 15-29, 30-44, 45-59, 60-69 and 70 years and over, estimated on an updated panel dataset of available death registration data from 107 countries for the years 1950-2002. Murray and Lopez divided causes of death into nine clusters of causes, chosen because mortality trends over the past 40 years in countries with good vital registration data suggest that the more specific causes within each cluster have followed a similar time-trend. With the exception of the HIV epidemic, tuberculosis, and the change in the composition of cardiovascular disease deaths and cancer deaths with socio-economic development, these nine clusters of causes appeared to capture much of the dominant trends in cause-specific mortality rates between 1950 and 1990.

For the updated projections, similar major cause clusters were used with the modification that diabetes mellitus was excluded from ‘Other Group II diseases (non-communicable diseases)’ and treated as a separate cause category (Table 1). The GBD Group I causes comprise communicable, maternal, perinatal and nutritional conditions: the full GBD cause list is defined in terms of ICD-9 and ICD-10 codes of the International Classification of Diseases in Annex Table A-3. Diabetes mellitus was treated as a separate cause category since the available evidence suggests that its dominant risk factor, overweight and obesity, is becoming more prevalent over time in both developed and developing regions, and is projected to continue to rise (WHO Global Infobase Team 2005). In contrast, age-specific death rates for ‘Other Group II diseases’ are generally projected to decrease with continuing economic development. Projections for diabetes mellitus are discussed in more detail below. Projections for HIV/AIDS mortality were carried out separately. These and adjustments to projections for tuberculosis mortality are described in Section 5 below.

Table 1. Nine major cause clusters used for estimation of parsimonious regression models

Major cause cluster	Cause	GBD cause code (see Annex Table A-3)
1	Group I excluding HIV	W001excluding W009
2	Malignant neoplasms	W060
3	Cardiovascular diseases	W104
4	Digestive diseases	W115
5	Respiratory diseases	W111
6	Other Group II (excluding diabetes)	W078, W080, W081, W098, W120, W124, W125, W131, W143
7	Road traffic accidents	W150
8	Other unintentional injuries	W151, W152, W153, W154, W155
9	Intentional injuries	W156
*	Diabetes mellitus	W079

3.1 The regression models

The original GBD projections assumed that there is a general relationship between mortality rates for the nine major cause-clusters and a limited set of socio-economic variables of the form:

$$M_{a,k,i} = f(HC, Y, SI, T) \quad (1)$$

where $M_{a,k,i}$ is the mortality rate in age group a and sex k from cause i , HC is a variable measuring human capital, Y is income per capita, SI is smoking intensity, and T is time. This basic functional relationship makes no specific assumptions about the relationships between these more distal socio-economic determinants and more proximate determinants of mortality rates such as environmental, life style and physiological risk factors. Nevertheless, the regression results presented below indicate that a considerable proportion of the variance in age-, sex- and cause-specific mortality rates can be explained by this limited set of distal determinants.

Income per capita, measured in international dollars, and adjusted for differences in purchasing power not captured in official exchange rates, is used as a general proxy for many aspects of development. Estimates of income per capita in international dollars have been prepared for all WHO Member States for the years 1950-2002 by the WHO Evidence and Information for Policy (EIP) cluster (see Section 4.1). Equally importantly, research has consistently shown that education is an important distal determinant of health status (Caldwell and Caldwell 1991; Caldwell 1979; Cleland and van Ginneken J 1988). Following Murray and Lopez, we use the average number of years of schooling of the population above the age of 25 to reflect average education levels. This variable has been labelled “human capital” and has been estimated for WHO Member States as described in Section 4.2.

In addition, a fourth variable, tobacco use, was included in the projections for cancers (malignant neoplasms), cardiovascular diseases and chronic respiratory diseases, because of its overwhelming importance in determining trends for these causes. Smoking prevalence rates from community surveys are notoriously poor measures of the overall health impact of smoking, since they do not reflect other important factors affecting exposure including duration, type, amount and mode of smoking. Tobacco use was thus measured in terms of “smoking intensity” - that component of observed lung cancer mortality that is attributable to tobacco smoking (Peto et al. 1992). Smoking intensity was calculated from the death registration data for each country-year, by subtracting estimated non-smoker lung cancer mortality rates from the overall lung cancer mortality rates (see Section 4.3). This smoking intensity variable was included in the regression equations for malignant neoplasms, cardiovascular diseases and chronic respiratory diseases for males and females aged 30 years and older.

The fourth independent variable used in the projections is time itself. Technology has profoundly changed in the health sector over the last 50 years and continues to change with substantial investments in research and development. Obtaining a measurement of technical change is not only difficult (such data are usually not available) but also controversial. Following Murray and Lopez, we used calendar year as a proxy measure of the impact of technological change on health status.

The specific functional form chosen for equation (1) was the following log-linear model:

$$\ln M_{a,k,i} = C_{a,k,i} + \beta_1 \ln Y + \beta_2 \ln HC + \beta_3 (\ln Y)^2 + \beta_4 T + \beta_5 \ln SI \quad (2)$$

where $C_{a,k,i}$ is a constant term, $M_{a,k,i}$ is the mortality level for age group a , sex k , and cause i , and Y , HC and T denote GDP per capita, human capital and time, respectively. The log of the smoking intensity SI is included in the equation only for malignant neoplasms, cardiovascular diseases, and respiratory diseases. With this functional form, the elasticity of the mortality rate with respect to GDP per capita and human capital is constant, as is the rate of change of mortality with respect to time. Hence, for instance, a 1 per cent change in per-capita income leads to a β_1 per cent change in the mortality rate for the particular age-cause group. The squared term for the log of GDP per capita is also included in the equation in order to allow for further non-linearity in the relationship between age-, sex- and cause-specific mortality and these independent variables.

Murray and Lopez used a variety of econometric approaches to estimate the equations of this form, including methods which take into account auto-correlation and heteroscedasticity. Because these methods substantially restricted the subset of panel data which could be used, and in particular resulted in much loss of information for moderate to high mortality populations, they chose to use ordinary least squares (OLS) regression based on the entire dataset for the final set of parameter estimates.

3.2 Death registration dataset

The original GBD projections used a panel dataset of 1394 country-years based on vital registration data from 47 countries for the years 1950-1990. For these new projections, death registration data from 106 countries for the years 1950-2002 were used to develop the regression equations. For many countries, the data series was incomplete. In total, 2,605 observation years were available, almost double those used for the original projections. The dataset includes most countries of Europe, the Americas, Australia, New Zealand and Japan, as well as a number of Eastern Mediterranean, Asian and African countries with useable death registration data. Country-years of death registration data were distributed as follows: high income countries (1261 country-years), other European countries (531), Latin America and the Caribbean (609), Eastern Mediterranean (36), sub-Saharan Africa (44), South East Asia (25), middle and low income countries of the Western Pacific (89).

Even though the dataset is extensive, it does not include many observations from populations with high rates of mortality. The original GBD projections used only observations considered reasonably complete and reliable, and the applications of predictive equations based on a largely high income country dataset to regions such as sub-Saharan Africa is obviously highly tentative. For the revised projections, all observations for which levels of completeness of child and adult death registration could be estimated were included after adjustments for incomplete registration.

Completeness of death registration data for countries with data in the period 1990-2002 has been analyzed for the GBD project using available demographic techniques (Mathers et al. 2003a). The Preston-Coale method, Brass Growth-Balance method, Generalized Growth-Balance method and Bennett-Horiuchi method were applied, as appropriate, to assess the level of completeness of the recorded mortality data for adults. If the data coverage estimate were high enough to be meaningful, death rates above age 5 were then adjusted accordingly.

Completeness of child death registration was separately assessed using all available survey, census and vital registration data.

For years prior to 1990, completeness of registration of child deaths was estimated through comparison with analyses of data on trends in child mortality over the past few decades (Ahmad, Lopez, and Inoue 2000). For adult deaths, it was not feasible to carry out detailed completeness analyses for earlier years. Instead, unpublished EIP analyses of predictors of adult death registration completeness were used to prepare initial estimates for males and females for country-years prior to 1990. These predictions were based on cross-sectional regressions of adult completeness estimates for recent years (1990-2002) on a number of variables relating to levels of development (per cent of population urban, telephone mainlines per capita, electricity consumption per capita). These initial estimates were then further adjusted after careful review of the implied all cause mortality trends and region-specific comparison of trends across countries at similar levels of economic development.

Table 2 summarizes the numbers of countries for which death registration data were available, by region, according to estimated levels of adult completeness. Because estimated levels of adult completeness for years prior to 1990 are uncertain, a number of regression models were run to test the sensitivity of the projection results to these assumptions. Regressions were rerun on a dataset where country-years with estimated levels of adult completeness below 90% were excluded. Regressions were also rerun with observations weighted according to level of completeness. These alternate regressions did not result in any substantial change in the resulting projections for major cause groups.

Table 2: Availability and completeness of adult death registration data, 1950-2002

	WHO Region						World
	AFRO	AMRO	EMRO	EURO	SEARO	WPRO	
Latest year incomplete (<90%)	1	12	1	8	1	3	26
Earlier years incomplete (<90%)	2	21	2	8	2	3	38
All years >90% complete	2	12	3	43	0	8	68
Total	4	33	5	51	2	11	106

In order to estimate mortality for the major cause clusters over a long period of time, causes of death coded according to the 6th, 7th, 8th, 9th and 10th Revisions of the International Classification of Disease (ICD) were analysed and a mapping of ICD codes for each of the nine cause-clusters across the five revisions of the ICD was developed. Additional pre-processing of country-year death registration data, included the following adjustments:

- unknown ages were redistributed;
- unknown sex was redistributed;
- unknown age and sex deaths were dropped;
- deaths coded to ICD codes for ill-defined causes were redistributed across Groups I and II;
- undetermined intent injury deaths were redistributed across unintentional and intentional;

- deaths coded to cancer and cardiovascular garbage codes were redistributed within detailed cause groups.

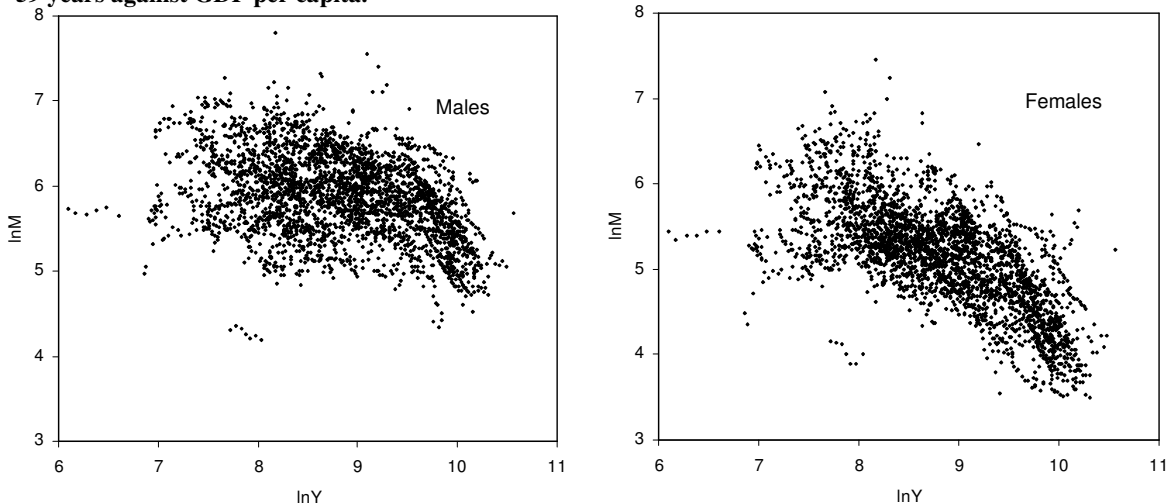
These adjustments are described in more detail elsewhere (Mathers et al. 2003a).

For the major cause regressions, the following observations were also excluded:

- country-years with less than 10 deaths for the age-sex-cause category;
- country-years with total male plus female population of less than 50,000;
- country-years for certain age-sex-cause groups in some small countries, where visual inspection suggested that data were not reliable.

The resulting regression dataset is illustrated in Figure 1, which shows plots of country-year observations for the log of the cardiovascular disease mortality rate (M) for ages 45-59 years against the log of GDP per capita (Y).

Figure 1: Scatterplot of country-year observations for cardiovascular disease mortality rates for ages 45-59 years against GDP per capita.



3.3 Regression models for low income countries

Whereas the original GBD projections applied a single set of models based on all observed death registration data for projections in all regions, these revised projections have used a second set of models for low income countries based on the observed relationships for a low income data set consisting of 3,468 country-years of observation where GDP per capita was less than \$10,000. This limit was chosen as all low income countries in 2002 (GDP per capita less than \$3,000) had projected GDP per capita of less than \$10,000 in 2030.

These regression results give somewhat more conservative declines for Group II in low income regions. The results are listed in Annex Table A-5. We applied the low income regression betas for countries where GDP per capita in 2002 is less than 3,000 international dollars - with slight modifications listed below in Table 3 to preserve regional homogeneity of approach. This corresponds to the 2002 boundary for World Bank income groups low income and lower middle income countries. This group includes almost all of Africa, EMRO D, SEAR D, and AMRO D and a handful of countries in AMRO B, EURO B and C, and some

countries in WPR B and SEAR B (these references are to the 14 subregions used in the reporting of the GBD results in recent World Health Reports). In none of these countries does projected per capita income exceed \$10,000 in 2030.

Table 3. Countries for which low income regression equations were used.

WHO Region	Low income regression betas
AFRO	All Member States ¹
AMRO	Bolivia, Guyana, Haiti, Honduras, Nicaragua
EMRO	Afganistán, Djibouti, Iraq Pakistan, Yemen, Somalia, Sudan
EURO	Armenia, Azerbaijan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
SEARO	Bangladesh, Bhutan, India, Democratic People's Republic of Korea, Maldives, Myanmar, Nepal, Timor-Leste
WPRO	Cambodia, Kiribati, Lao People's Democratic Republic, Mongolia, Niue, Papua New Guinea, Solomon Islands, Tuvalu, Viet Nam,

¹ A few have incomes just above 3000 (SA, Seychelles, Mauritius, etc), but decided preferable to keep same method for all

3.4 Selection of parsimonious predictive equations

Following the same criteria as the original GBD projections, parsimonious equations were developed based on two criteria. First, if the sign for a variable was consistent with our prior hypothesis, but the parameter estimate was not significant at the 5 per cent level, this variable was excluded from the model. If the sign of a parameter estimate was the opposite of our prior hypothesis, then the variable was excluded from the model if the parameter estimate was not significant at the 1 per cent level. In the case where the coefficient for $\ln Y$ was not significant, but that for $(\ln Y)^2$ was, then the term for $(\ln Y)^2$ was dropped from the equation first. When more than one variable was to be excluded according to these criteria, both variables were dropped only if an F-test for the combination of variables was not significant. Annex Table A-4 summarizes the final parsimonious regression equations for each of the nine cause-clusters for the fourteen age-sex groups that were used to project death rates.

In general, these equations are broadly similar to those estimated for the original projections. Apart from injuries, they explain a surprising proportion of the variance for many age-sex-cause categories. For males and females aged 70 and above, the R^2 for many cause-clusters was generally lower than for other age groups, probably reflecting poorer quality of coding of causes of death or the smaller range of variation in mortality rates between countries at these older ages. The lower proportions of variance explained for injuries may reflect lower levels of temporal variation in these causes.

For some cause-clusters in some age-sex groups, the R^2 for the regression equation was low—for example, the R^2 for road traffic accidents among males aged 0-4 years was 0.03 (Annex Table A-4). In the original GBD projections, it was assumed that the age-sex specific mortality rate will stay constant for those causes where the R^2 was less than 10 per cent. In addition, constant rates were assumed for intentional injuries despite R^2 values as high as 0.30 for females aged 45-59 years, due to implausibly rapid predicted rises and the generation of implausible age-patterns.

The following cause-age-sex groups also had R^2 below 10%:

- Malignant neoplasms: low income regressions for males 5-14, 15-29 and females 5-14
- Other Group II: low income regressions for males and females aged 0-4

- RTA (low income and full data set) females 5-14, 70+, and for full dataset regressions female 60-69 also.

For all these groups, the projected trends by region were consistent with those for other age groups. So to preserve age structure, we have left these regression betas in the projections.

We carefully examined the regional trends resulting from the application of the regression results for the injury cause groups, and decided to use the regression equations for road traffic accidents and unintentional injuries. Due to low R^2 for older age groups, we assumed unintentional injury rates were constant for males aged 70 and over, and for females aged 60 and over. For intentional injuries, we assumed constant death rates for males aged 0-4, 60-69, 70 and over, and for females aged 0-4, 45-59, 60-69 and 70 and over. We further modified predicted trends for violence and war deaths as described in Section x.x.

We also tested several variant regression models to examine the sensitivity of the final projection results to the adjustments for incomplete death registration. The regression analyses were also carried out with observations weighted by the inverse of the square root of the number of deaths in the observation (to reflect greater uncertainty associated with smaller numbers of deaths), and with observations based on incomplete death registration data given lower weight reflecting greater uncertainty. Projected trends in death rates for major cause groups were not substantially altered by use of regression estimates from either of these two alternative analyses and it was concluded that the inclusion of observations from smaller populations, and from countries with incomplete death registration, were not substantively changing the projections.

3.5 Diabetes

Whereas the original GDP projections treated diabetes as part of a single “Other Group II” cause group for which age-specific death rates were projected to decline with development, the new projections treated diabetes as a separate cause. Initial regression analysis of the historical data found inconsistent trends between males and females, probably reflecting the large variations across countries and inaccuracies in recording diabetes as underlying cause of death in many death registration systems. While overall trends for diabetes mortality showed no consistent relationship across the sexes or levels of development, the regression analysis found significant betas for T (year) with death rates increasing with time.

For this reason, a separate projection model for diabetes mortality was developed using the Comparative Risk Assessment (CRA) project's analysis of the relative risk of diabetes mortality with increasing prevalence of overweight and obesity (as measured by body mass index) and WHO projections of population distributions of body mass index (BMI). This model was based on the finding that one half or more of global diabetes mortality was attributable to high BMI in 2000: 50% for males and 66% for females. In the European region and other high income countries around 80% or more of diabetes mortality was attributable to high BMI relative to a counterfactual normal distribution of BMI with mean 21 and standard deviation 1 kg/m² (James et al. 2004).

For a population aged a and sex k , with BMI distribution $P_{a,k}(x)$, where x is the BMI level, the relative risk of diabetes mortality compared with a population with the counterfactual BMI distribution of $P'_{a,k}(x)$ is given by:

$$RR_{a,k} = \int_{x=0}^m RR_{a,k}(x)P_{a,k}(x)dx - \int_{x=0}^m RR_{a,k}(x)P'_{a,k}(x)dx \quad (3)$$

where $RR_{a,k}(x)$: is relative risk of diabetes mortality at BMI level x , and m : is the maximum BMI level (Murray et al. 2004).

We used WHO projections of BMI distributions by country (WHO Global Infobase Team 2005) to estimate the relative risk of diabetes mortality in future year t , for ages 30 and over, compared to the CRA counterfactual BMI distribution, as follows:

$$RR_{a,k,t} = \int_{x=10}^{61} \exp \left[\ln(rr_{a,k}) \times \left(x - 21 - \frac{x - m_{a,k,t}}{sd_{a,k,t}} \right) \right] \times N \left(\frac{x - m_{a,k,t}}{sd_{a,k,t}} \right) dx \quad (4)$$

where $rr_{a,k}$ is the relative risk of diabetes mortality for a one unit increase in BMI. BMI distributions in year t were assumed to be normally distributed with mean $m_{a,k,t}$ and standard deviation $sd_{a,k,t}$. James et al. reviewed the evidence on the association of diabetes mortality with BMI and found that a constant relative risk of diabetes mortality for each one unit increase in BMI. fitted the available data well (James et al. 2004). We used their estimates of $rr_{a,k}$ given in Table 4.

Table 4. Relative risk of diabetes mortality for one unit increase in BMI (James et al. 2004).

	Age group (years)			
	30-44	45-59	60-69	70+
Males	1.36	1.24	1.18	1.27
Females	1.47	1.34	1.21	1.20

Country-specific projections of BMI distributions for WHO Member States from 2000 to 2010 were used (WHO Global Infobase Team 2005). Projected trends in BMI were assumed to flatten between 2010 and 2015 and to be constant beyond 2015. For the baseline projections, the diabetes mortality rate associated with the counterfactual BMI distribution (mean mean 21 and standard deviation 1 kg/m²) was assumed to be declining at one half the rate for ‘Other Group II’ causes. The rate of decline was varied for the optimistic and pessimistic scenarios to three quarters and one quarter of the rate of decline for ‘Other Group II’ causes.

3.6 Chronic respiratory diseases

Initial projections for chronic respiratory diseases resulted in substantially increasing rates for high income countries. However, smoking is the main risk factor for chronic obstructive pulmonary disease (COPD) in high income countries and has been declining in most of these countries. It is likely that the initial projections may reflect increasing propensity to code COPD as underlying cause of death with time, particularly with shift to use of ICD-10 in the 1990s. The CRA analysis of the mortality risk of COPD associated with tobacco smoking (Ezzati and Lopez 2003a; Ezzati and Lopez 2004b) was used, together with projections of smoking intensity, to project future trends in COPD mortality. Similar projections were carried out for asthma and other chronic respiratory diseases, where the smoking attributable fractions are much smaller. The non-smoker rates for all these chronic respiratory diseases were assumed to be declining with socioeconomic growth at one half the rate for “Other non-communicable diseases”. This assumption was varied for the optimistic and pessimistic scenarios as for diabetes.

3.7 Comparison of model-based projections for 2002 with GBD 2002 estimates

The regression equations were used to predict mortality rates by cause and age for each region using 2002 country-specific values for income per capita, human capital, smoking intensity and year. When this was done, the predictions did not agree exactly with the GBD estimates of mortality rates by cause in 2002, since very different approaches have been used. Following the approach used in the original GBD projections, we thus estimated a series of age-, sex-, cause- and region-specific scalars such that:

$$M_{a,k,i,c} = K_{a,k,i,c} \times M_{a,k,i,c}^* \quad (5)$$

where $M_{a,k,i,c}$ is the age-, sex-, cause- and country-specific death rate in 2002, $M_{a,k,i,c}^*$ is the predicted death rate for cause i at age a and sex k in country c based on the regression equation in 1990, and $K_{a,k,i,c}$ are the age-, sex-, cause- and region-specific scalars. To make projections, the set of scalars $K_{a,k,i,c}$ were then held constant during the period of the projections.

4. Projections of GDP per capita, human capital, smoking intensity and technological change

Revised country-level projections have been used for GDP per capita, human capital and smoking intensity. These are described in this section. In addition, the regression betas for time, reflecting technological change, were modified for low income countries as described in Section 4.4.

4.1 Income per capita projections

Income per capita was measured using average GDP per capita expressed in international dollar terms. WHO has prepared consistent estimates of GDP per capita in international dollars for the years in the 1990s through to 2001; for details refer to the Statistical Annex Notes of the World Health Report 2004 (World Health Organization 2004). For earlier years, income series for WHO Member States were estimated using information from the Penn World Tables (Heston, Summers, and Aten 2002; Summers and Heston 1991) and, for some missing years, growth rates of real GDP per capita in local currency units.

International dollar estimates are derived by dividing local currency units by an estimate of their purchasing power parity (PPP) compared to US dollars. PPPs are the rates of currency conversion that equalise the purchasing power of different currencies by eliminating the differences in price levels between countries.

Unpublished country-specific and regional income growth forecasts by the World Bank were used to project GDP per capita for all WHO Member States. Country-specific projections were used for 144 countries for the period 2002-2015. For other countries, relevant World Bank regional growth rates for the period 2002-2012 were applied to the country-specific GDP per capita for 2002. Beyond 2015, projected growth rates for most regions approach 3% per annum, with somewhat lower growth rates in sub-Saharan Africa, the Middle East and high income countries (around 2.5%). Table 5 summarizes the resulting regional average annual growth rates in GDP per capita by World Bank region for the periods 2002-2005, 2006-2015, and 2015-2030.

For the optimistic scenario, growth rates in GDP per capita were assumed to be approximately 40% higher than the baseline projection, and for the pessimistic scenario to be around 50% of the growth rate in the baseline projection (Table 5). Figure 2 summarizes projections of GDP per capita for the three scenarios by World Bank income group. Figure 3 provides a similar summary by WHO region.

Figure 2: Projections of GDP per capita by income group, for three scenarios: baseline (solid lines), optimistic (dotted lines) and pessimistic (dashed lines).

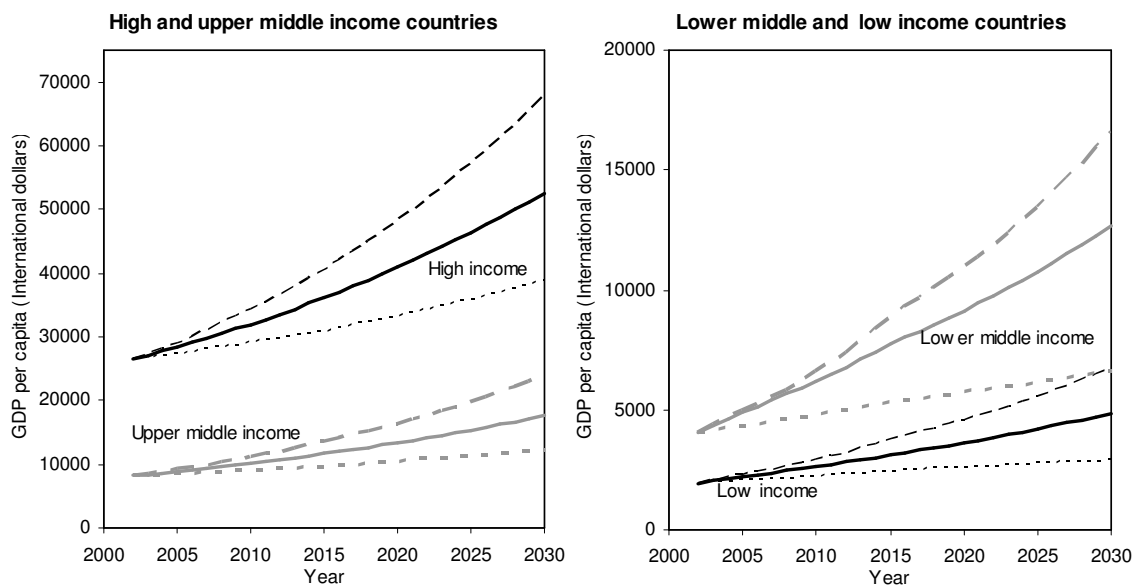
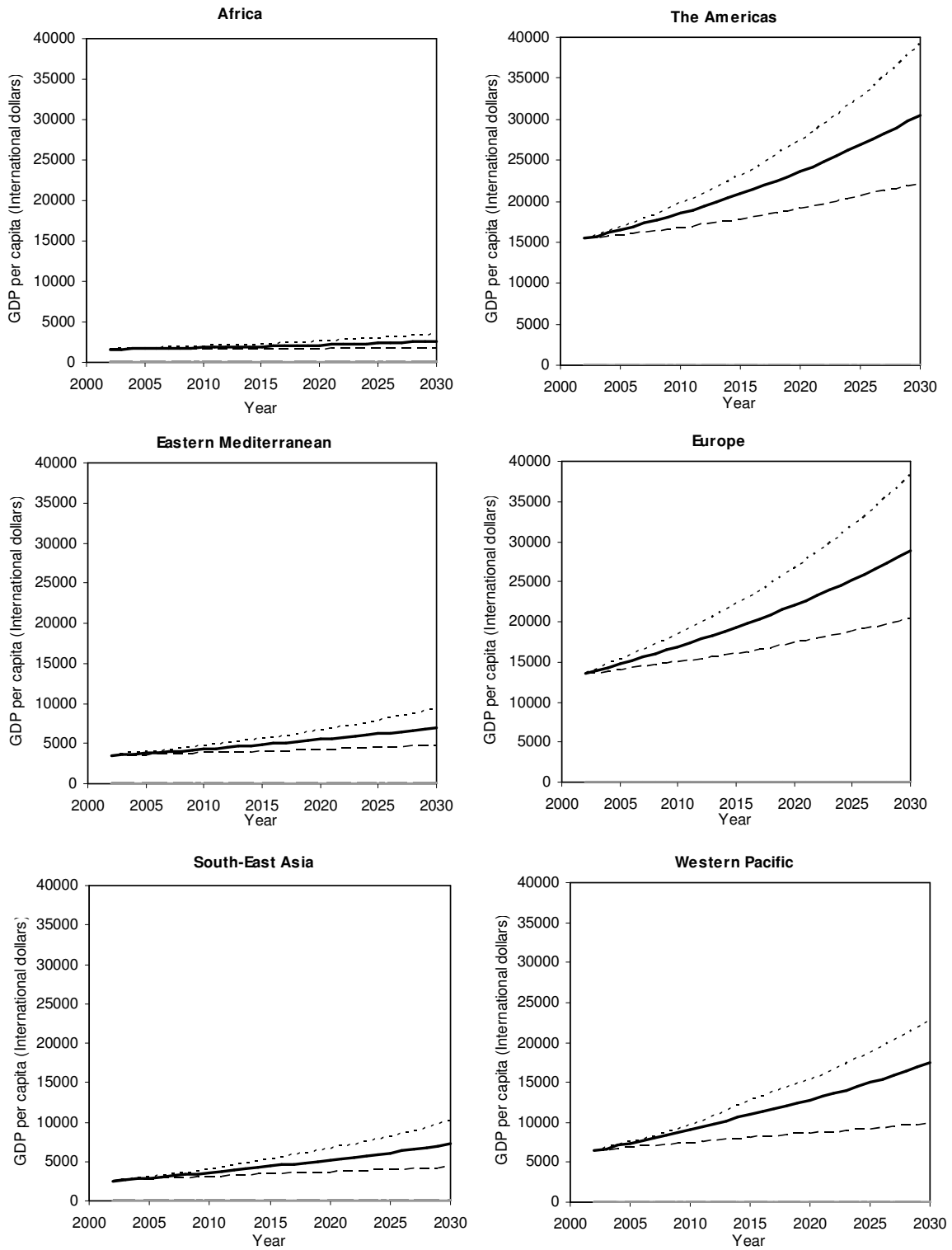


Table 5. Projected average annual growth rates in GDP per capita, by World Bank region, 2002-2030

Scenario/Period	World Bank Region						
	East Asia and Pacific	Europe and Central Asia	High Income	Latin America and Caribbean	Middle East & N. Africa	South Asia	Sub-Saharan Africa
Baseline							
2002-2005	6.4	5.9	2.3	2.0	2.9	4.7	2.0
2006-2015	5.4	3.6	2.4	2.4	2.6	4.2	2.1
2015-2030	3.7	3.0	2.5	2.7	2.5	3.3	2.5
Pessimistic							
2002-2005	3.2	0.5	1.0	1.0	0.5	2.0	0.0
2006-2015	2.7	1.0	1.2	1.2	1.0	2.0	0.5
2015-2030	1.5	1.5	1.5	1.5	1.5	1.5	1.0
Optimistic							
2002-2005	7.0	6.0	2.9	2.6	3.2	5.2	2.5
2006-2015	7.5	5.0	3.4	3.4	3.7	4.8	3.0
2015-2030	4.5	4.0	3.5	3.8	3.5	4.4	3.5

Figure 3 Projections of GDP per capita by WHO region, for three scenarios: baseline (solid lines), optimistic (dotted lines) and pessimistic (dashed lines).



4.2 Human capital projections

Human capital is measured in terms of the average years of schooling in the adult population as constructed by Barro and Lee (Barro and Lee 1996). Revised estimates and projections of human capital for WHO Member States have been prepared by EIP for the period 1950-2030 drawing on the Barro-Lee estimates for 98 countries for five-yearly intervals from 1950 to 1990 and observed relationships between growth in human capital and growth in GDP.

The data were interpolated and a locally-weighted smoothing technique was used to obtain an annualized panel. In order to fill in for countries for which average years of schooling were not available from Barro-Lee, a regression was run with average years of schooling as the dependent variable and lagged 15-year primary school enrollment, lagged 10-year secondary school enrollment, lagged 10-year tertiary school enrollment, and current literacy as independent variables. Then a hierarchical procedure was used in order to fill in the missing data: where all four independent variables were available, and the dependent variable missing, the predicted value was used. Next, if tertiary enrollment was unavailable, then predictions from the remaining three variables regression were used to fill in for average years of schooling. And so on until, for a handful of countries, predictions based solely on literacy rates were used since no enrolment data were available whatsoever. For some countries and for some years, average years of schooling were available from an alternate source: the Demographic and Health Survey (DHS). In such cases, this was also used as an explanatory variable and predictions generated for those years and those countries for which DHS data were available were used to scale the entire panel of years.

In the dataset for 1950-2002, there is a clear relationship between the growth rate in human capital and levels of income and human capital. This relationship was modelled by an equation of the following form:

$$r = \alpha + \beta_1 HC + \beta_2 \ln Y + \beta_3 HC * \ln Y \quad (5)$$

where r is the the growth rate in human capital HC , and Y is income per capita. OLS regression was used to estimate the parameters of this equation, pooling 2,733 observations for both males and females, resulting in the following relationship (with R^2 of 43%):

$$r = -0.006 + 0.00137 * HC + 0.00476 * \ln Y - 0.00053 * HC * \ln Y \quad (6)$$

For typical low income countries, with $\ln Y$ around 8 and HC around 5, the average annual growth rate in human capital is around 2 per cent per annum. This equation was used to fill in some missing HC values for some countries for early years, and also to generate the three scenarios for human capital projections. For the pessimistic projection, we arbitrarily modified the equation so that the coefficient for HC was 0.001 lower (ie. 0.00037), resulting in around 30% lower annual growth rate in HC for a typical low income country. For the optimistic projection, we modified the equation so that the coefficient for HC was 0.001 higher (ie. 0.00237), resulting in around 30% higher annual growth rate in HC for a typical low income country. Optimistic and pessimistic projections for HC were then calculated for years 2003-

2030 for all WHO Member States using the 2002 estimated *HC* as starting point, and the optimistic and pessimistic GDP projections. Figure 4 summarizes projections of human capital for the three scenarios by World Bank income group. Figure 5 provides a similar summary by WHO region.

Figure 4.3 Projections of human capital by sex and income group, for three scenarios: baseline (solid lines), optimistic (dotted lines) and pessimistic (dashed lines).

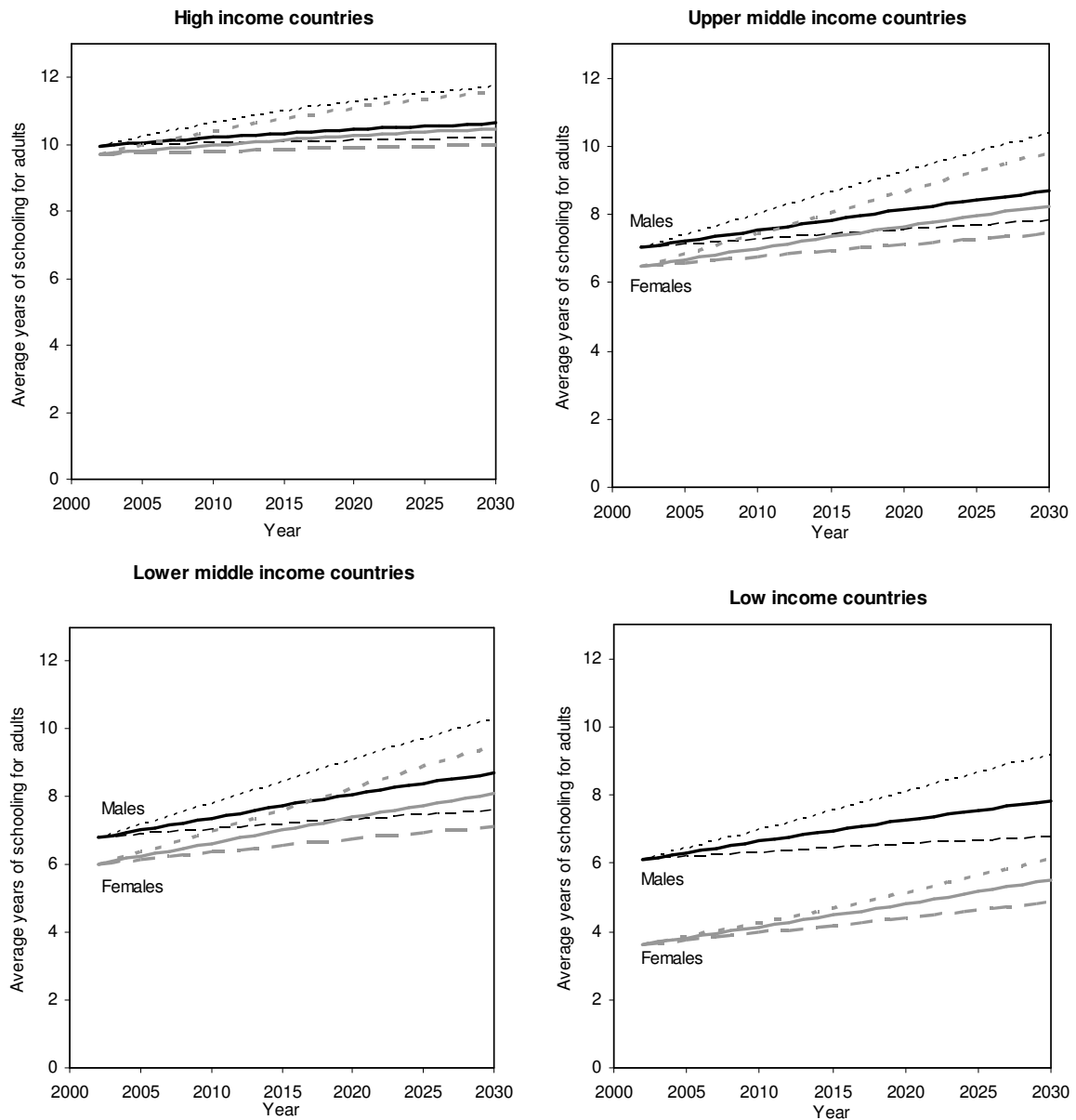
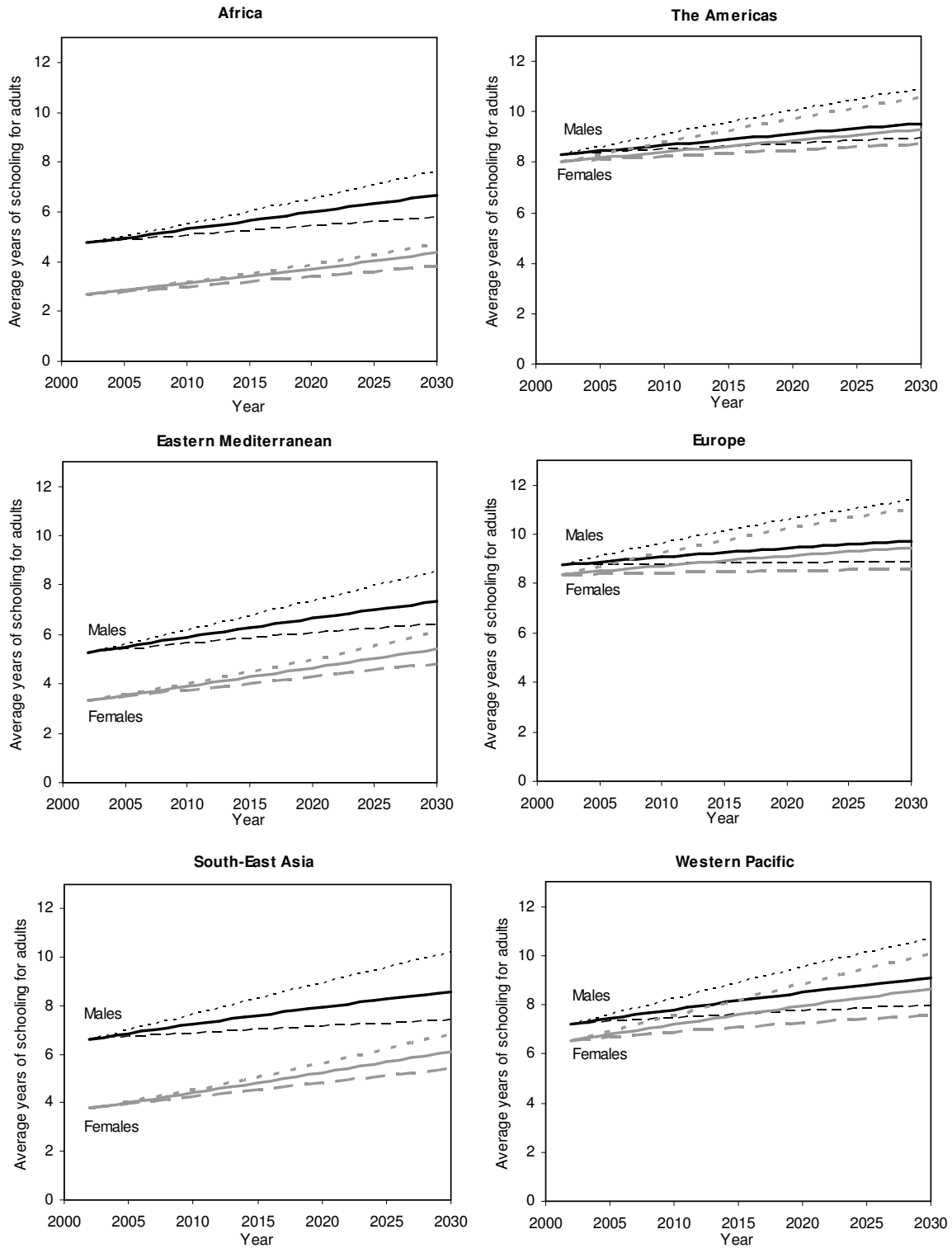


Figure 5: Projections of human capital by sex and WHO region, for three scenarios: baseline (solid lines), optimistic (dotted lines) and pessimistic (dashed lines).



4.3 Smoking intensity projections

Smoking is associated with substantially increased risks of death due to lung cancer, cardiovascular disease, as well as many other cancers and causes of death (Ezzati and Lopez 2004a). These risks depend on the cumulative history of tobacco exposure, including the length of time smoked, the amount of tobacco smoking, characteristics such as tar and nicotine content, and the form of smoking or other consumption. Current prevalence of tobacco smoking is thus an inadequate predictor of the accumulated risk from smoking, even if prevalence data were available for all countries. Additionally, many of the diseases caused by smoking, particularly cancers including lung cancer, occur after long delays. Based on an examination of historical trends in lung cancer mortality and tobacco consumption in the United Kingdom, Murray and Lopez estimated that lung cancer mortality trends followed tobacco consumption trends with an average time lag of 25 to 30 years.

Murray and Lopez thus used smoking intensity, essentially the lung cancer mortality caused by tobacco smoking, as the covariate to predict the accumulated mortality risk of smoking for all causes (Peto et al. 1992). Smoking intensity was calculated for the historical mortality country-year observations by subtracting non-smoker lung cancer rates from observed total lung cancer mortality rates in the data. Higher non-smoker lung cancer mortality rates were used in China and South East Asian countries reflecting the higher levels of lung cancer in non-smokers due to indoor air pollution from exposure to smoke from solid fuels (Ezzati and Lopez 2004a; Ezzati and Lopez 2003c).

Ezzati and Lopez developed projections of smoking intensity for 14 sub-regions of the WHO regions for the Comparative Risk Assessment project, based on an analysis of past and current age-sex-specific smoking prevalence calibrated to regional characteristics of the tobacco epidemic for different subregions (Ezzati and Lopez 2004a; Ezzati and Lopez 2003b). The tobacco epidemic was divided into five stages, and each stage was characterized in terms of appropriate age-sex patterns and trends for tobacco smoking prevalence and numbers of cigarettes smoked per day. Next, country-level per capita tobacco consumption data were used to prepare age-sex-specific estimates of per capita consumption. Finally, they projected age-sex-specific lung cancer mortality, and hence smoking intensity, based on the consumption projections and a statistical model of the relationship between lung cancer mortality and lagged consumption (Giroso and King 2002).

Detailed projections of age-sex-specific smoking intensity at country level ideally require historical information on trends in age-sex-specific tobacco consumption, both in terms of proportions of the population smoking, and in terms of quantity and types of tobacco consumed by smokers. Shibuya et al. have carried out such projections for four high income countries: Australia, Canada, United Kingdom and the United States of America (Shibuya, Inoue, and Lopez 2005). A three-factor age-period-cohort model for lung cancer mortality was estimated for these four countries using historical data on age-sex-specific tobacco consumption, average tar content and adult tobacco consumption per capita. The optimal exposure variable was found to be the product of average tar content and adult cigarette consumption per capita lagged for 25-30 years for both males and females in all four countries. Because of this lag, the future course of lung cancer mortality, and hence smoking intensity, for the next 30 years is already essentially determined by current and past tobacco smoking exposure. The projected age-sex-specific estimates of smoking intensity by Shibuya et al. for these four countries were used for 2002 to 2030 under all three scenarios.

For projecting smoking intensity for other countries, there was neither the data nor the time available to prepare such detailed age-period-cohort projection models. The information available to us included the country-specific estimates of smoking intensity for 2002 derived from the GBD 2002 estimates, the 14 subregional projections of smoking intensity prepared by Ezzati and Lopez for the Comparative Risk Assessment project (Ezzati and Lopez 2004a), more recent data on country-specific trends in adult per capita consumption of cigarettes (World Bank online database at <http://www1.worldbank.org/tobacco/database.asp>), and recent observed trends in age-sex-specific lung cancer mortality rates for countries with available death registration data.

Given that the main objective of the current projections is to produce regional mortality projections, we used the available information (described above) to prepare country-specific projections for the smoking intensity covariate as follows:

1. The regional projections of age-sex-specific SI were used to prepare age-sex-specific SI projections for each country in the region, by shifting the regional projections with a variable time lag to match the base SI estimates for the country for 2002. Any differences between the regional SI pattern and the country base SI estimates for 2002 that could not be accommodated by adjusting the time lag, were adjusted by scaling the regional SI estimates. These country-specific estimates were then used for the pessimistic scenario.
2. A separate set of age-sex-specific SI trends were prepared by applying to the 2002 country base SI estimates, the observed time trends in per capita adult consumption of tobacco from 1970 to 2000, with a 25-year time lag. For the baseline scenario, country-specific SI projections were prepared using the average of the annual trends in age-sex-specific SI for these projections and the projections prepared in step 1. In other words, the regional-based projections were adjusted to some extent by using the country-specific information on recent trends in apparent tobacco consumption.
3. For many countries in most regions, the SI projections based on apparent consumption trends were lower than those based on the regional projections. For the optimistic scenario, country-specific SI projections were based on the apparent consumption trends where they gave lower SI levels, and on the regional-based projections where they gave lower SI levels.
4. For all three scenarios, the resulting country-specific SI projections were further adjusted for countries with recent death registration data using estimated trends in age-sex-specific lung cancer mortality. Annual trends were estimated for lung cancer mortality using log-linear Poisson regression models as described in Section 5.3. Country-specific SI projections were adjusted for these countries by applying revised age-sex-specific annual SI trends calculated as a weighted sum of the trend estimated from the country mortality data and the trend projected under the scenario. The weight given to the trend estimated from the death registration data decreased from 100% for 2003, to 75% for 2004, and decreasing by 25% for each subsequent year. By 2015 the weight given to the Poisson trend estimate declines to 5%.

The resulting projections of smoking intensity (SI) under the pessimistic, baseline and optimistic scenarios are shown in Figure 6 by sex and income group, and in Figure 7 by sex and WHO region. For some regions, the baseline SI projections are substantially lower than the pessimistic SI projections (based on the previous regional projections of Ezzati and Lopez), reflecting flat or declining per capita consumption trends in these regions. It is possible that tobacco consumption has not increased as fast as previously projected, perhaps

in part due to global tobacco control efforts, but it is also possible that the apparent consumption trends understate the true levels of tobacco exposure, and that the pessimistic scenario is more realistic. These differences between scenarios affect mainly the projections for lung cancer and chronic lung diseases. Projections for cardiovascular diseases, and other diseases caused by tobacco smoking, are less sensitive to these variations in projections, in part because tobacco smoking is a less dominant risk factor (that is, there are a number of other major risk factors for these diseases also), and in part, because the broad trends in the projections are also dominated by population ageing.

Figure 6: Projections of smoking intensity (SI) by sex and income group, for three scenarios: baseline (solid lines), optimistic (dashed lines) and pessimistic (dotted lines).

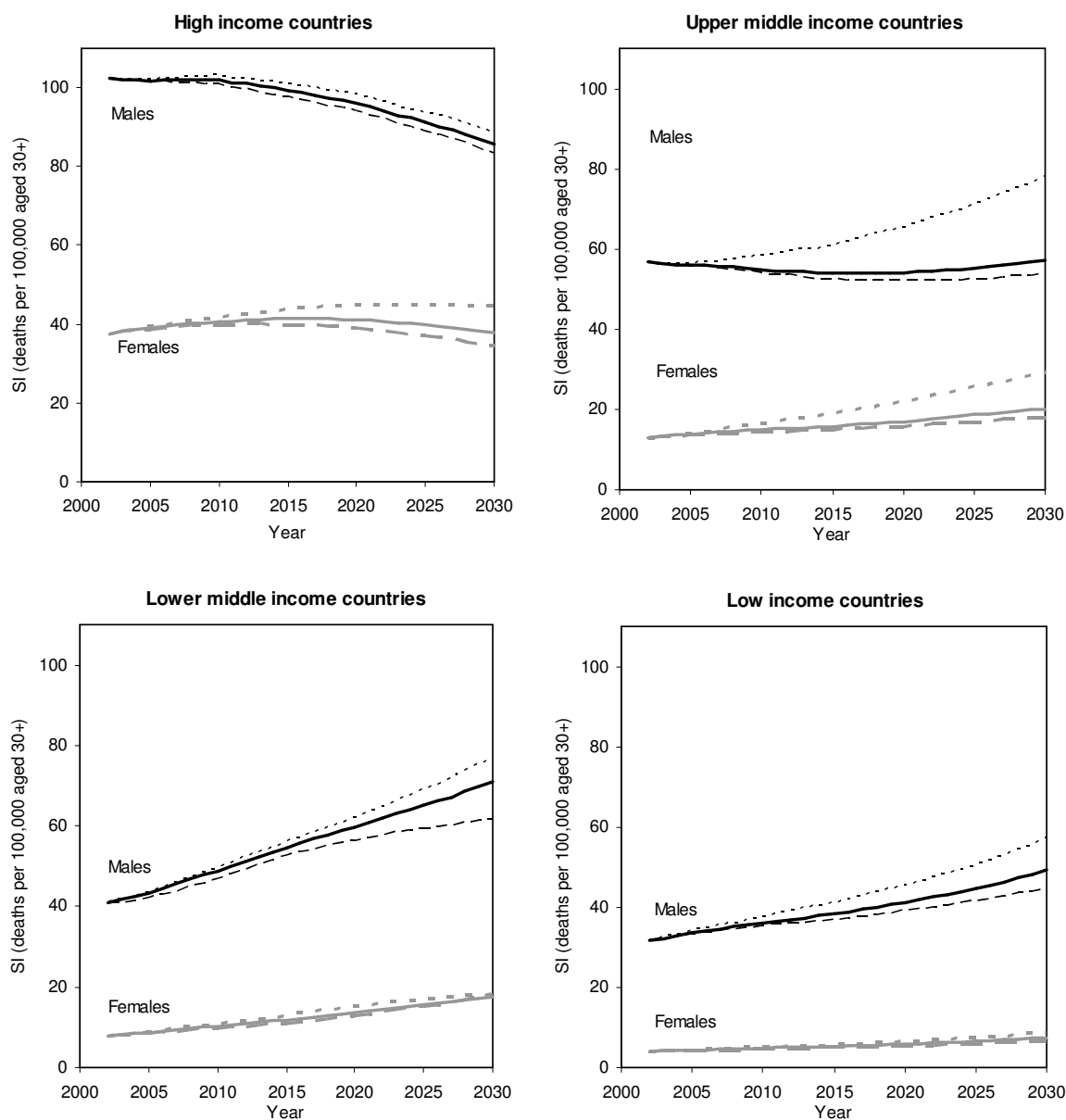
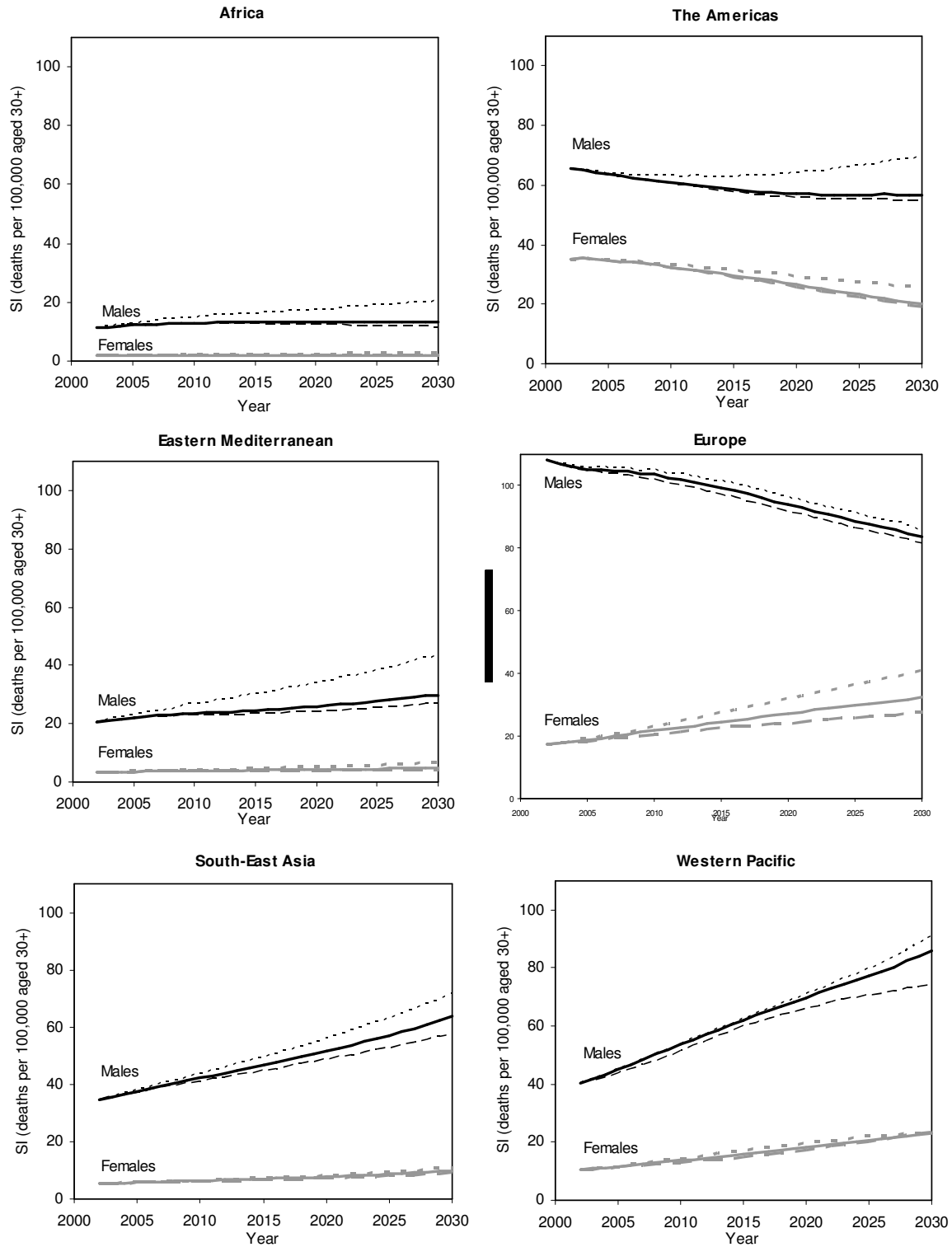


Figure 7: Projections of smoking intensity (SI) by sex and WHO region, for three scenarios: baseline (solid lines), optimistic (dotted lines) and pessimistic (dashed lines).



4.4 Modification of regression parameters for low income countries

The original GBD projections assumed that the improvement in mortality rates with time, holding socioeconomic conditions constant, that had been observed in the historical data drawn largely from middle income and high income countries, applied in low income countries such as those of sub-Saharan Africa. This assumption has been retained for the optimistic projection scenario. For the baseline scenario, we tested this assumption by using the regression equations to back-project child mortality under age 5 years from 2002 to 1990 and to compare the regional results with the observed regional trends in child mortality for 1990 to 2002. The observed trends were estimated from WHO country-level estimates of child mortality for 2002 (World Health Organization 2004) and from estimates for 1990 published by Ahmad et al. (Ahmad, Lopez, and Inoue 2000), with some revisions to ensure consistency with the interpretation of the time series data used for the 2002 estimates.

For low income countries, the regression equations predicted a greater decline in child mortality from 1990 to 2002 than was observed, and the difference was greater for sub-Saharan Africa than for other low income countries. For middle and high income countries, the observed and predicted trends were reasonably consistent. It was found that the improvement rate with time for low income countries (GDP per capita < \$3,000) has been assumed to be one half that observed in the historical data. We attempted to improve the regression predictions for low income countries by setting the regression coefficients for time to zero. This still resulted in a greater decline in child mortality than observed. A reasonable fit to the observed trends for 1990-2002 was achieved by halving the regression coefficients for human capital for low income countries, and setting the time coefficients to zero for sub-Saharan Africa and, for other low income countries, to one quarter of the regression estimates.

For the pessimistic scenario, the regression coefficients for both time and human capital were set to zero for low income countries. For the optimistic scenario, the regression coefficients for human capital were set to three quarters of the regression values for low income countries. For sub-Saharan African countries, the coefficients for time were set to one quarter of the regression values, and for other low income countries to three quarters of the regression values. In effect, the revised projections assume that projected rates of change for cause-specific mortality rates over time, given levels of constant income and human capital, will be slower than those observed in the mainly high and middle income countries with death registration data over the last 50 years.

5. Regression equations for detailed causes

For the original GBD projections, Murray and Lopez chose not to attempt to model the relationship between GDP per capita, human capital, smoking intensity and time, with more specific causes of death such as tuberculosis, liver cancer etc, due to the difficulties of comparing detailed cause-of-death data coded according to different revisions of the International Classification of Diseases (Murray and Lopez A.D. 1996). Instead, they applied a variant of the Preston cause-of-death model approach, which models the relationship of the trend for a detailed cause of death with the trend for the broader cause group containing it.

5.1 Regression equations for detailed causes

We follow the original GBD approach in estimating the following relationships:

$$\ln M_{a,k,i,d} = \beta_{a,k,i,d} \ln M_{a,k,i} + C_{a,k,i,d} \quad (5)$$

where $M_{a,k,i,d}$ is the mortality rate from specific cause d within cause group i for age group a and sex k , $M_{a,k,i}$ is the mortality rate for cause group i for age group a and sex k , and $\beta_{a,k,i,d}$ is the coefficient from the OLS regression. These constant elasticity regressions provide estimates of the percentage change in death rates from a specific case d for a given percentage change in the mortality rate for a broader cause-cluster i .

To avoid biasing the results due to changes in specific cause death rates due to coding changes associated with use of different versions of ICD, we have restricted the analysis to country-years for which deaths were coded using ICD-9. We chose ICD-9 rather than ICD-10 because this gave a larger number of observations over a longer period. The regression parameters were estimated on 1,357 country-year observations for 98 countries. For each individual regression, observations were excluded from analysis if they related to less than 50 deaths. Following the original projection methods, we use the regression results only where the relationship was reasonably strong as measured by an R^2 greater than 0.25 and a β coefficient with a p-value <0.001 . The resulting coefficients are shown in Annex Table A-6. For any cause-age-sex groups not shown in these tables, the β coefficient was set to 1.

To project mortality from all of the detailed causes, scalars were estimated to adjust the predicted values for 2002 to match the GBD estimates for each detailed cause in 2002 by country. These scalars were then used to predict the cause-specific mortality rate based on the projected mortality rate for the broader cause-cluster for each time period in the projection, as follows:

$$\ln M_{a,k,i,d,c} = \beta_{a,k,i,d} \ln M_{a,k,i,c} + C_{a,k,i,d} + \ln S_{a,k,i,d,c} \quad (6)$$

where $M_{a,k,i,d,c}$ is the projected mortality rate for cause d in cause cluster i for age group a , sex k , and country c , $M_{a,k,i,c}$ is the projected mortality rate for cause d in cause cluster i for age

group a , sex k , and country c , $S_{a,k,i,d,c}$ is the age-, sex-, country- and cause-specific scalar, and $\beta_{a,k,i,d}$ and $C_{a,k,i,d}$ are the coefficient and constant respectively from the OLS regression.

Finally, the predicted detailed age-, sex-, country- and cause-specific mortality rates were adjusted so that they summed across all causes d within cause cluster i to the total projected age-, sex-, and country-specific mortality rates for cause cluster i .

5.2 Modifications for detailed causes in the intentional injury cause cluster

The intentional injury cause cluster contains three detailed cause: suicide, homicide and war (we ignore the other intentional injury category which contains negligible estimated deaths). The major cause cluster regression equation for intentional injury predicted generally falling death rates in middle and low income countries and rising death rates in high income countries. For homicide (deaths due to intentional violence), this is the opposite of the observed trends in the larger high income countries. For this reason, homicide death rates were assumed to remain constant under the baseline scenario (and modified by country-specific observed trends as described in Section 5.3). Similarly, war deaths were assumed to remain constant under the baseline scenario.

For the optimistic scenario, homicide death rates were held constant in high income countries (and modified by country-specific observed trends), but allowed to follow the intentional injury projected trends for middle and low income countries. For the pessimistic scenario, projected trends for intentional injuries were assumed to apply for all countries.

For the optimistic scenario, war death rates were assumed to decline at 1.5% per annum from 2006 onwards. For the pessimistic scenario, war death rates were assumed to have risen between 2002 and 2005 for the EMRO and AMRO regions, reflecting largely the impact of the wars in Afghanistan and Iraq, and then to remain constant over time in all regions.

5.3 Adjustments for recent observed trends for selected causes

For high income countries with populations of 5 million or more, and with at least 5 years of recent death registration data, cause-age-sex specific trends in mortality rates were estimated for ischaemic heart disease, cerebrovascular disease, tuberculosis, suicide and homicide using a log-linear Poisson regression model for country-years of data from 1985 onwards, and with an exponentially decreasing weight for earlier country years (each earlier year given 0.85 times the weight of the next year in the regression). This weighting scheme was chosen to give greater weight to the trends in more recent years, based on experience with the projection of all-cause mortality rates for estimation of life tables for the GBD (Mathers et al. 2003a).

The resulting estimates for recent annual trend rates are shown in Annex Table A-8. These estimated trends by cause, age and sex were used to adjust the initial years of projection for these causes for the selected countries. The country-specific trends were given 100% weight for the first projection year (2003), then a weight decreasing by a factor of 0.85 for each subsequent year, until by 2015 the trend is fully determined by the projection models trends. This adjustment ensured that available country-specific information on recent trends in mortality was incorporated into the projections for selected important causes.

The overall effect of these adjustments is summarized in Table 6. At the global level, the largest impacts are for ischaemic heart disease (around 4% increase in projected deaths in 2015) and for homicide (around 2% increase in projected deaths in 2015). At the level of income groups, the largest impacts are for males in high income countries: a 15% decrease for

tuberculosis deaths in 2015, a 10% decrease in cerebrovascular disease deaths in 2015, and a 16% decrease in homicide deaths in 2015.

Table 6: Comparison of projected numbers of deaths in 2015 with and without adjustments for recent observed trends for selected causes

	High income		Middle income		Low income		World	
	Male	Female	Male	Female	Male	Female	Male	Female
Tuberculosis								
Without adjustment	9,369	5,306	301,745	151,786	807,687	419,184	1,118,802	576,276
With adjustment	8,008	5,284	312,281	154,110	812,689	420,071	1,132,978	579,465
Per cent change	-14.5	-0.4	3.5	1.5	0.6	0.2	1.3	0.6
Ischaemic heart disease								
Without adjustment	751,658	680,907	1,506,936	1,442,133	2,012,902	1,756,108	4,271,523	3,879,157
With adjustment	755,817	709,158	1,628,079	1,545,672	2,047,291	1,789,063	4,431,215	4,043,902
Per cent change	0.6	4.1	8.0	7.2	1.7	1.9	3.7	4.2
Cerebrovascular disease								
Without adjustment	379,322	520,301	1,597,136	1,738,409	1,024,809	1,177,496	3,001,278	3,436,225
With adjustment	340,737	477,020	1,627,621	1,788,981	1,025,666	1,177,716	2,994,036	3,443,736
Per cent change	-10.2	-8.3	1.9	2.9	0.1	0.0	-0.2	0.2
Suicide								
Without adjustment	107,017	34,848	279,303	200,742	230,308	146,918	616,628	382,510
With adjustment	104,443	32,290	286,235	200,163	232,264	147,005	622,942	379,459
Per cent change	-2.4	-7.3	2.5	-0.3	0.8	0.1	1.0	-0.8
Homicide								
Without adjustment	17,513	6,574	268,246	48,528	242,730	81,008	528,491	136,111
With adjustment	14,801	5,789	280,967	52,211	243,485	81,645	539,253	139,646
Per cent change	-15.5	-11.9	4.7	7.6	0.3	0.8	2.0	2.6

6. Projections for HIV/AIDS and TB

Projections of mortality due to HIV/AIDS have been prepared by UNAIDS and WHO (UNAIDS-WHO Working Group on Global HIV-AIDS-STI surveillance). The UNAIDS and WHO Working Group has produced consistent HIV projections for several scenarios making certain assumptions about the future of the HIV epidemics in all regions and with varying treatment scale-up assumptions both for adult and children. The baseline and projection assumptions are summarized in the following section.

6.1 UNAIDS and WHO projections of mortality for HIV/AIDS

Projected prevalence curves were based on current country-specific models for 2004 (UNAIDS 2004; UNAIDS Reference Group on Estimates Model and Projections. 2002) and assumptions about future trends in prevalence in 125 low-income and middle-income countries. For countries with generalized epidemics (mostly in Sub-Saharan Africa), the model variables were estimated from sentinel site prevalence data. In most cases the projected epidemics remained stable. For countries with epidemics concentrated in groups with higher risk behaviour, a three-step process was used to produce the base estimates (end-2003) of HIV/AIDS. First, for each country, the size of groups at highest risk of acquiring HIV/AIDS was identified and estimated. Second, estimates of point prevalence were made for these groups by application of the most up-to-date prevalence rates up to 2003 for these groups to the populations. Finally, prevalence in low-risk populations was estimated by allowing for transmission from high-risk to low-risk groups via sexual mixing.

Projections of these epidemics were based on assumptions about degree of saturation for each of the high-risk groups, time to saturation, and spread from high-risk to low-risk populations over time. For Eastern Europe, Asia and North Africa and the Middle East, the assumed saturation levels were as follows: intravenous drug users - 25% by 2010, sex workers - 15% by 2015, men who have sex with men - 20% by 2015, clients of sex workers - 7.5% by 2020. The exception was the saturation levels for intravenous drug users in Russia and Ukraine and for some of the Caucasian countries where saturation levels were assumed to reach 50%. In addition, prevalence ratios of low to high risk were assumed of 0.1 in 2005, 0.15 in 2010, 0.2 in 2020 and 0.3 in 2030 for most countries (for some countries current evidence required some adjustment to this ratio). For Latin America and the Caribbean, epidemic curves developed for the 2003 round of estimates were used assuming stable prevalence into the future.

Table 6: Baseline coverage estimates as of December 2004 (adults) and 2003 (child).

Region	Adult ART coverage (%)	Child ART and co-trimoxazole (CTX) coverage (%)	Prevention of mother-to-child transmission (PMTCT) programs (%)
Africa	8	0	5
Asia	9	0	5
Eastern Europe	5-10	3	34
Latin America & Caribbean	65	32	37

Source: Adult coverage from "3x5" Progress Report: (WHO and UNAIDS 2004). Child coverage based on 2003 coverage survey: (USAID 2004).

Baseline adult antiretroviral treatment (ART) coverage estimates for each scenario were based on December 2004 coverage estimates published by WHO and UNAIDS (Table 6). For child ART and co-trimoxazole (CTX) coverage and for prevention of mother-to-child transmission (PMTCT) programs, regional coverage levels were based on the 2003 coverage survey unless country specific values were available (Table 6).

Three additional scenarios assuming fast, medium or slow increase in coverage of ART, PMTCT programs and CTX treatment were applied to project future trends for the HIV epidemic (Table 7). For each scenario the maximum coverage (i.e., the percent of individuals in need of treatment who receive it) was fixed at a certain level and year, while assuming a linear increase from current coverage. Similar scenarios were applied to children ART and co-trimoxazole (CTX) coverage. The base scenario also shown in Table 7 was projected by holding current levels of adult ART, children ART and co-trimoxazole, and PMTCT coverage at the 2004 levels, ie. assuming no increase in coverage.

Table 7: Peak coverage (and year) for HIV/AIDS scenarios for different regions in the world

Region	Model	Africa	Asia	Eastern Europe	Latin America and Caribbean
Adult ART coverage (%)	Slow	60 (2012)	60 (2012)	60 (2012)	70 (2013)
	Medium	80 (2012)	80 (2012)	80 (2012)	80 (2012)
	Fast	80 (2009)	80 (2009)	80 (2009)	80 (2007)
Child ART coverage (%)	Slow	60 (2012)	60 (2012)	60 (2012)	70 (2013)
	Medium	80 (2012)	80 (2012)	80 (2012)	80 (2012)
	Fast	80 (2009)	80 (2009)	80 (2009)	80 (2007)
PMTCT coverage (%)	Slow	60 (2012)	60 (2012)	60 (2012)	60 (2012)
	Medium	80 (2012)	80 (2012)	80 (2012)	80 (2012)
	Fast	80 (2009)	80 (2009)	80 (2009)	80 (2009)
Co-trimoxazole coverage (%)	Slow	60 (2012)	60 (2012)	60 (2012)	70 (2013)
	Medium	80 (2012)	80 (2012)	80 (2012)	80 (2012)
	Fast	80 (2009)	80 (2009)	80 (2009)	80 (2009)

Current ART treatment was assumed to have a minimal effect on current prevalence in countries in Africa, Asia and Eastern Europe, whereas in Latin America and the Caribbean ART treatment was assumed to have a significant effect on current prevalence. Early detection of HIV prevalence among children was assumed to be available only in countries in Eastern Europe and not in the other regions. For the other regions, regional adjustments were applied to specify the proportion of children in need of CTX: 53% (sub-Saharan Africa), 45% (Asia), 34% (Eastern Europe), 50% (Latin America and Caribbean) and 30% in other countries.

The treatment scenarios assumed no effect of treatment on transmission and incidence rates, and no additional prevention efforts resulting in reductions of transmission and incidence rates. These treatment scenarios suggest that globally between 9.5 and 17.3 million adults (age 15 to 49 years) and between 900,000 and 2.3 million children (age 0 to 14 years) would require antiretroviral treatment by 2015. Of these, up to 13.8 million adults and 1.9 million children would be on treatment. These scenarios also suggest that in 2015 between 4.5 and 5.0 million deaths may be due to AIDS, rising to 6.7 - 6.9 million in 2030 (Table 8).

Table 8: Projected deaths (millions) due to HIV/AIDS under four treatment scenarios, 125 low and middle income countries

Age group/year	Baseline	Slow	Medium	Fast
Adults 15-49 years				
2005	2.59	2.43	2.22	2.22
2015	4.20	3.91	3.55	3.60
2030	5.36	5.33	5.25	5.25
Children 0-14 years				
2005	0.52	0.45	0.38	0.38
2015	0.64	0.37	0.24	0.24
2030	0.69	0.41	0.27	0.27
All ages				
2005	3.47	3.22	2.91	2.91
2015	5.54	5.00	4.52	4.58
2030	7.08	6.86	6.75	6.75

6.2 Baseline, optimistic and pessimistic mortality projections for HIV/AIDS

Baseline projections

Baseline projections for HIV/AIDS age-sex specific mortality rates were based on the UNAIDS and WHO “medium” scenario for treatment scale-up. Under this scenario, ART coverage reaches 80% by 2012 in all regions (Table 7). For the 67 mainly high income countries not included in the UNAIDS and WHO scenario projections, the HIV/AIDS epidemics are mainly concentrated epidemics in at-risk populations only. For the baseline scenario, we assumed zero trends in HIV/AIDS mortality for these countries after examining trends in available death registration data which gave inconsistent trends for some countries. For small countries with middle or low income, AIDS death rates were assumed to follow the same time trend as regional projections.

The UNAIDS and WHO projections differ slightly for the baseline year of 2002 from those in the GBD 2002. This relates mainly to the age distribution of deaths, rather than the all-age totals at regional level. To ensure consistent projections for HIV/AIDS mortality, the 2002 HIV/AIDS death rates by country, age and sex were replaced by the rates for 2002 in the medium scenario projections, except for certain specific countries as described below. The final projected numbers HIV/AIDS deaths were calculated by applying projected death rates to WHO projected populations (see Section 8), and hence will differ slightly from the numbers in the UNAIDS projections.

The GBD estimates of HIV/AIDS mortality for 2002 were revised to reflect country-level estimates consistent with those published for 2003 in the 2004 Report on the Global AIDS Epidemic (UNAIDS 2004), with the exception of certain countries, including Russia and Brazil, where HIV/AIDS mortality estimates were based on a detailed analysis of death registration data for recent years.

In some cases, the country-specific HIV/AIDS mortality estimates for 2002 in the UNAIDS and WHO medium scenario differed substantially both from the GBD 2002 estimates and from the published UNAIDS estimates for 2003. We closely examined the baseline HIV projections for the 9 selected countries examined in the Global Report on Chronic Diseases, plus others where the GBD estimates for 2002 were significantly different to the UNAIDS

projections for 2002. Table 9 compares the GBD estimates for HIV/AIDS mortality in 2002 with the UNAIDS published estimates for 2003 for the 9 countries.

Table 9: Comparison of base estimates of HIV/AIDS deaths for 9 countries

WHO Member State	Estimated total HIV/AIDS deaths		Comparison of UNAIDS and WHO projections with published 2003 UNAIDS estimates
	GBD 2002 (a)	UNAIDS 2003 (b)	
United Kingdom	187	<500	Not included
Canada	458	1,500	Not included
Brazil	13,000	15,000	Higher estimated deaths in 2002
Russian Federation	14,700	Not published	Higher estimated deaths in 2002
China	42,700	44,000	Lower estimated deaths in 2002
India	357,100	Not published (c)	Similar to implied estimate for 2002 (c)
Pakistan	5,000	4,900	Lower estimated deaths in 2002
Nigeria	275,700	310,000	Similar to published estimate for 2002
Tanzania	118,000	160,000	Lower estimated deaths in 2002

(a) Numbers above 1,000 rounded to nearest 100

(b) Estimated deaths in 2003 for persons aged 0-49 years as published in July 2004 (UNAIDS 2004)

(c) Published total for South and South East Asia of 460,000 after subtraction of numbers for other countries implies an Indian total in the range 330,000 - 345,000

Projections for certain countries were adjusted to ensure general consistency both with the GBD 2002 base, and with the UNAIDS and WHO projections for years beyond 2005. For countries where the GBD 2002 base was lower than the projection for 2002, the GBD base was projected forward using a projected growth rate based on the UNAIDS and WHO projections. For countries where the GBD 2002 base was higher than the projection for 2002, the HIV/AIDS death rates were kept constant for a few years until the projections overtook them.

For China, India and Pakistan, HIV death rates estimated for 2002 as part of the GBD analysis were assumed to remain constant to 2005. The resulting numbers are consistent with the published UNAIDS numbers for China and Pakistan in 2003. For Russia, death rates were projected from the GBD 2002 base by applying the implied regional projected trends for Eastern Europe from the UNAIDS and WHO projections. For Brazil, HIV death rates were estimated by the GBD for 2002 from analysis of death registration data. These were projected forward assuming Brazil has 50% faster growth in HIV deaths than the UNAIDS projections for Latin America. The resulting projected HIV/AIDS deaths are consistent with the published UNAIDS figure for 2003 and approach the deaths projected by UNAIDS and WHO for years beyond 2015.

The resulting baseline projections of HIV/AIDS deaths at regional level are reasonably close to the WHO and UNAIDS projections for years 2005 and beyond, but are consistent with the GBD base estimates for 2002.

Pessimistic scenario

The pessimistic projections for HIV/AIDS age-sex specific mortality rates were based on the UNAIDS and WHO "slow" scenario for treatment scale-up. Under this scenario, ART coverage reaches 60% by 2012 in all regions except Latin America, where it reaches 70% in 2013 (Table 7). These projections were adjusted as for the baseline projections to match the the GBD estimates of HIV/AIDS mortality for 2002. HIV/AIDS mortality rates in high income countries were assumed to remain constant as in the baseline scenario.

Optimistic scenario

The treatment scenarios assumed no effect of treatment on transmission and incidence rates. Approaches to modelling prevention effects have been published recently (Salomon et al. 2005b) and were used to prepare an optimistic scenario involving additional prevention efforts. Salomon et al. modeled a number of scenarios involving additional prevention efforts in sub-Saharan Africa. They modeled a scenario in which a comprehensive prevention package (Stover et al. 2002) has only partial effectiveness at the population level and no ART scale-up occurs. They also modeled several scenarios combining treatment and prevention efforts. In the optimistic scenario, ART coverage is scaled up (in a scenario similar to the medium scenario described above) and optimal assumptions are made about treatment impact on transmissibility and patient behaviour. It is assumed that the widespread availability of treatment enables the full impact of the prevention efforts to be attained (Stover et al. 2002). In their pessimistic scenario, an emphasis on treatment leads to less effective implementation of prevention resulting in only 25% attainment of the maximum potential impact of prevention efforts.

For the optimistic projection scenario for HIV/AIDS mortality projections here, we used a third unpublished scenario for mixed treatment-prevention scale-up prepared by Salomon et al. which is approximately halfway between their published optimistic and pessimistic scenarios (Salomon et al. 2005a). It was not possible to directly use their projected mortality rates, because the ART scale-up scenario that they used differed somewhat from the UNAIDS and WHO medium scenario described above, with ART coverage reaching 80% in 2010 rather than 2012. We thus estimated the additional impact of the prevention effort on annual mortality trends in sub-Saharan Africa for the period 2003 to 2020 by comparison of Salomon et al.'s treatment-only scenario with the combined treatment-prevention scenario. The additional impact of the modeled prevention effort does not significantly affect HIV/AIDS mortality rates until 2008, after which there is an additional annual decline rising to 3% in 2015, and remaining reasonably constant in the range 3.1-3.3% to 2020.

For preparing the HIV/AIDS projections for the optimistic scenario, we applied these additional regional annual declines for years 2008 and beyond to the baseline projections of HIV/AIDS mortality rates for countries in sub-Saharan Africa. For low and middle income countries in other regions, we applied additional annual rates of decline rising from 0.1% in 2005, to 0.5% in 2008, to 3% in 2015, and remaining constant at 3% for subsequent years. HIV/AIDS mortality rates in high income countries and other regions were assumed to remain constant until 2008, and then to start declining with an annual rate of decline increasing to 3% in 2015, and remaining constant for subsequent years.

Comparison of scenarios

Figure 8 summarizes projected HIV/AIDS deaths by income group for the three scenarios. Figure 9 similarly summarizes the projected deaths by WHO region. The declining death rates for years 2005 to 2010 in the baseline and pessimistic scenario, followed by increasing death rates, reflects the effects of the assumed treatment scale-up scenarios. Rapidly increasing levels of ART coverage result in postponement of deaths for a number of years, but once the ART coverage plateaus at its final level, death numbers continue to rise reflecting largely the underlying growth in population. As shown in Table 10, HIV incidence rates essentially remain constant in the baseline scenario for sub-Saharan Africa, and the global growth in incident cases and in deaths is largely driven by population growth in sub-Saharan Africa.

Figure 8: Projections of total AIDS deaths (thousands) by income group, for three scenarios: baseline (solid lines), optimistic (dotted lines) and pessimistic (dashed lines).

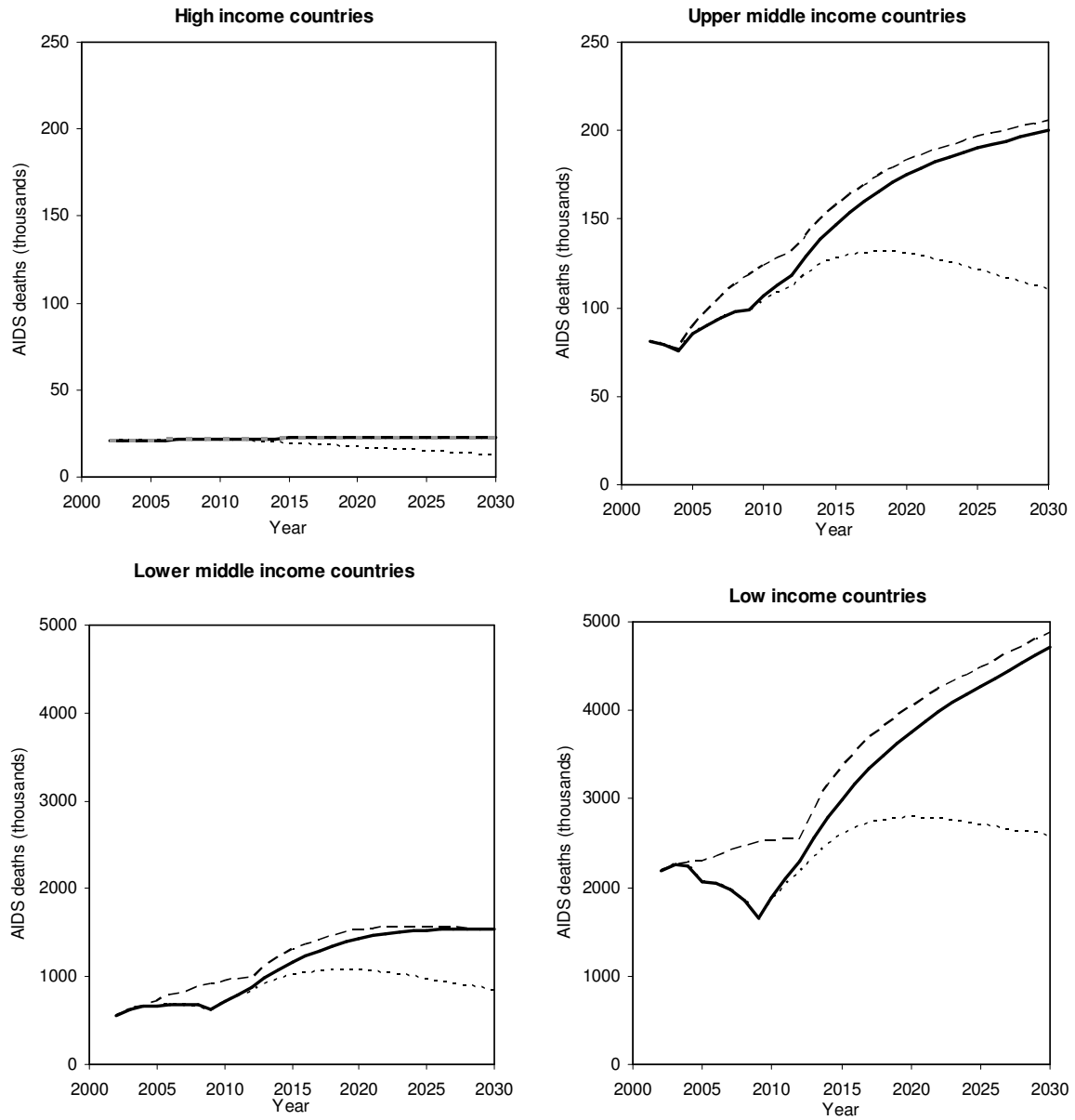


Figure 9: Projections of total AIDS deaths (thousands) by WHO region, for three scenarios: baseline (solid lines), optimistic (dotted lines) and pessimistic (dashed lines).

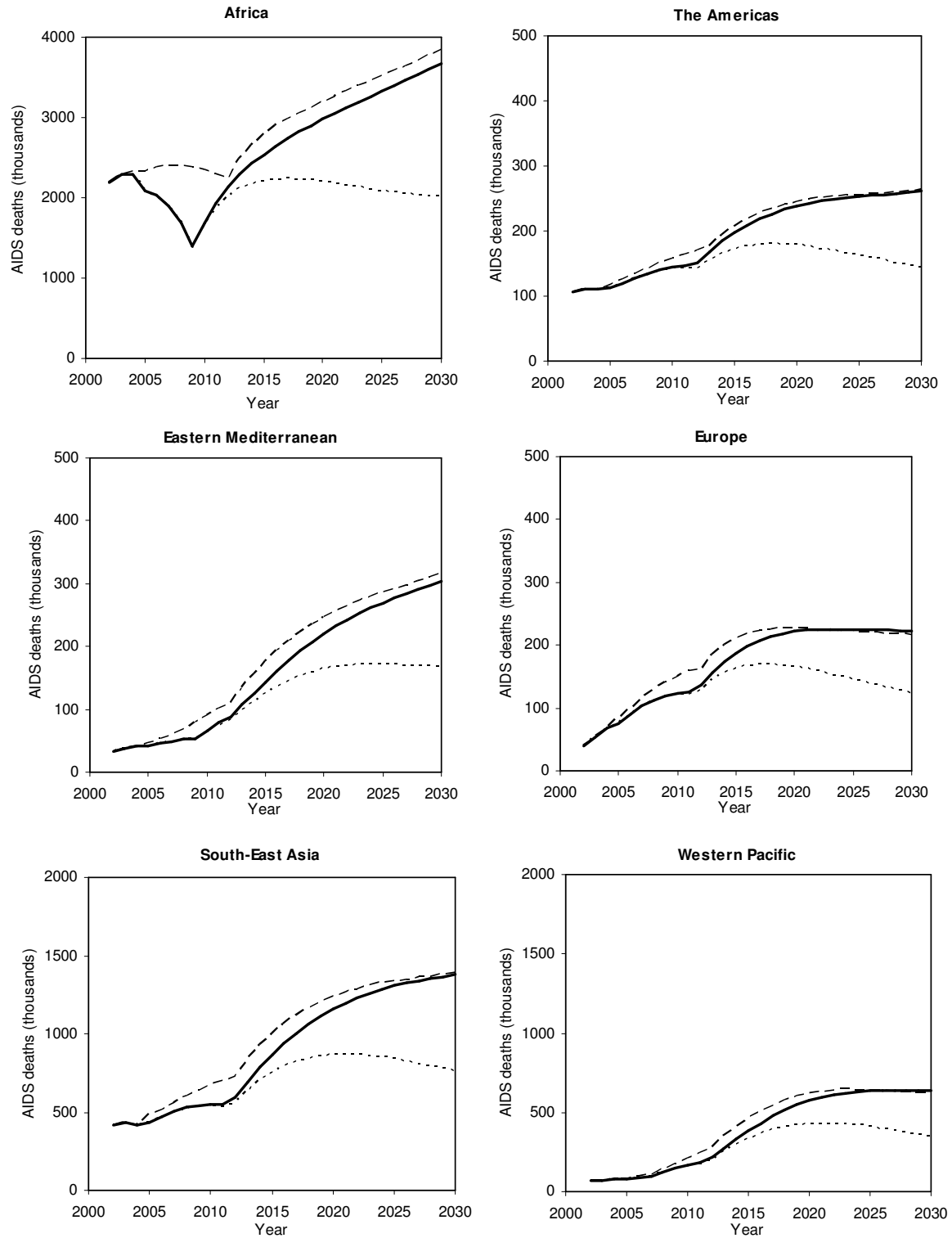


Table 10. Projected incidence and mortality (numbers and rates) for HIV/AIDS under the baseline and optimistic scenarios, by WHO region, 2005, 2015 and 2030

WHO Region	Baseline scenario			Av. annual change (%) 2005-2030	Optimistic scenario			Av. annual change (%) 2005-2030
	2005	2015	2030		2005	2015	2030	
Incidence (thousands)								
AFRO	3,169	3,983	4,972	1.8	3,169	2,627	2,405	-1.1
AMRO	333	339	364	0.4	333	217	145	-3.3
EMRO	200	297	409	2.9	200	191	171	-0.6
EURO	319	263	231	-1.3	319	171	96	-4.7
SEARO	1,155	1,432	1,552	1.2	1,155	931	655	-2.2
WPRO	545	643	645	0.7	545	418	270	-2.8
World	5,722	6,957	8,174	1.4	5,722	4,554	3,743	-1.7
Mortality (millions)								
AFRO	2,085	2,537	3,664	2.3	2,085	2,228	2,138	0.1
AMRO	112	197	293	3.9	112	172	146	1.1
EMRO	42	144	305	8.2	42	126	170	5.7
EURO	75	187	222	4.4	75	163	126	2.1
SEARO	437	866	1,377	4.7	437	756	771	2.3
WPRO	79	382	635	8.7	79	334	355	6.2
World	2,830	4,312	6,495	3.4	2,830	3,779	3,706	1.1
Incidence rate per 1,000								
AFRO	4.41	4.44	4.24	-0.2	4.41	2.90	1.96	-3.2
AMRO	0.38	0.35	0.34	-0.4	0.33	0.22	0.13	-3.6
EMRO	0.37	0.45	0.48	1.1	0.20	0.29	0.20	0.0
EURO	0.36	0.31	0.28	-1.0	0.32	0.20	0.11	-4.0
SEARO	0.70	0.77	0.75	0.3	1.16	0.50	0.31	-5.1
WPRO	0.31	0.35	0.34	0.4	0.55	0.23	0.14	-5.3
World	0.89	0.98	1.04	0.6	5.72	0.64	0.47	-9.5
Mortality rate per 1,000								
AFRO	2.90	2.83	3.12	0.3	2.90	2.46	1.74	-2.0
AMRO	0.13	0.20	0.27	3.1	0.13	0.18	0.13	0.2
EMRO	0.08	0.22	0.36	6.3	0.08	0.19	0.20	3.8
EURO	0.08	0.22	0.27	4.7	0.08	0.19	0.15	2.3
SEARO	0.26	0.47	0.66	3.8	0.26	0.40	0.37	1.3
WPRO	0.04	0.21	0.34	8.4	0.04	0.18	0.19	5.8
World	0.44	0.61	0.82	2.5	0.44	0.53	0.46	0.2

6.3 Modifications of tuberculosis projections

Because of the powerful interaction between tuberculosis and HIV infections in regions such as sub-Saharan Africa, Murray and Lopez modified the original projections from 1990 to 2020 for tuberculosis death rates. They assumed that the increased case-load due to tuberculosis in HIV-positive persons is likely to influence the annual risk of infection of tuberculosis in HIV-negative persons in the community. The increasing global burden of tuberculosis during the 1990s has been linked to the HIV/AIDS epidemic, and there is some evidence that the increased burden of HIV-associated TB cases also increases TB transmission rates at the community level (Corbett, Watt, and Walker 2002). Estimated total global tuberculosis deaths among HIV-negative persons decreased by 20 per cent from an estimated 1.96 million in 1990 (Murray and Lopez A.D. 1996) to 1.56 million in 2002 (GBD 2002 base estimate), but in sub-Saharan Africa where the HIV epidemic has been strongest, estimated tuberculosis deaths in HIV-negative persons fell from 386,000 in 1990 to 348,000 in 2002, only a 10 per cent decrease. In African countries with an HIV prevalence >4 per cent in adults aged 15-49, tuberculosis incidence and mortality rates for HIV-negative persons increased by an estimated 150 per cent and 90 per cent respectively between 1990 and 2003 (World Health Organization 2005a).

For the baseline projections from 1990, Murray and Lopez assumed that tuberculosis mortality in sub-Saharan Africa would remain constant until 2010 and then begin to decline at 1 per cent per annum. In India, it was assumed that mortality would remain constant from 1990 to 2000 and then begin to decline at 2 per cent per annum. Based on the trends in tuberculosis mortality and HIV/AIDS prevalence during the 1990s in high and low HIV-prevalence African countries, we assumed for the baseline projections that tuberculosis mortality would continue to increase by 1.5 per cent per year in African countries with an HIV prevalence >4 per cent in adults aged 15-49 in 2002, then remain constant until 2020 and subsequently decline at one per cent per annum. For low-HIV-prevalence African countries, we assumed a similar trend, but with a lower rate of increase of 0.5 per cent per year until 2010 (Table 11).

Based on the observed rate of increase of tuberculosis in African countries with high and low HIV-prevalence during the 1990s, on the estimated tuberculosis incidence and mortality trends in other regions during the 1990s, and on the baseline projections of HIV prevalence for those regions, we modified the tuberculosis projections for other regions as shown in Table 11. For the pessimistic scenario, we assumed somewhat longer periods of growth in tuberculosis death rates or slower rates of decline. For the optimistic scenario, we assumed that tuberculosis mortality rates would remain constant until 2010 and then begin to decline in sub-Saharan Africa, and that in all other regions, tuberculosis mortality would decline at the rates predicted by the regression equations for Group I conditions.

We must emphasise that these projections for tuberculosis death rates draw on historical observed trends, on projections of economic growth, with simplistic assumptions about the interaction with the HIV epidemic and are not intended to forecast what is most likely to happen. Additional planned effort to achieve the Millennium Development Goal (MDG) target for tuberculosis may result in faster progress than projected according to these methods. Additionally, the WHO Communicable Diseases cluster is currently carrying out more sophisticated and detailed projections of tuberculosis mortality, and it is planned to incorporate these in a subsequent version of these projections.

Table 11. Modification of tuberculosis mortality trends (average annual per cent increase in age-specific death rates) for baseline, optimistic and pessimistic projection scenarios

Sub-region¹	Period	Baseline	Pessimistic	Optimistic
Sub-Saharan Africa				
HIV prevalence 0-4%	2003-2010	0.5%	0.5%	0%
	2011-2020	0%	0.5%	-2.5%
	2020-2030	-1%	-0.5%	-3.5%
HIV prevalence >4%	2003-2010	1.5%	1.5%	1%
	2011-2020	0.0%	1%	-2%
	2020-2030	-1%	-0.5%	-3%
AMRO A		Group I projected trend	Group I projected trend	Group I projected trend
AMRO B	2003-2030	-3%	-2%	Group I projected trend
AMRO D	2003-2030	-2%	-2%	Group I projected trend
EMRO²	2003-2010	-1%	-1%	Group I projected trend
	2011-2020	-2%	-2%	Group I projected trend
	2020-2030	-3%	-3%	Group I projected trend
EURO A	2003-2030	Group I projected trend	Group I projected trend	Group I projected trend
EURO B, C³	2003-2030	-3%	-2%	Group I projected trend
SEARO B	2003-2030	Group I projected trend	Group I projected trend	Group I projected trend
SEARO D	2003-2030	-2%	-1.5%	Group I projected trend
WPRO A	2003-2030	Group I projected trend	Group I projected trend	Group I projected trend
WPRO B	2003-2030	-2%	-1.5%	Group I projected trend

1 Sub-regions of the 6 WHO Regions as defined in the Annex to World Health Report 2004 (WHO 2004).

2 Annual increase of 1% assumed for Iraq and Afghanistan for the period 2003-2005.

3 For Central Asian republics, assumed annual increase of 1% for 2003-2005 and 0% for 2006-2010, -1% for 2011-2020, -2% for 2021-2030.

7. Projecting years lived with disability

The World Health Organization has undertaken new assessments of the Global Burden of Disease for the years 2000 to 2002, with consecutive revisions and updates published annually in WHO's World Health Reports. These assessments use a health gap measure, the Disability Adjusted Life Year (DALY), developed by Murray and Lopez (Murray and Lopez 1996) to quantify the equivalent years of full health lost due to diseases and injury in 17 sub-regions of the WHO regions. The DALY was introduced as a summary metric for lost health in the original Global Burden of Disease Study, sponsored by the World Bank (Murray, Lopez, and Jamison 1994; World Bank 1993). The DALY combines years of life lost from premature death and years of life lived with disabilities in a single indicator allowing assessment of the total loss of health from different causes (Murray 1996).

The GBD estimates for 2002 have been used as a base for projections of burden of disease to 2030. From the projections of mortality by cause, age and sex, it is a simple matter to calculate projected Years of Life Lost (YLL). However, in order to project DALYs, it is also necessary to project Years Lived with Disability (YLD). Given the lack of good information on trends in disability and health state distributions, the approach used here to project YLDs is an elaboration of the methods and assumptions used by Murray and Lopez in the original GBD projections (Murray and Lopez A.D. 1996).

7.1 The GBD 2002 base estimates

The data sources and methods used for the GBD 2002 are documented elsewhere (Mathers et al. 2003b; Mathers et al. 2003a) and summary results for 14 regions of the world are published in the World Health Report 2004 (World Health Organization 2004) and on the world wide web (www.who.int/evidence/bod). These estimates have been revised for some causes as follows:

- HIV/AIDS deaths have been revised to reflect the latest estimates published in the 2004 Report on the global AIDS epidemic (UNAIDS 2004). Estimates of HIV/AIDS mortality for some countries were substantially revised to take into account new and different sources of data, such as national household surveys, as well as improved information on emerging epidemics in Eastern Europe, Asia and the Americas.
- Further updates were also carried out for malaria, schistosomiasis and intestinal helminths. Country-specific estimates of malaria mortality and incidence were updated to reflect recent work carried out in collaboration with other WHO programs and external expert groups to refine and revise these country-specific estimates of malaria mortality (Korenromp et al. 2003; Rowe et al. 2005).

7.2 Methods and assumptions for cause-specific YLD projections

Projections of YLDs were carried out using a similar approach to that of the original GBD projections. Disease and injury causes were divided into three distinct categories, and a different method used to approximate YLDs for each category:

- For causes with significant case-fatality (see Table 12), incidence rates and YLD rates were generally assumed to change in line with projected mortality rates. In other

words, age-sex-specific death/incidence ratios were assumed to remain constant, and average durations and disability weights also remain constant. For ischaemic heart disease and stroke, future case fatality rates were assumed to decline with improvements in income per capita in line with the cross-regional variations seen in the 2002 estimates.

- For non-communicable disease causes without significant mortality (table 12), age-sex-specific prevalence rates were generally assumed to remain constant into the future. For vision and hearing disorders, prevalence rates and disability weights were assumed to decline with improvements in income per capita in line with the cross-regional variations seen in the 2002 estimates.
- The prevalences of non-fatal communicable diseases and nutritional deficiencies were assumed to decline at between 50% to 100% of the mortality rate declines for Group I causes.

HIV/AIDS was treated separately, as the WHO and UNAIDS Working Group provided incidence and prevalence projections, as well as mortality projections. For the calculation of YLD, the duration for HIV seropositive cases not yet progressed to AIDS was assumed to remain constant, and the duration for cases that have progressed to AIDS was assumed to double between the years 2005 and 2012. For the optimistic scenario, the incidence of HIV was assumed to be decreased by the same ratio as the mortality for HIV ten years later.

The detailed assumptions used for the projection of YLDs for each cause are summarized in Table 12. As with Murray and Lopez, we recognize that the approach taken to projecting YLDs is extremely crude, and that the projections of DALYs are likely to be even more uncertain than the projections of deaths. Substantial research remains to develop robust and unbiased methods for measuring trends in case fatality rates, survival times and disability due to specific causes, let alone collecting such data across all regions of the world.

7.3 Modifications to YLD estimates associated with income projections

It is thought that declines in cardiovascular disease mortality over recent decades in high income countries have resulted from a mix of prevention and treatment interventions. Treatment interventions would have resulted in declining case-fatality rates but not incidence rates. To take this into account in the projections of YLD, we modified the mortality to incidence ratio method to take into account changes in the ratio with improving GDP per capita for ischaemic heart disease and stroke. We estimated this association by regressing the mortality/incidence ratio for these causes against GDP per capita (Y) using the 2002 estimates for the 17 sub-regions of the WHO regions for age groups 30 and over, by sex. Examination of the regression data (see Figure 10) suggested that the simplest functional form giving a reasonably linear fit to the data was to use $1/\ln(Y)$ as the independent variable in a simple linear regression.

Vision and hearing loss are leading causes of YLD burden in developed and developing regions. In the cross-sectional GBD estimates for 2002, the burden is significantly lower in high income regions because of lower prevalence of vision disorders (glaucoma, cataracts and age-related vision disorders) and lower disability weights for adult-onset hearing loss and cataracts. The latter is predominantly associated with higher prevalence of hearing aid use and treatment for cataracts. To avoid over-estimating the projected burden of sense organ disorders, the relevant prevalence rates and disability weights were adjusted for GDP growth

using regression models estimated on the cross-sectional GBD 2002 estimates for 17 regions. Examples of these regressions are shown in Figure 10.

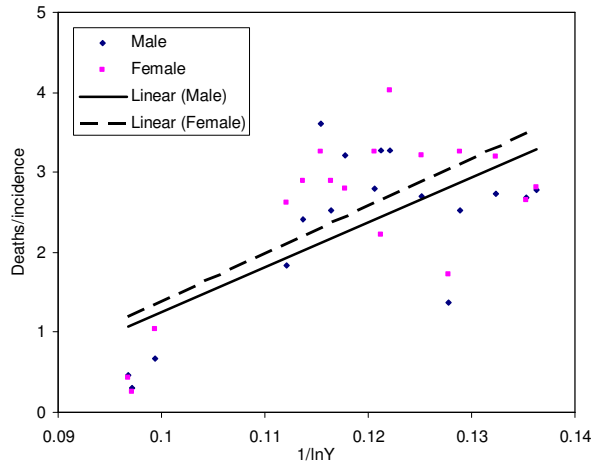
Table 12. Methods and assumptions used to project cause-specific YLDs.

Broad category	Projection method*	Causes
A. Incidence/mortality ratio	Age-sex-country specific incidence to mortality ratios assumed to remain constant into the future	Tuberculosis, HIV/AIDS, pertussis, diphtheria, measles, tetanus, meningitis, hepatitis B, hepatitis C, malaria, lower respiratory infections, maternal conditions, perinatal conditions, site-specific malignant neoplasms, other malignant neoplasms, diabetes mellitus, endocrine disorders, Parkinson disease, rheumatic heart disease, hypertensive heart disease, inflammatory heart disease, other cardiovascular diseases, chronic obstructive pulmonary disease, other respiratory diseases, digestive diseases, nephritis and nephrosis, other genitourinary system diseases, abdominal wall defect, anencephaly, anorectal atresia, oesophageal atresia, renal agenesis, congenital heart anomalies, spina bifida, other congenital anomalies, all injury cause categories
	Inc/mortality ratio for ages 30 and over adjusted as in accordance with GDP projections (see text)	Ischaemic heart disease, cerebrovascular disease
B. Constant rates	Age-sex-country specific incidence rates assumed to remain constant into the future	Diarrhoeal diseases, upper respiratory infections, other neoplasms, unipolar depressive disorders, bipolar affective disorder, schizophrenia, epilepsy, alcohol use disorders, Alzheimer and other dementias, multiple sclerosis, drug use disorders, post-traumatic stress disorder, obsessive-compulsive disorder, panic disorder, insomnia (primary), migraine, mental retardation attributable to lead exposure, other neuropsychiatric disorders, other sense organ disorders, asthma, benign prostatic hypertrophy, skin diseases, musculoskeletal conditions, other musculoskeletal disorders, cleft lip, cleft palate, Down syndrome, oral conditions
	Age-sex-country specific incidence and prevalence rates for ages 30 and over adjusted to decline with increasing GDP (see text)	Glaucoma, cataract, age-related vision disorders
	Age-sex-country specific disability weights for ages 30 and over adjusted to decline with increasing GDP (see text)	Cataract, adult-onset hearing loss
C. Declining rates	Constant annual decline in age-sex-country -specific incidence rates	Poliomyelitis (10% per annum), leprosy (5% per annum)
	Decline at 100% of Group I excluding HIV and TB	Tropical-cluster diseases, dengue, Japanese encephalitis, trachoma,
	Decline at 75% of Group I excluding HIV and TB	Intestinal nematode infections, other infectious diseases, otitis media, nutritional deficiencies
	Decline at 50% of Group I excluding HIV and TB rates	Sexually transmitted diseases excluding HIV
D. Incidence projections	Explicit projection models used also for incidence, prevalence and durations	HIV/AIDS

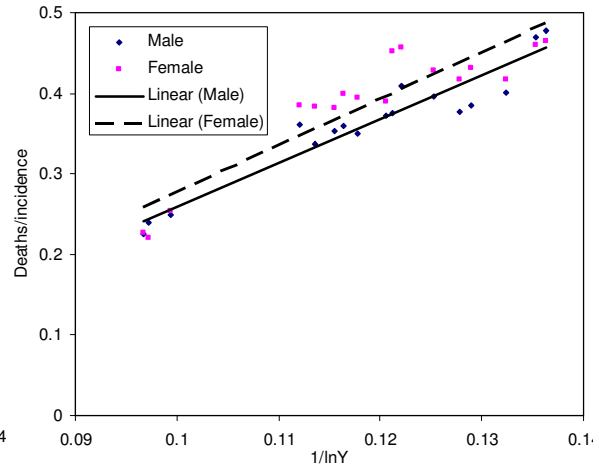
* Where not specifically mentioned, average durations and disability weights used in the calculation of YLDs are assumed to remain constant.

Figure 10: Examples of regressions of case fatality rates, prevalence rates and disability weights against income per capita (Y), GBD estimates for 17 regions, 2002 .

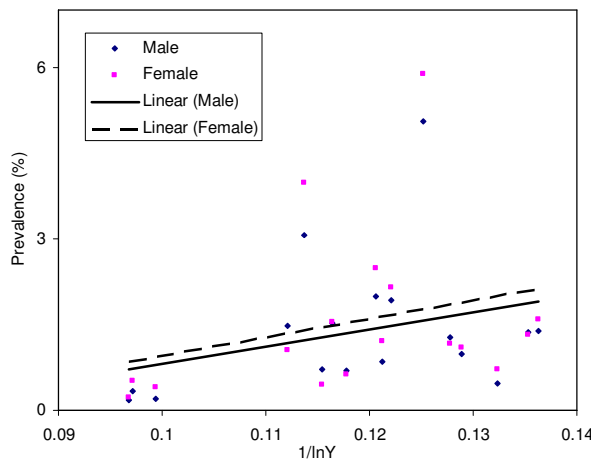
(a) IHD deaths/angina incidence, 60-69 years



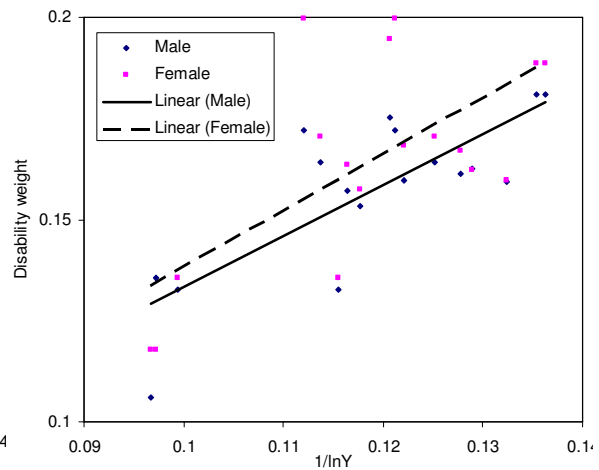
(b) Cerebrovascular disease deaths/first-ever stroke incidence, 70-79 years



(c) Age-related vision loss, low vision, 45-59 years



(d) Severe hearing loss, 60-69 years



8. Projection scenarios

8.1 Optimistic, baseline and pessimistic scenarios

Table 13 summarizes the assumptions and inputs for the optimistic, baseline and pessimistic scenarios. These are described in more detail in relevant earlier sections.

Table 13. Summary of assumptions and inputs for baseline, optimistic and pessimistic projection scenarios

	Baseline scenario	Pessimistic scenario	Optimistic scenario
Projected covariates			
GDP per capita	World Bank projections	Assume GDP annual growth rates from 2005 at 50% of baseline projections, with some regional variations	Assume GDP annual growth rates from 2005 approximately 40% higher than baseline projections, somewhat lower increase for high income countries, China and India
Human capital	EIP projections based on projected GDP growth	Approximately 1% lower annual growth with GDP compared to baseline scenario	Approximately 1% higher annual growth with GDP compared to baseline scenario
Smoking intensity	Weighted average based on previous EIP regional projections, country trends in apparent consumption, and lung cancer trends where available.	Weighted average giving more weight to previous EIP regional projections.	Weighted average giving more weight to country trends in apparent consumption.
Adjustment factor for major cause regression coefficients			
Time	0 for AFRO low income countries, 0.25 for other low income countries	0 for AFRO low income countries, 0 for other low income countries	0.25 for AFRO low income countries, 0.75 for other low income countries
Human capital	0.5 for low income countries	0 for low income countries	0.75 for low income countries
Disease-specific mortality projections			
HIV/AIDS	Achievement of 80% ARV coverage by 2012	Achievement of 60% ARV coverage by 2012 in all regions except Latin America (60% by 2013)	Achievement of 80% ARV coverage by 2012 plus additional prevention activities
Tuberculosis	Modified for interaction with HIV/AIDS in middle and low income countries (Table x)	Modified for interaction with HIV/AIDS in middle and low income countries (Table x)	Modified for interaction with HIV/AIDS in sub-Saharan Africa only - see Table x
Diabetes	Non-overweight death rates declining at 50% of rate for Other Group II deaths	Non-overweight death rates declining at 25% of rate for Other Group II deaths	Non-overweight death rates declining at 75% of rate for Other Group II deaths
COPD and asthma	Non-smoker death rates declining at 50% of rate for Other Group II deaths	Non-smoker death rates declining at 25% of rate for Other Group II deaths	Non-smoker death rates declining at 75% of rate for Other Group II deaths
Violence	Assume rates constant over time in high income countries	Projected trends for intentional injuries assumed to apply	Assume rates constant over time in high income countries
War	Assume rates constant over time in all regions	Assume rates rise for EMRO and AMRO regions between 2002 and 2005 and then remain constant over time in all regions	Assume rates decline at 1.5% per annum from 2006 onwards.

8.2 The bold goal scenario

The bold goal for chronic diseases proposed in the Global Report on Preventing Chronic Diseases (World Health Organization 2005b), was modeled in terms of an additional 2 percent annual decline in non-communicable disease mortality rates from 2006 to 2015 as projected under the baseline scenario. Annual rates of change in age-sex-country-specific death rates for all non-communicable disease causes were calculated for the baseline mortality projections from 2005 to 2015 and then adjusted by subtraction of an additional 2% per annum. Death rates for years 2006 to 2015 were then recomputed using the adjusted annual trends for age-sex-country-specific rates. Note that the final death rates for non-communicable diseases in 2015 under the bold goal scenario will be substantially lower than the baseline projections, since the additional 2% annual declines are cumulative.

8.3 Scenario for no further scale-up of ART treatment for AIDS

Projections were also carried out using UNAIDS and WHO projections of HIV/AIDS mortality holding current levels of adult ART, children ART and co-trimoxazole, and PMTCT coverage at the 2004 levels. All other assumptions and inputs were as for the baseline projections shown in Table 13. Population projections were revised to reflect the changes in all-cause mortality rates due to the HIV/AIDS mortality projections.

8.4 Achievement of MDG targets

Work is currently underway to develop a scenario where MDG health targets are reached in 2015 and to examine the consequences for global mortality and burden of disease patterns.

9. Population projections

Future population growth and changes in age composition are determined by levels and trends in three factors: fertility, mortality and migration. To ensure consistency between the projected mortality rates and the projected population numbers, we have used the WHO projections of mortality rates, together with UN medium variant assumptions for fertility rates and migration rates (United Nations Population Division 2003), to prepare consistent population projections for all regions. These were calculated as follows for each of the baseline, optimistic, pessimistic and other scenarios:

- Cause-specific mortality projections were first aggregated to obtain estimates of all-cause mortality in each of the seven age groups for each country.
- Mortality rates for these seven age groups were then used to estimate mortality rates for each five-year age group from 0-4 through to 95 and over, using the ratio of the five-year age group mortality rate to the larger age band mortality rate, based on the GBD estimates of mortality by country for 2002.
- UN Population Division 2002 revision medium variant projections of fertility rates (see Table 13) by maternal age and country were applied to projected female population numbers in each of the scenarios in order to project the size of the birth cohort for each country for future years.
- Population projections for each five-year age group were then obtained using the projected birth and death rates, and applying the UN Population Division 2002 revision medium variant projections of net migration rates by age, sex and country.

9.1 Comparison of projected population with UN and previous GBD projections

Figure 11 summarizes our projected life expectancies at birth under the baseline scenario and compares them with the UN projections (2002 revision) for more developed and less developed countries. The WHO projected life expectancies are slightly lower than the UN projections, particularly for males in less developed countries, reflecting somewhat higher adult death rates in the WHO baseline mortality projections (see also Table 14).

Figure 11: Comparison of WHO and UN projected life expectancies at birth, by sex, more developed and less developed countries, 2002 - 2030.

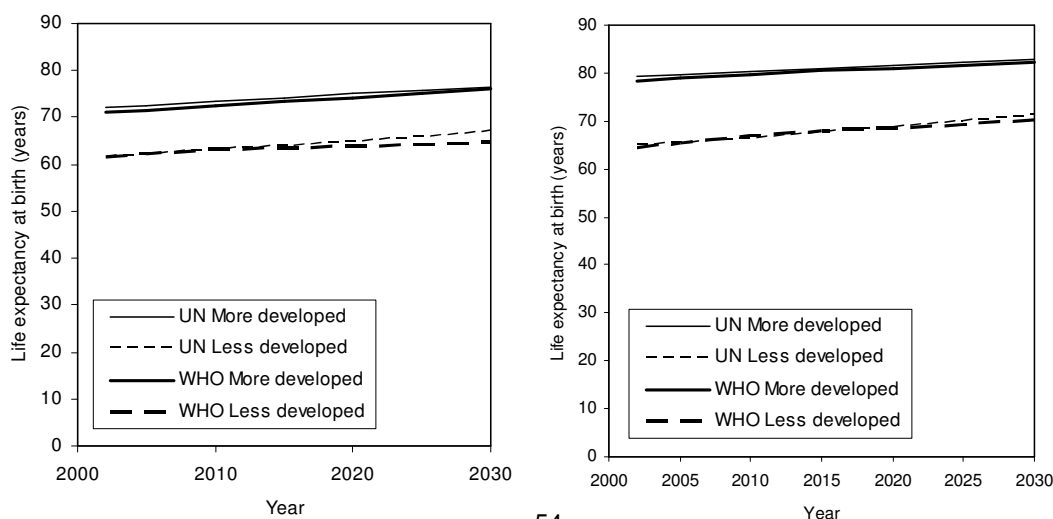


Table 14. WHO and UN projected life expectancies at birth, by sex, more developed and less developed countries, 2002 - 2030.

	2002	2005	2010	2015	2020	2025	2030
More developed regions¹							
Males							
UN Projections	72.0	72.6	73.4	74.2	75.0	75.8	76.4
Baseline projections	71.1	71.5	72.4	73.6	74.2	75.1	76.0
Females							
UN Projections	79.3	79.7	80.4	81.0	81.7	82.3	82.8
Baseline projections	78.4	78.8	79.5	80.5	80.8	81.5	82.2
Less developed regions							
Males							
UN Projections	61.6	62.2	63.1	64.0	64.9	66.0	67.1
Baseline projections	61.4	62.1	63.2	63.4	63.8	64.2	64.7
Females							
UN Projections	65.0	65.5	66.5	67.6	68.8	70.0	71.2
Baseline projections	64.4	65.5	67.2	67.9	68.7	69.4	70.2

¹ More developed regions include all of Europe, North America, Australia, New Zealand and Japan

The projected global population in 2015 under the baseline scenario was 7.1 billion compared to the UN medium variant projection of 7.2 billion, a difference of -1.4%. The range in the projected global population in 2015 was from 7.06 billion (pessimistic scenario) to 7.12 billion (optimistic scenario). By 2030, the difference between WHO and UN baseline projections of population grew to 3%, and the range from pessimistic to optimistic scenarios to 7.74 - 8.04 billion (Figure 12). Annex Tables 8 onwards contain details of population projections for each scenario for the years 2005, 2015 and 2030.

Figure 12: Comparison of WHO and UN global population projections, for three scenarios, 2002 - 2030.

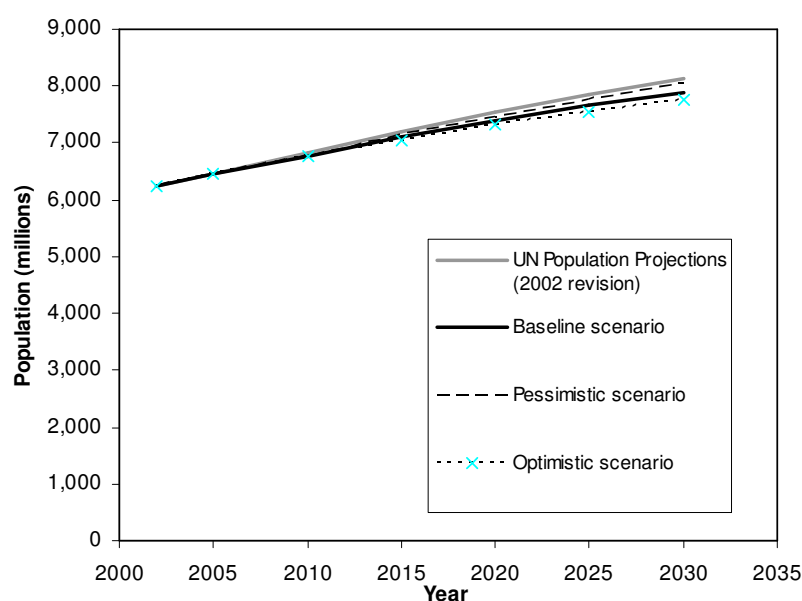


Table 15. Regional population growth: WHO and UN (2002 revision) population projections, 2002 - 2030.

	Total population (millions)			Population growth (%)	
	2002	2015	2030	2002-2015	2002-2030
UN Projections					
African Region	673	881	1,148	30.9	70.7
Region of the Americas	858	986	1,113	15.0	29.7
Eastern Mediterranean	507	668	861	31.8	69.9
European Region	878	886	877	0.9	-0.2
South East Asian Region	1,591	1,884	2,144	18.5	34.8
Western Pacific Region	1,718	1,878	1,970	9.3	14.7
World	6,225	7,184	8,113	15.4	30.3
Baseline projections					
African Region	673	897	1,173	33.3	74.3
Region of the Americas	858	974	1,079	13.5	25.8
Eastern Mediterranean	507	665	845	31.2	66.9
European Region	878	861	829	-1.9	-5.6
South East Asian Region	1,591	1,860	2,074	16.9	30.4
Western Pacific Region	1,718	1,841	1,891	7.1	10.1
World	6,225	7,097	7,893	14.0	26.8

1 More developed regions include all of Europe, North America, Australia, New Zealand and Japan

Figure 13: Comparison of global population projections for 2002-2030 with original GBD population projections for 1990-2020 (Murray and Lopez 1996), baseline scenarios

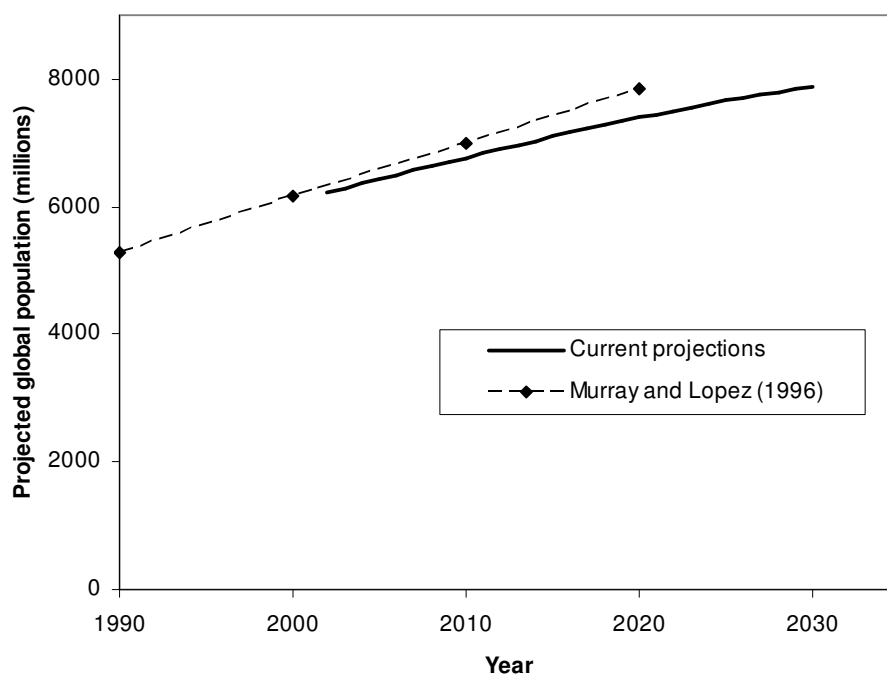


Table 15 summarizes regional and global population growth over the period 2002 to 2030 for the UN population projections and for the WHO baseline scenario. Overall, the projections are reasonably similar, with somewhat lower growth rates for the WHO projections, reflecting the higher death rates projected here. The largest difference in the population growth projections is for the European region, where we project the total population to decline at a faster rate than the UN projections.

Figure 13 compares the global population projections from 1990 to 2020 from the original GBD study (Murray and Lopez A.D. 1996) with the current population projections from 2002 to 2030. The 2002 baseline population is slightly lower than that projected by Murray and Lopez and we project a lower rate of population growth due to both lower estimates of future fertility rates and higher projected mortality rates. Our projected global population in 2020 of 7.40 billion under the baseline scenario is 5.6% lower than the 2020 baseline projection of 7.84 billion for the original GBD projections.

We also examined the sensitivity of the population projections, and of the resulting cause of death projections to the assumption that fertility rates will follow the UN Population Division 2002 revision medium variant projections.

9.2 Sensitivity of results to fertility assumptions

The population projections affect only the projected numbers of deaths, the death rate projections are independent of population. The UN medium variant projections for fertility rates assume that total fertility in all countries converges eventually toward a level of 1.85 children per woman. However, not all countries reach this level during the projection period, that is, by 2050. The assumed trends are shown for regional average total fertility rates in Table 16. The UN Population Division has recently released the 2004 revision of its population projections (United Nations Population Division 2005), and these are also shown in Table 16. In general, there is little difference between the 2002 and 2004 revisions, with some small reductions in projected fertility rates globally, but small increases in projected fertility rates for least developed countries.

If fertility rates do not decline in developing countries as fast as assumed in the medium variant scenario, then there will be more children born in future years, and total numbers of child deaths will be higher. Thus the cause of death distribution will be shifted towards those causes predominant in childhood. Variations in projected fertility rates will only affect population numbers up to age 28 for projections from 2002 to 2030.

We examined the effect of higher fertility rates in the future using the UN high fertility assumptions. Under the high variant, fertility is projected to remain 0.5 children above the fertility in the medium variant over most of the projection period. That is, countries reaching a total fertility of 1.85 children per woman in the medium variant have a total fertility of 2.35 children per woman in the high variant at the end of the projection period.

We compared the projected cause distribution (deaths and DALYs) for the 2030: baseline scenario using medium fertility projections and a scenario using a high fertility variant population projections. The greater numbers of children and younger adults in the population under the latter scenario result in larger numbers of deaths from causes predominant at earlier ages, and in the projected total global deaths, which are around 1 million higher under the high fertility variant. However, the impact on the cause of death distribution, at the broad level, is much less, as shown in Table 17 and Figure 14.

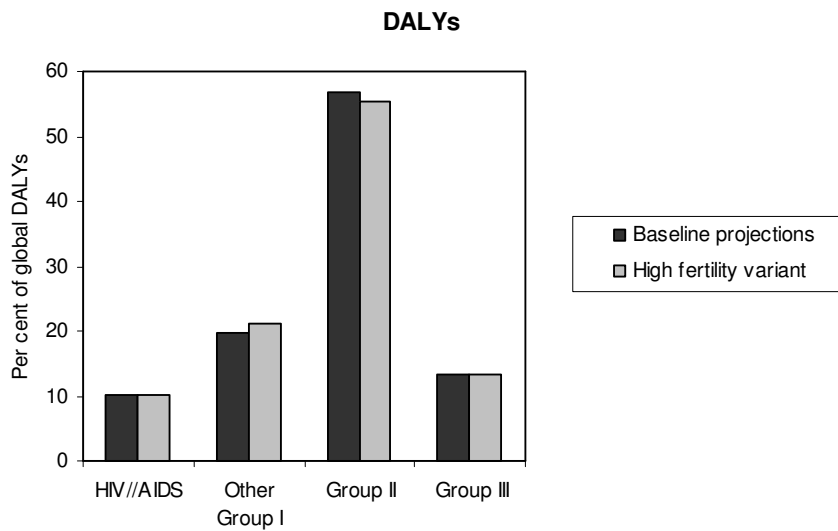
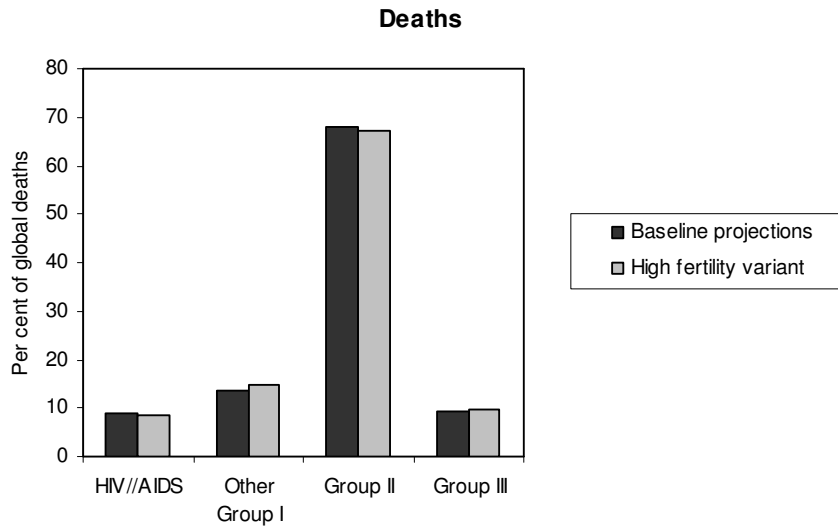
Table 16. Regional population growth: WHO and UN (2002 revision) population projections, 2002 - 2030.

	Total fertility (children per woman)		
	2005	2015	2025-2030
World			
Medium variant - 2002 revision	2.64	2.46	2.25
Medium variant - 2004 revision	2.60	2.42	2.23
High variant - 2004 revision	2.73	2.87	2.73
More developed regions			
Medium variant - 2002 revision	1.57	1.62	1.75
Medium variant - 2004 revision	1.58	1.63	1.72
High variant - 2004 revision	1.70	2.07	2.21
Less developed regions			
Medium variant - 2002 revision	2.85	2.59	2.31
Medium variant - 2004 revision	2.83	2.58	2.31
High variant - 2004 revision	2.95	3.03	2.81
Least developed countries			
Medium variant - 2002 revision	4.95	4.23	3.42
Medium variant - 2004 revision	4.87	4.24	3.50
High variant - 2004 revision	4.98	4.69	4.00

Table 17: Comparison of projected cause distribution (deaths and DALYs) for 2030: baseline scenario using medium fertility projections and a scenario using a high fertility variant population projections

Cause group	Deaths (% of total)		DALYs (% of total)	
	Baseline	High fertility	Baseline	High fertility
HIV/AIDS	8.7	8.5	10.3	10.1
Other Group I	13.7	14.9	19.7	21.1
Group II	68.1	67.1	56.9	55.4
Group III	9.5	9.6	13.2	13.4

Figure 14: Comparison of projected cause distribution (deaths and DALYs) for 2030: baseline scenario using medium fertility projections and a scenario using a high fertility variant population projections



10. Results

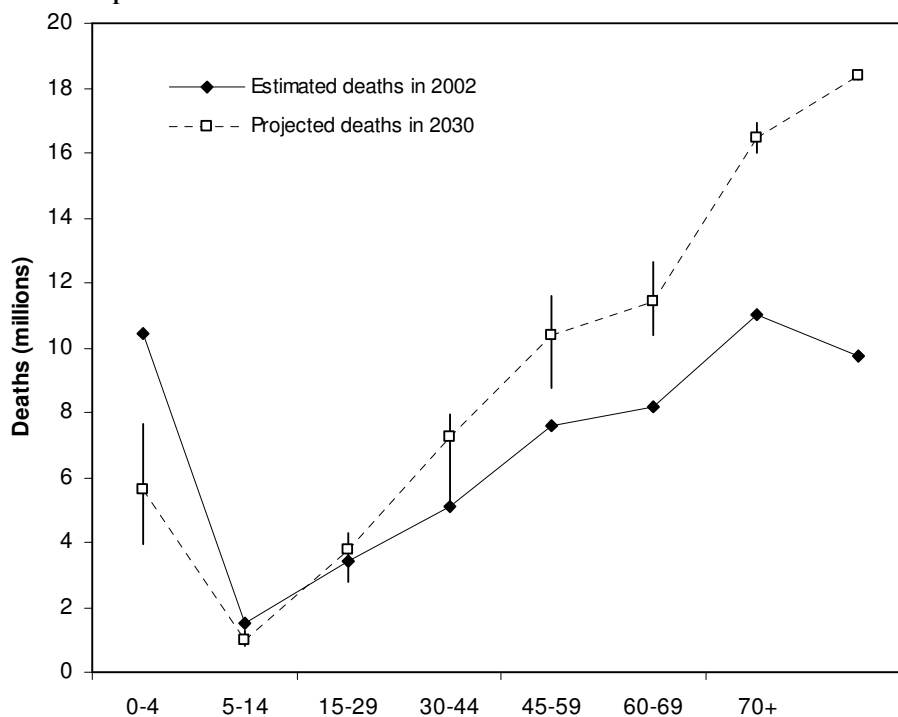
This section provides an overview of the projections for mortality and burden of disease. Detailed projection results for 2005, 2015 and 2030 are presented in Annex Tables 8 to 27, which are included at the end of this working paper and are also available in downloadable Excel spreadsheets on the WHO website at www.who.int/evidence/bod. Base GBD results for 2002 are also available on the WHO website at the same location.

The results presented here for the baseline, optimistic and pessimistic projections represent the numerical consequences of the assumptions and methods described in the earlier parts of this paper, applied to the Global Burden of Disease estimates for the year 2002. These starting estimates involve considerable uncertainty for certain regions and for certain causes, as do the projections of the covariates used to generate the mortality projections. The uncertainties and limitations of the projections are discussed in greater detail in Section 11. At this point, we simply remind the reader that these projections do not necessarily represent reliable predictions of the future, but rather a set of visions of the future resulting from explicit assumptions, covariate projections, and starting estimates.

10.1 All-cause mortality

Figure 15 shows the projected global numbers of deaths in 2030 by age in the three scenarios, compared with the numbers of deaths by age in 2002. In all three scenarios there is a dramatic shift in the distribution of deaths from younger to older ages. The risk of death for children aged under 5 is projected to fall substantially in the baseline scenario, by almost 30% between

Figure 15: Global numbers of deaths by age and sex: baseline, optimistic and pessimistic scenarios for 2030 compared with 2002 estimates



2005 and 2015, and by over 40% between 2005 and 2030. These rates of decline are similar to those projected between 2005 and 2015 in the original GBD projections. The vertical bars attached to the points for 2030 in Figure 15 represent the range of deaths projected under the optimistic and pessimistic scenarios. These ranges are largest for children and young to middle aged adults. The ranges for global projected deaths become smaller at older ages since increases or decreases in projected age-specific rates are counterbalanced by the effects of projected population numbers at older ages of increases or decreases in the mortality rates.

Figure 16: Projected life expectancy at birth in 2020 by WHO region: baseline, optimistic and pessimistic scenarios compared with 2002 estimates

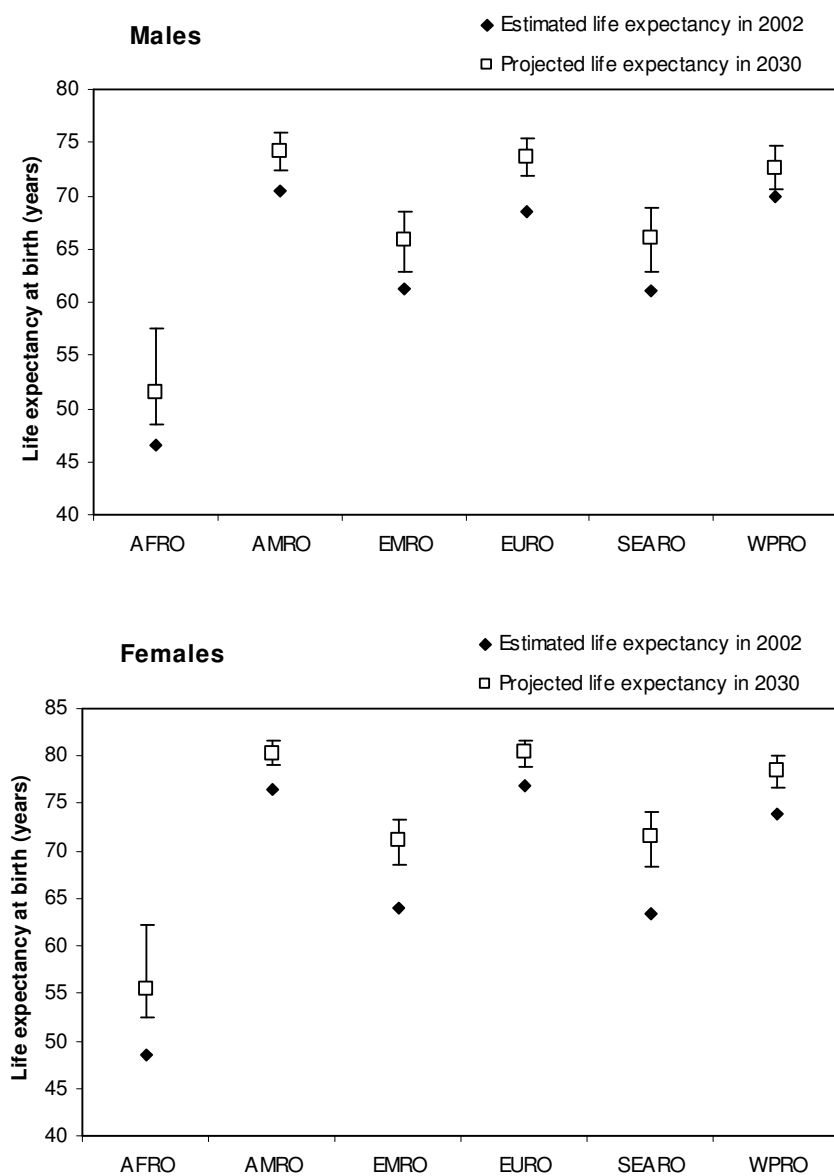


Figure 16 shows projected life expectancies at birth in 2020 under the three scenarios, by WHO region. Figure 17 shows a similar picture for countries grouped by income. Life expectancy at birth is projected to increase in all WHO regions, with the largest increases in the African region, the Eastern Mediterranean and the South-East Asian regions. In all regions except the European region, life expectancy increases are greater for females than for males.

Table 18 summarizes increases in life expectancy at birth and at age 60 for WHO regions from 2002 to 2030. Increases in life expectancy at birth are greatest in the African region and South East Asian Region, with an increase of 8.2 years projected for females in the South East Asian region. Life expectancy at birth is projected to increase to 85 years in 2030 for females in high income countries.

Figure 17: Projected life expectancy at birth in 2020 by income group: baseline, optimistic and pessimistic scenarios compared with 2002 estimates

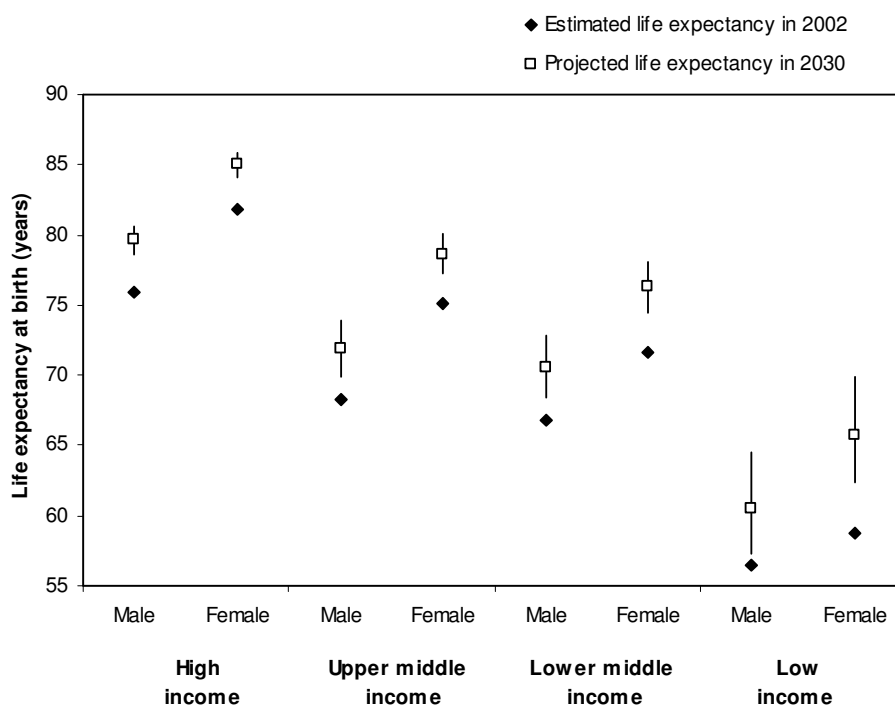


Table 18: Projected life expectancies at birth and at age 60, by sex and WHO region, 2002-2030

	Life expectancy at birth		Life expectancy at age 60		Female minus male		
	Male	Female	Male	Female	LE at birth	LE at age 60	
African Region							
2002	46.5	48.4	13.9	15.8	2.0	1.9	
2030	51.6	55.4	14.1	16.0	3.8	1.9	
<i>Increase</i>	<i>5.1</i>	<i>6.9</i>	<i>0.2</i>	<i>0.2</i>	<i>1.8</i>	<i>0.0</i>	
Region of the Americas							
2002	70.5	76.5	19.2	22.3	6.0	3.2	
2030	74.2	80.3	21.3	24.3	6.1	3.0	
<i>Increase</i>	<i>3.7</i>	<i>3.8</i>	<i>2.1</i>	<i>1.9</i>	<i>0.1</i>	<i>-0.2</i>	
Eastern Mediterranean							
2002	61.2	64.0	15.5	17.4	2.8	1.9	
2030	65.9	71.2	17.0	19.3	5.3	2.4	
<i>Increase</i>	<i>4.8</i>	<i>7.2</i>	<i>1.5</i>	<i>2.0</i>	<i>2.5</i>	<i>0.4</i>	
European Region							
2002	68.5	76.8	17.5	21.7	8.3	4.2	
2030	73.6	80.4	21.0	23.9	6.7	2.9	
<i>Increase</i>	<i>5.1</i>	<i>3.6</i>	<i>3.5</i>	<i>2.3</i>	<i>-1.5</i>	<i>-1.3</i>	
South East Asian Region							
2002	61.1	63.4	15.3	16.9	2.3	1.6	
2030	65.9	71.5	16.7	19.3	5.6	2.6	
<i>Increase</i>	<i>4.8</i>	<i>8.2</i>	<i>1.4</i>	<i>2.4</i>	<i>3.3</i>	<i>1.0</i>	
Western Pacific Region							
2002	69.9	73.9	17.8	20.6	4.0	2.8	
2030	72.6	78.5	19.0	22.6	5.9	3.5	
<i>Increase</i>	<i>2.7</i>	<i>4.6</i>	<i>1.2</i>	<i>1.9</i>	<i>1.9</i>	<i>0.7</i>	

10.2 Cause-specific mortality

Table 19 compares the projected annual average changes in age-standardized death rates for selected major causes for the original GBD projections from 1990 (for the period 2000-2020) and for the current projections (for the period 2002-2020). The projections for HIV/AIDS differ substantially, with a projected average annual increase of 3 per cent for males and 2 per cent for females in the current projections, compared to a 1.3 per cent annual decline in the original projections. Other causes with projected increases in age-standardized rates include lung cancer (albeit at a lower rate than the original projections), diabetes, chronic respiratory diseases, road traffic accidents, violence and war.

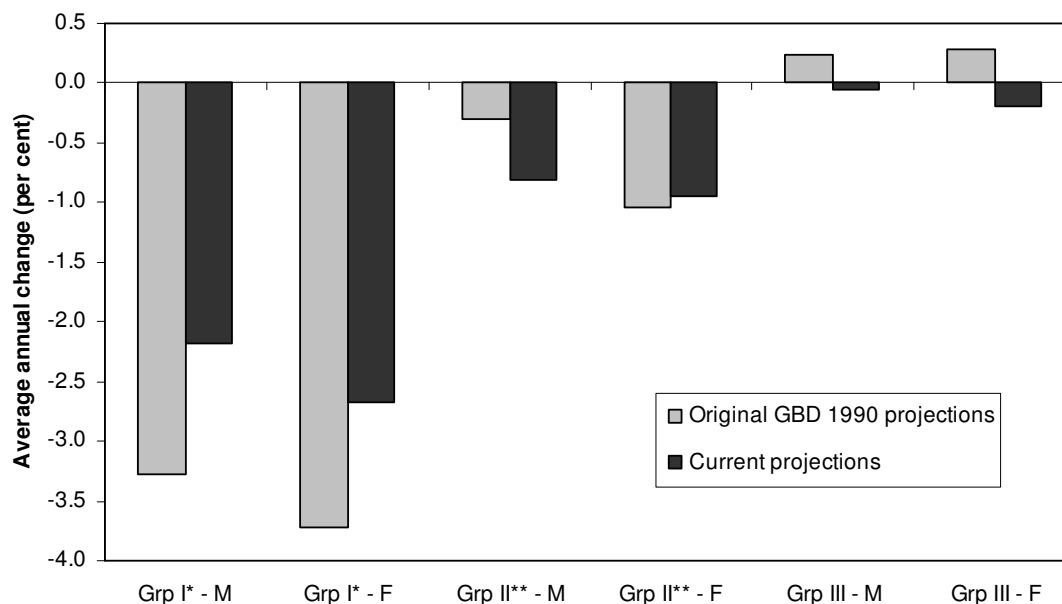
For the cause groups where age-specific death rate projections were based on the regression analyses, the average annual rates of change are broadly similar. Group I causes, excluding HIV/AIDS and tuberculosis, decline with average annual rates of change typically in the range around one third slower than the original GBD projections (Figure 18). To some extent, this reflects the more conservative projections for low income countries, where the coefficient of the time factor was reduced or set to zero. Average rates of decline for Group II causes (excluding lung cancer and chronic respiratory conditions) are similar for males and females in the current projections, and similar to those for females in the original projections. However the differential between males and females in the original projections has

disappeared in the current projections, with males have a greater average annual rate of decline for Group II conditions than previously projected.

Table 19: Projected average annual rates of change in age-standardized death rates for selected causes: a comparison of current projections for 2002-2020 with the original GBD projections for 2000-2020

	Average annual change (%) in age-standardized death rate, world, 2000-2020*			
	GBD 1990		GBD 2002	
	Males	Females	Males	Females
All causes	-0.6	-1.2	-0.6	-1.0
Group I	-2.7	-3.0	-1.0	-1.7
Infectious	-2.5	-2.6	-0.3	-0.9
Tuberculosis	-1.6	-1.1	-0.7	-0.9
HIV/AIDS	-1.3	-1.3	3.0	2.1
Malaria	-3.1	-3.6	-1.4	-1.7
Other infectious	-3.5	-3.9	-2.5	-3.0
Respiratory infections	-2.9	-3.2	-2.6	-3.3
Perinatal conditions*	-3.6	-3.9	-1.6	-1.9
Other Group I	-3.2	-5.1	-3.0	-3.5
Group II	-0.2	-0.9	-0.6	-0.8
Cancer	0.3	-0.4	-0.2	-0.4
Lung cancer	0.7	0.6	0.1	0.3
Other cancers	0.2	-0.6	-0.3	-0.5
Diabetes mellitus	-1.6	-1.2	1.2	1.6
Cardiovascular diseases	-0.3	-1.2	-1.1	-1.2
Ischaemic heart disease	-0.4	-1.1	-1.1	-1.1
Cerebrovascular disease	-0.3	-1.1	-1.1	-1.2
Respiratory diseases	0.2	0.2	0.4	0.2
Digestive diseases	-0.5	-1.2	-1.3	-1.7
Group III	0.2	0.3	-0.1	-0.2
Unintentional injuries	0.0	0.2	-0.2	-0.2
Road traffic accidents	1.1	1.7	1.1	1.1
Poisonings	-1.1	-0.6	-1.9	-1.1
Falls	-0.8	-0.6	-0.6	-0.2
Fires	-0.4	-0.5	-0.6	-0.6
Drownings	-1.3	-1.2	-1.4	-1.7
Other unintentional injuries	-0.7	-0.6	-1.1	-0.8
Intentional injuries	0.6	0.5	0.2	-0.2
Self-inflicted injuries	-0.3	-0.2	-0.3	-0.4
Violence	0.9	0.4	0.4	0.2
War	1.4	1.3	1.3	0.9
Other unintentional injuries	-0.7	-0.6	-1.1	-0.7

Figure 18: Projected average annual rates of change in age-standardized death rates for the three major cause groups: a comparison of current projections for 2002-2020 with the original GBD projections for 2000-2020



* Group I (communicable, maternal, perinatal and nutritional conditions) excluding HIV/AIDS and tuberculosis
 ** Group II (non-communicable diseases) excluding lung cancer and chronic respiratory diseases

In the current projections for road traffic accidents, male and female age-standardized death rates increase at the same average annual rate of 1.1 per cent, whereas female death rates increased faster than male in the previous projections (Table 19). Together with changed assumptions concerning trends for deaths due to violence and war, this leads to slightly declining average annual rates for injury mortality in the current projections, whereas age-standardized injury deaths were increasing in the previous projections.

Figure 19 summarizes the contributions of major causes to global trends in numbers of deaths for the three major cause groups. Large declines in mortality between 2002 and 2030 are projected for all of the principal Group I causes with the exception of HIV/AIDS. Under the baseline scenario involving scale-up of ARV coverage to 80% by 2012, but not additional prevention efforts, HIV/AIDS deaths increase from 2.8 million in 2002 to 6.5 million in 2030. Total deaths due to other Group I causes decline from 15.5 million in 2002 to 10.2 million in 2030. Unfortunately, this is substantially offset by the projected rise in HIV/AIDS deaths. Under the optimistic scenario involving additional HIV prevention activity, there are projected to be 3.7 million HIV/AIDS deaths in 2030, so that total deaths due to Group I conditions would decline from 32 per cent of all deaths in 2002 to 16 per cent of all deaths in 2030.

Although age-specific death rates for most Group II conditions are projected to decline, ageing of the population will result in significantly increasing total deaths due to most Group II conditions over the next thirty years (Figure 19). Global cancer deaths are projected to increase from 7.1 million in 2002 to 11.4 million in 2030, and global cardiovascular deaths from 16.7 million in 2002 to 23.0 million in 2030. Overall, Group II conditions will account for two thirds of all deaths in 2030 under the baseline scenario.

Figure 19: Baseline projections of deaths from Group I, Group II and Group III causes, world, 2002-2030

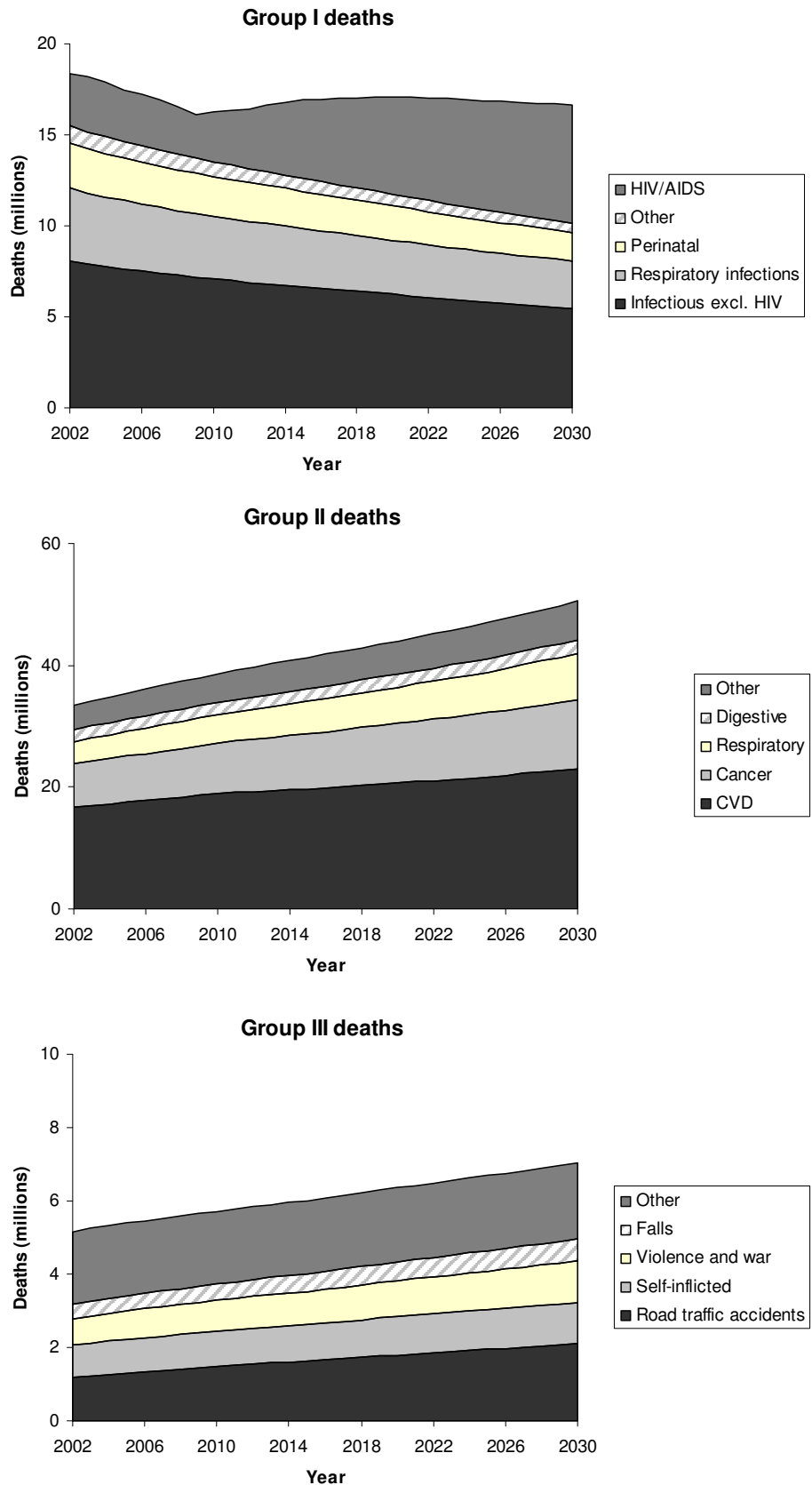
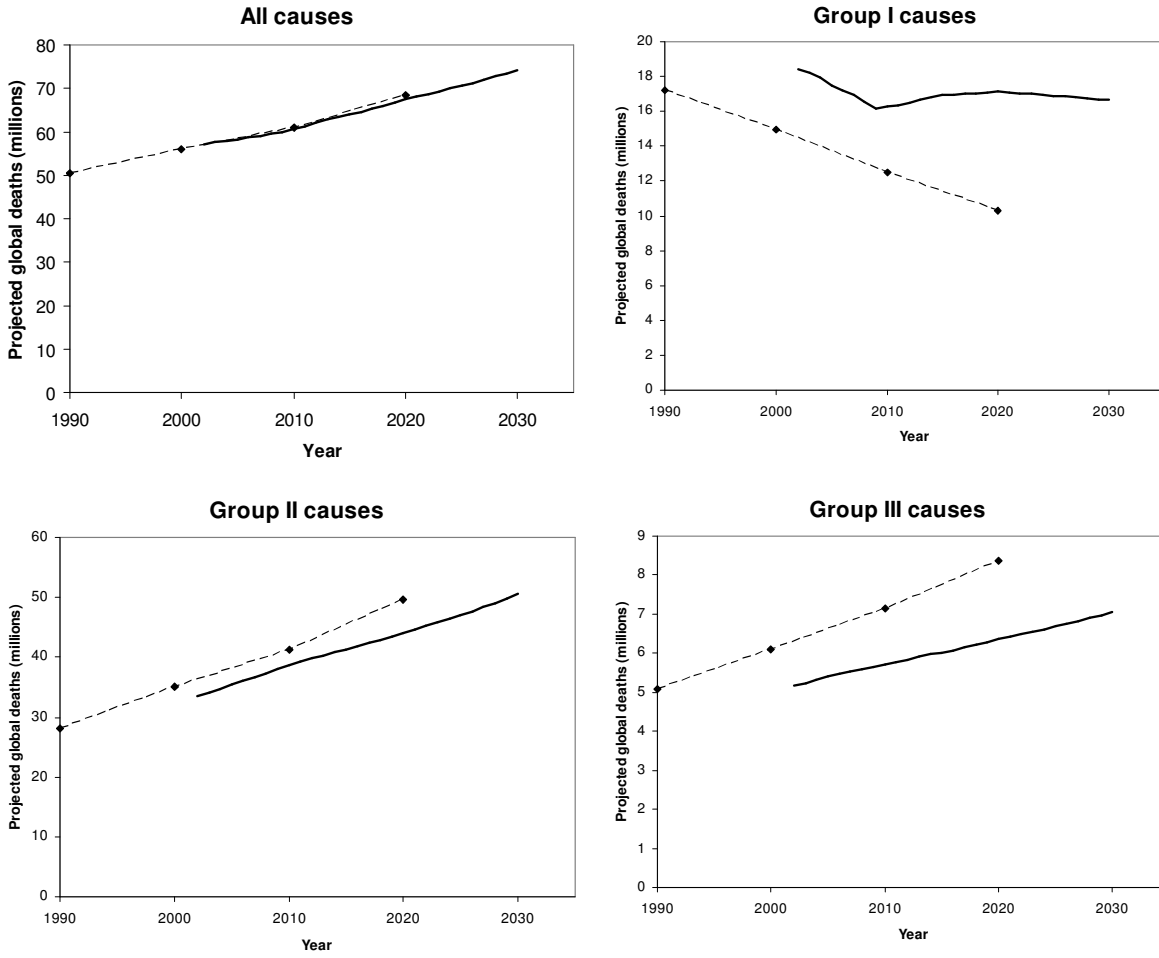


Figure 20: Comparison of baseline projections 2002-2030 with the original GBD projections 1990-2020: global deaths for all causes, and major cause groups



The projected 40 per cent increase in global deaths due to injury between 2002 and 2030 are predominantly due to the increasing numbers of road traffic accident deaths, together with increases in population numbers more than offsetting small declines in age-specific death rates for other causes of injury. Road traffic accident deaths are projected to increase from 1.2 million in 2002 to 1.9 million in 2030, primarily due increased motor vehicle fatalities associated with economic growth in low and middle income countries.

Figure 20 compares projected global deaths for each of the three major cause groups for 2002 to 2030 with the corresponding projections for 1990 to 2020 from the original GBD study (Murray and Lopez A.D. 1996). Projections for Group I causes are substantially different, mainly because of the very large difference in projected HIV/AIDS mortality. The HIV/AIDS projections used by Murray and Lopez seriously underestimated to size of the HIV epidemic: they projected 1.3 million HIV/AIDS deaths in 2000 dropping to 1.2 million in 2020, whereas the current best estimate of global HIV/AIDS deaths in 2000 is a little under 3 million, and projected to rise to 5.4 million in 2020 under the baseline scenario.

Total global deaths for Group II and Group III causes are projected to increase at a somewhat slower rate than the original GBD projections (Figure 20), and in addition, the base levels for these causes in 2002 are somewhat lower than the levels projected by the original GBD study. Despite these differences for all three major cause groups, and differences in projected global population numbers, the projections of total global all cause deaths are almost identical to those in the original GBD study. Projected global deaths in 2020 under the baseline scenario are 67.5 million, compared to 68.3 million projected by Murray and Lopez from the 1990 base. Additionally, the overall trend in total deaths is almost identical. This congruence is almost certainly a coincidence, since the global total death projections are derived from summing separate projections across 12 major cause groups, and almost all of the inputs to those projections have changed significantly from those used in the original projections.

Figure 21 compares projected global deaths for selected Group I causes for 2002 to 2030 with the corresponding projections for 1990 to 2020 from the original GBD study (Murray and Lopez A.D. 1996). As noted above, projections for HIV/AIDS mortality differ substantially, as do the base 2002 levels compared with the projected 2002 levels from the original projections. Despite these differences, projected trends for global deaths due to most Group I causes other than HIV/AIDS are broadly similar. The new projections for tuberculosis deaths show a flattening after 2020, after a period of increase generally similar to the earlier projections.

Figure 22 compares projected global deaths for selected Group II causes with the corresponding projections from the original GBD study (Murray and Lopez A.D. 1996). The new baseline projections for lung cancer give lower global numbers and also a lower rate of increase. Additionally, the very substantial difference in projections for diabetes mellitus reflects the change in method to reflect increasing risk of diabetes associated with projected increases in overweight and obesity. This results in an average annual increase in age-standardized death rates for diabetes of 1.2 per cent for men and 1.6 per cent for women, compared to projected declines of around 1.2 to 1.6 per cent in the original projections (Table 15). Projected trends in global respiratory deaths are similar for the two sets of projections (Figure 22), but the projected rates of increase in global deaths due to cancers, cardiovascular disease and digestive disorders are all somewhat slower for the current projections.

Figure 23 compares the projected global deaths for selected Group III (injury) causes. Projected increases for road traffic accidents are somewhat slower in the current projections, whereas trends for other unintentional causes are quite similar. There are some substantial differences in trends for intentional causes, reflecting different assumptions and decisions concerning use of the regression parameters.

Figure 21: Comparison of baseline projections 2002-2030 with the original GBD projections 1990-2020: global deaths for selected Group I causes (communicable, maternal, perinatal and nutritional conditions)

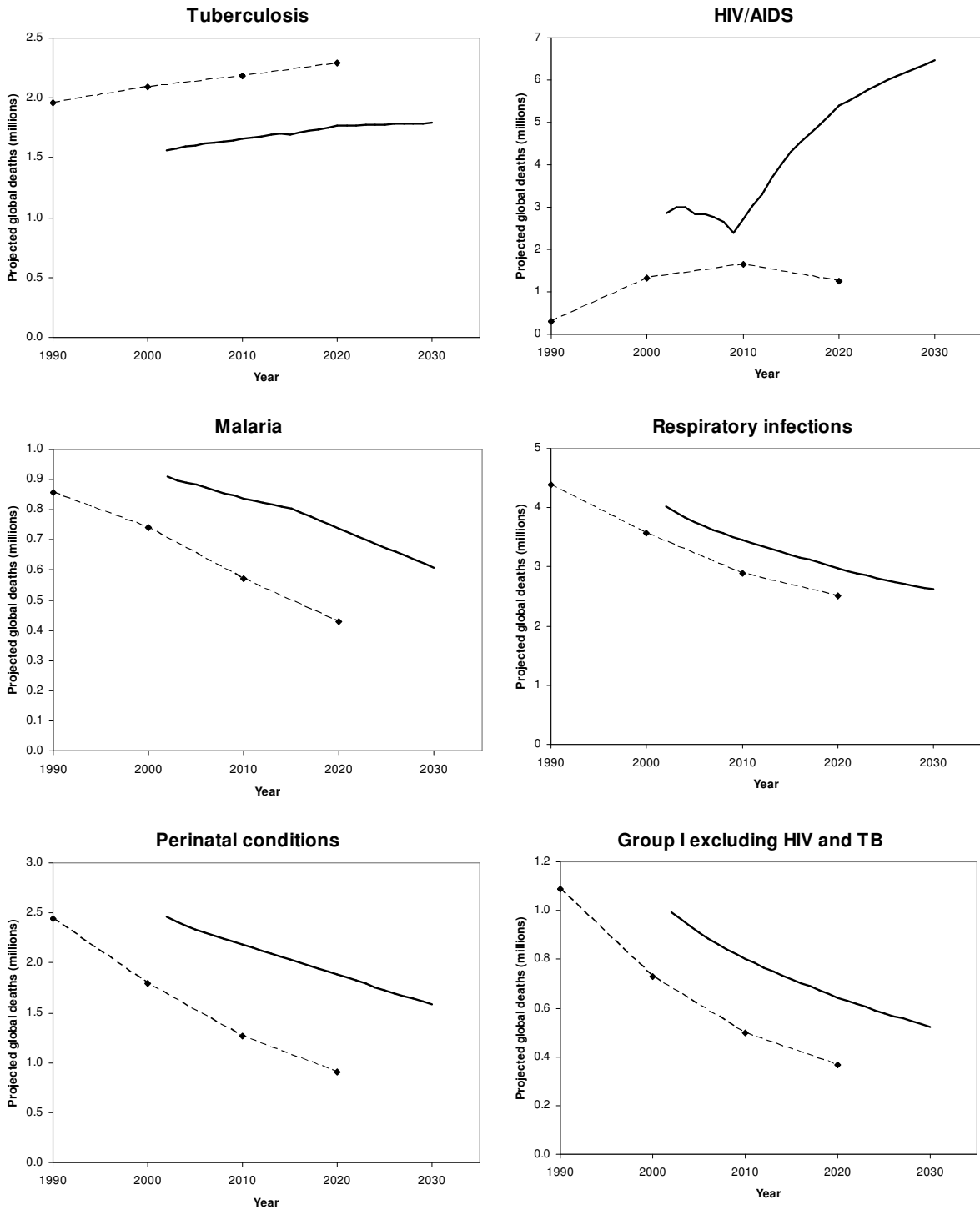


Figure 22: Comparison of baseline projections 2002-2030 with the original GBD projections 1990-2020: global deaths for selected Group II causes (non-communicable diseases)

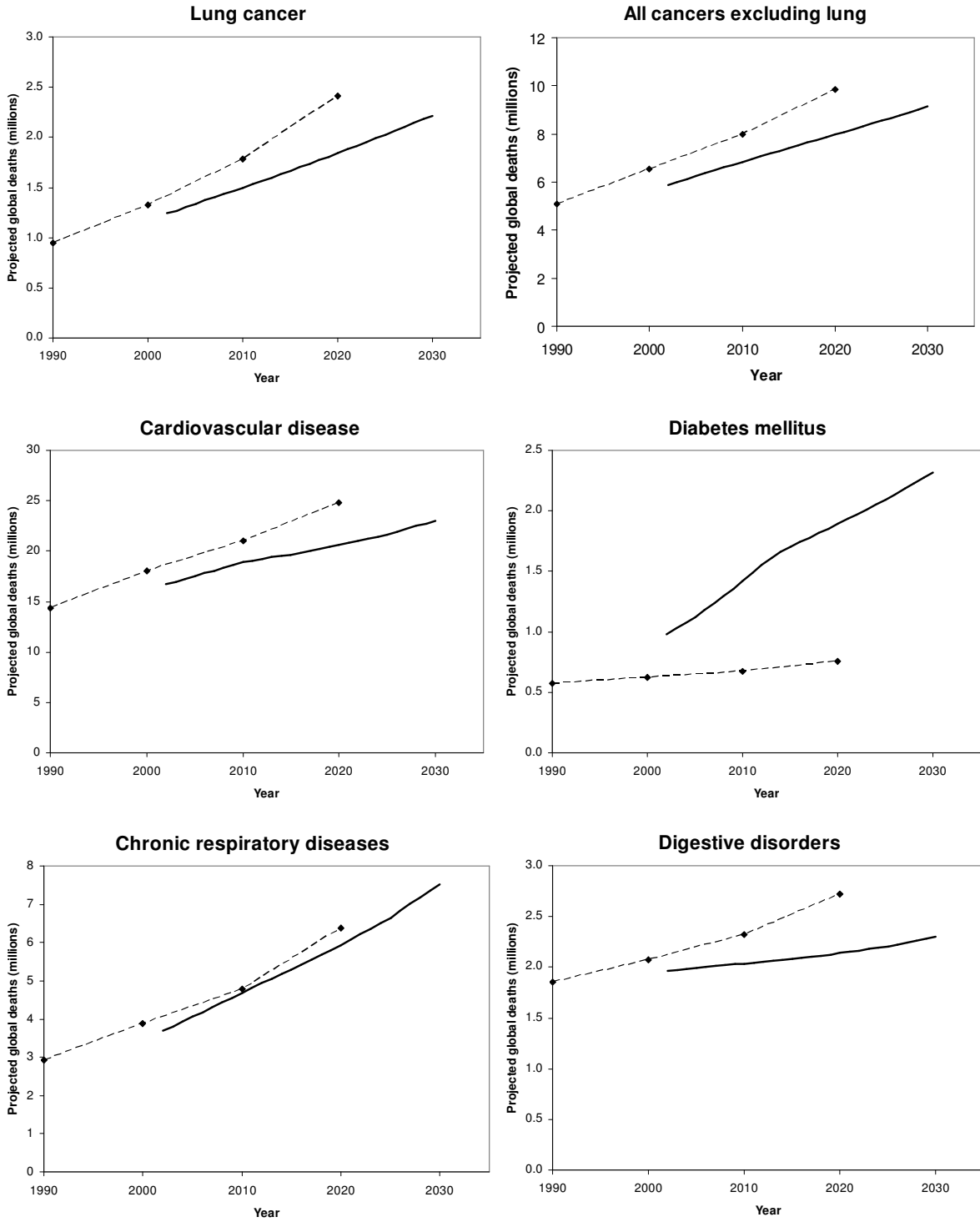


Figure 23: Comparison of baseline projections 2002-2030 with the original GBD projections 1990-2020: global deaths for selected Group III causes (injuries)

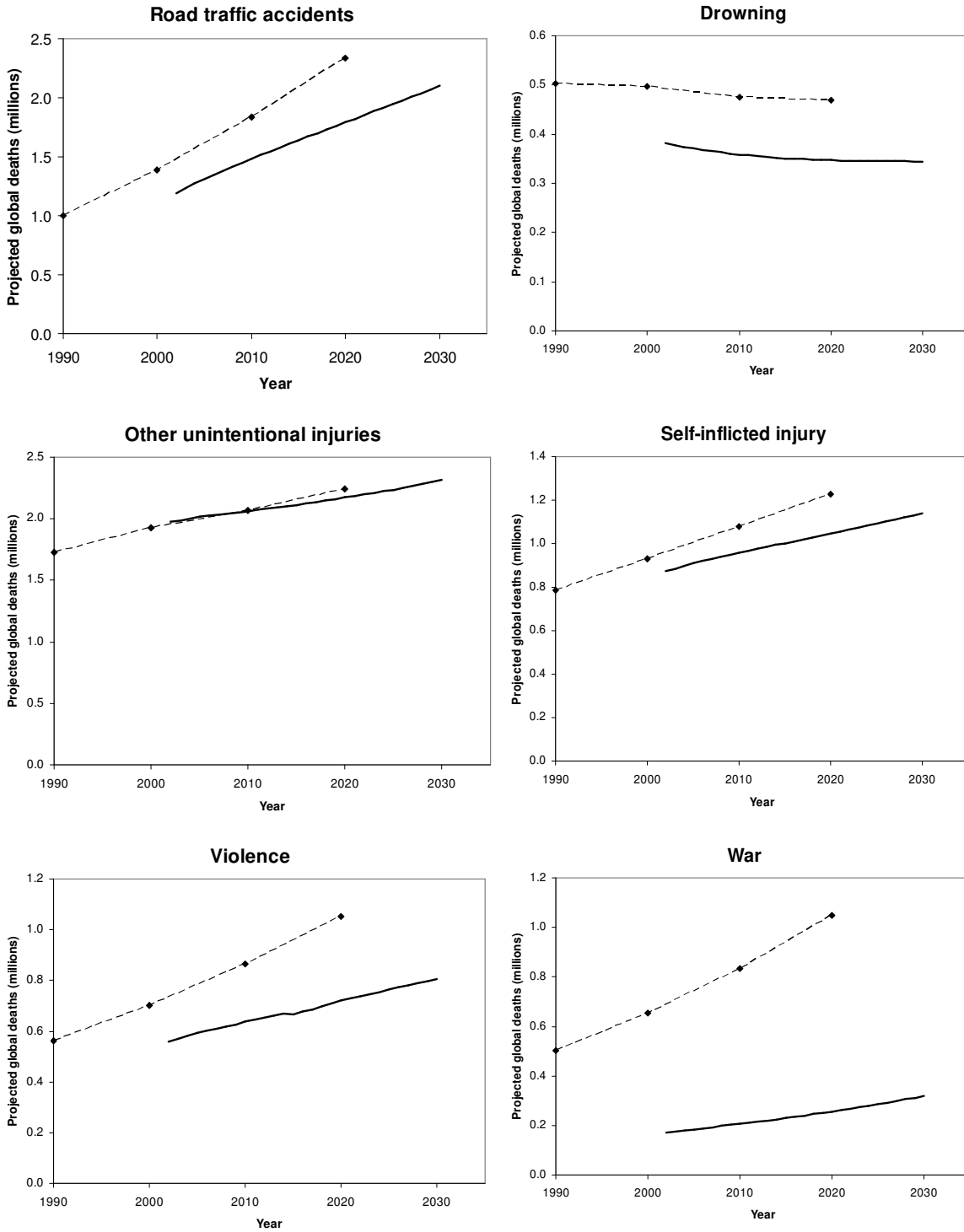


Figure 24 compares the range in projected global deaths for selected cause groups for the optimistic and pessimistic scenarios in 2030 with the optimistic and pessimistic scenarios for 2020 in the original GBD study (Murray and Lopez A.D. 1996). The plot illustrates the relative ranges around the baseline projections, which in both cases are approximately 30 years out from the base year. The relative ranges between optimistic and pessimistic projected deaths are generally similar for most cause groups, with specific exceptions reflecting differences in the assumptions for the optimistic and pessimistic scenarios in the current projections.

Figure 24: Comparison of projected global death ranges for optimistic and pessimistic scenarios for current projections in 2030 (light grey bars) and original GBD projections for 2020 (solid black bars): selected causes

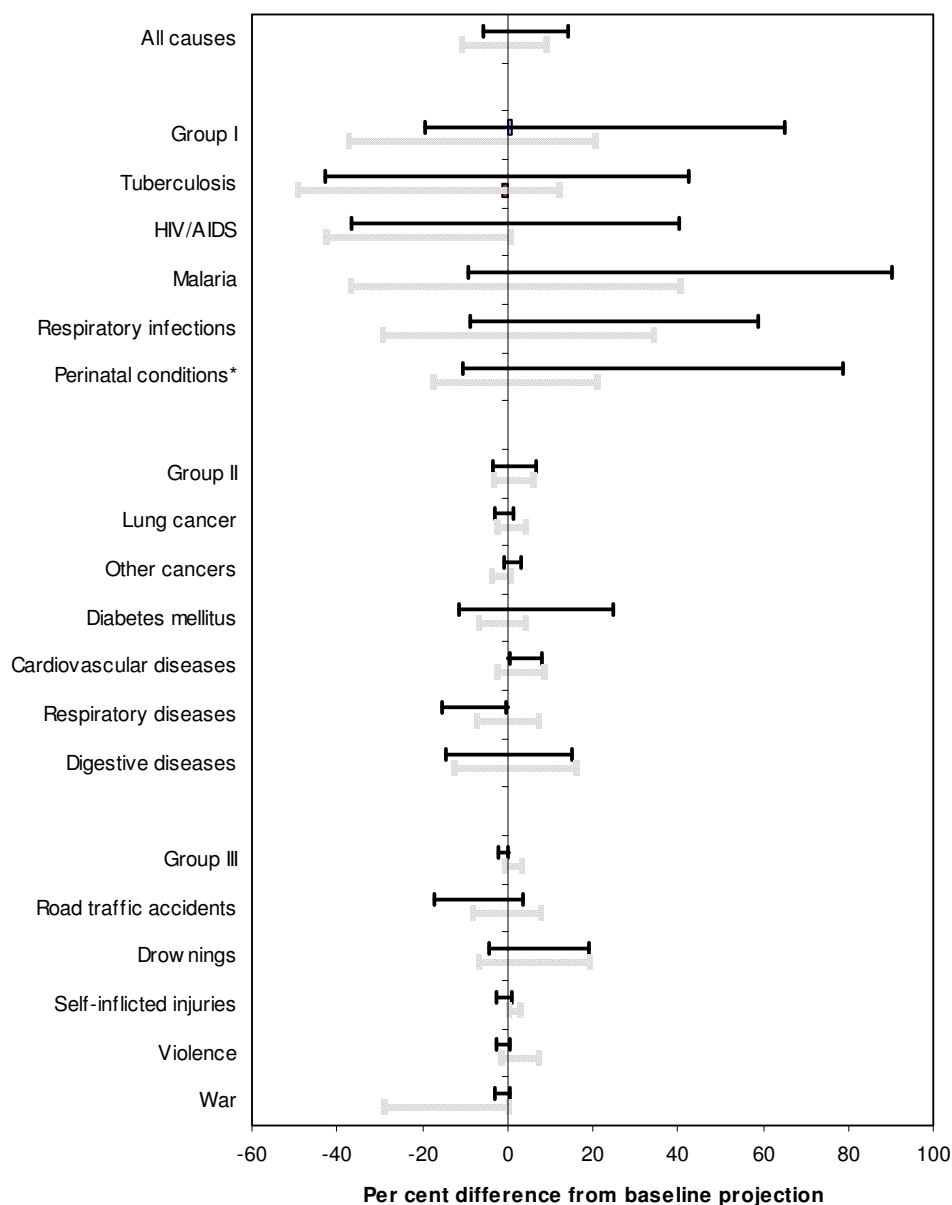


Table 20: Comparison of projected deaths under three scenarios, by cause group, 2015,

Cause ^b	Global deaths (000)			Per cent deviation from baseline scenario		Deaths (000) in low and middle income countries		
	Optimistic	Baseline	Pessimistic	Optimist.	Pessimist.	Optimistic	Baseline	Pessimistic
Population (000)	7,124	7,097	7,057	0	-1	6,147	6,121	6,083
All Causes	60,204	64,279	68,774	-6	7	51,465	55,322	59,571
I. Communicable, maternal, perinatal nutritional conditions	14,013	16,973	19,572	-17	15	13,515	16,432	19,007
A. Infectious & parasitic diseases	8,909	11,009	12,598	-19	14	8,781	10,868	12,451
1. Tuberculosis	1,186	1,712	1,815	-31	6	1,173	1,699	1,801
2. STDs excluding HIV	120	149	184	-20	23	120	149	183
3. HIV/AIDS	3,779	4,348	4,764	-13	10	3,760	4,326	4,742
4. Diarrhoeal diseases	1,030	1,304	1,612	-21	24	1,024	1,298	1,606
5. Childhood-cluster diseases	612	791	968	-23	22	611	790	968
6. Meningitis	85	106	140	-20	31	82	104	137
7. Hepatitis ^c	59	73	94	-19	27	56	70	90
8. Malaria	33	40	49	-17	23	23	29	37
9. Tropical-cluster diseases	644	805	938	-20	17	644	805	938
10. Leprosy	103	129	158	-20	23	103	129	158
11. Dengue	4	5	6	-18	21	4	5	6
12. Japanese encephalitis	7	9	12	-27	33	7	9	12
13. Trachoma	6	7	10	-19	42	6	7	10
14. Intestinal nematode infections	0	0	0	-16	21	0	0	0
B. Respiratory infections	6	8	10	-22	28	6	8	10
C. Maternal conditions	2,671	3,210	3,822	-17	19	2,334	2,846	3,443
D. Perinatal conditions	269	364	467	-26	28	269	363	467
E. Nutritional deficiencies	1,877	2,035	2,248	-8	10	1,861	2,017	2,227
II. Noncommunicable diseases	286	355	437	-19	23	270	337	419
A. Malignant neoplasms	40,236	41,279	43,014	-3	4	32,470	33,355	34,903
7. Trachea/bronchus/lung cancers	9,016	9,080	9,037	-1	0	6,676	6,741	6,708
B. Other neoplasms	1,638	1,667	1,711	-2	3	1,142	1,163	1,197
C. Diabetes mellitus	187	188	187	0	-1	116	117	117
D. Endocrine disorders	1,629	1,704	1,755	-4	3	1,275	1,335	1,374
E. Neuro-psychiatric conditions	258	269	282	-4	5	177	186	197
F. Sense organ diseases	1,300	1,331	1,376	-2	3	846	866	899
G. Cardiovascular diseases	4	4	4	-2	3	4	4	4
3. Ischaemic heart disease	19,324	19,674	20,742	-2	5	16,103	16,379	17,333
4. Cerebrovascular disease	8,331	8,475	8,908	-2	5	6,894	7,010	7,398
H. Respiratory diseases	6,360	6,438	6,772	-1	5	5,554	5,620	5,935
1. COPD	5,014	5,301	5,599	-5	6	4,432	4,693	4,964
2. Asthma	3,816	4,044	4,291	-6	6	3,468	3,679	3,908
I. Digestive diseases	286	305	321	-6	5	250	267	281
J. Genito-urinary diseases	1,917	2,080	2,294	-8	10	1,546	1,684	1,877
K. Skin diseases	994	1,023	1,067	-3	4	797	822	861
L. Musculoskeletal diseases	86	88	90	-2	2	68	69	71
M. Congenital anomalies	123	126	131	-3	4	70	72	75
N. Oral conditions	382	410	448	-7	9	359	385	421
III. Injuries	2	2	2	-4	4	1	1	1
A. Unintentional injuries	5,955	6,028	6,188	-1	3	5,480	5,535	5,661
1. Road traffic accidents	4,076	4,102	4,208	-1	3	3,758	3,767	3,843
2. Poisonings	1,683	1,639	1,548	3	-6	1,589	1,534	1,426
3. Falls	329	339	380	-3	12	313	321	359
4. Fires	477	481	493	-1	3	385	388	399
5. Drownings	326	333	354	-2	6	317	323	343
6. Other unintentional injuries	332	350	392	-5	12	318	335	375
B. Intentional injuries	927	960	1,041	-3	8	835	864	940
1. Self-inflicted injuries	1,879	1,927	1,980	-2	3	1,722	1,768	1,818
2. Violence	997	1,002	1,027	-1	2	861	866	889
3. War	668	679	703	-2	4	647	658	680

Table 21: Comparison of projected deaths under three scenarios, by cause group, 2030,

Cause ^b	Global deaths (000)			Per cent deviation from baseline scenario		Deaths (000) in low and middle income countries		
	Optimistic	Baseline	Pessimistic	Optimist.	Pessimist.	Optimistic	Baseline	Pessimistic
Population (000)	8,038	7,893	7,745	2	-2	7,028	6,890	6,750
All Causes	66,188	74,273	80,817	-11	9	57,061	64,770	70,906
I. Communicable, maternal, perinatal nutritional conditions	10,393	16,681	20,044	-38	20	9,950	16,180	19,519
A. Infectious & parasitic diseases	6,934	11,959	13,816	-42	16	6,823	11,827	13,679
1. Tuberculosis	924	1,792	2,023	-48	13	913	1,781	2,010
2. STDs excluding HIV	81	128	188	-37	47	81	127	188
3. HIV/AIDS	3,706	6,495	6,487	-43	0	3,694	6,473	6,464
4. Diarrhoeal diseases	546	901	1,326	-39	47	540	895	1,320
5. Childhood-cluster diseases	298	523	777	-43	49	298	522	776
6. Meningitis	44	70	113	-36	62	43	68	111
7. Hepatitis ^c	37	56	85	-34	53	35	53	82
8. Malaria	22	30	43	-29	42	15	22	34
9. Tropical-cluster diseases	382	608	854	-37	40	382	608	854
10. Leprosy	70	110	158	-37	44	70	110	158
11. Dengue	3	4	6	-30	41	3	4	6
12. Japanese encephalitis	3	5	8	-39	74	3	5	8
13. Trachoma	3	4	8	-38	90	3	4	8
14. Intestinal nematode infections	0	0	0	-25	38	0	0	0
B. Respiratory infections	3	5	8	-37	52	3	5	8
C. Maternal conditions	1,846	2,617	3,512	-29	34	1,536	2,274	3,153
D. Perinatal conditions	137	263	424	-48	62	137	262	424
E. Nutritional deficiencies	1,307	1,582	1,911	-17	21	1,299	1,572	1,898
II. Noncommunicable diseases	169	260	381	-35	46	154	244	365
A. Malignant neoplasms	48,800	50,550	53,512	-3	6	40,603	42,063	44,695
7. Trachea/bronchus/lung cancers	11,356	11,364	11,107	0	-2	8,863	8,923	8,729
B. Other neoplasms	2,163	2,216	2,305	-2	4	1,692	1,734	1,804
C. Diabetes mellitus	233	231	225	1	-3	151	152	150
D. Endocrine disorders	2,154	2,317	2,414	-7	4	1,728	1,859	1,934
E. Neuro-psychiatric conditions	296	311	331	-5	6	206	217	233
F. Sense organ diseases	1,575	1,612	1,673	-2	4	1,041	1,062	1,106
G. Cardiovascular diseases	5	5	5	-2	2	5	5	5
3. Ischaemic heart disease	22,432	23,029	25,021	-3	9	19,243	19,641	21,375
4. Cerebrovascular disease	9,440	9,737	10,589	-3	9	8,035	8,239	8,972
H. Respiratory diseases	7,573	7,677	8,289	-1	8	6,751	6,821	7,386
1. COPD	6,969	7,530	8,078	-7	7	6,355	6,862	7,354
2. Asthma	5,443	5,896	6,347	-8	8	5,093	5,511	5,922
I. Digestive diseases	343	379	414	-9	9	302	334	366
J. Genito-urinary diseases	2,013	2,303	2,676	-13	16	1,582	1,840	2,187
K. Skin diseases	1,226	1,257	1,324	-3	5	992	1,019	1,078
L. Musculoskeletal diseases	114	116	119	-1	3	92	93	95
M. Congenital anomalies	147	152	159	-3	5	86	89	94
N. Oral conditions	277	321	377	-13	17	258	299	353
III. Injuries	2	2	2	-5	6	2	2	2
A. Unintentional injuries	6,995	7,042	7,261	-1	3	6,508	6,528	6,692
1. Road traffic accidents	4,822	4,763	4,893	1	3	4,507	4,422	4,508
2. Poisonings	2,262	2,100	1,922	8	-9	2,198	2,018	1,808
3. Falls	331	349	415	-5	19	319	335	396
4. Fires	599	594	601	1	1	486	482	489
5. Drownings	337	351	388	-4	11	328	342	378
6. Other unintentional injuries	321	345	410	-7	19	308	331	394
B. Intentional injuries	972	1,024	1,157	-5	13	866	916	1,042
1. Self-inflicted injuries	2,173	2,279	2,368	-5	4	2,001	2,105	2,184
2. Violence	1,138	1,138	1,167	0	3	989	987	1,015
3. War	791	805	864	-2	7	770	783	834

Table 20 summarizes total deaths (global, and low and middle income countries) for the three scenarios for second-level cause groups, and selected major specific causes, in 2015. Projected global deaths in 2015 ranged from 60.2 million under the optimistic scenario to 68.8 million under the pessimistic scenario, variations of -6 per cent to + 7 per cent relative to the baseline projections. Table 21 similarly summarizes the optimistic and pessimistic projections for 2030 for various causes. Projected global deaths in 2030 ranged from 66.2 million under the optimistic scenario to 80.8 million under the pessimistic scenario, variations of -11 per cent to + 9 per cent relative to the baseline projections.

10.3 Leading causes of death

Table 22 lists the 10 leading causes of death according to the baseline scenario for males, females and both sexes combined as projected for 2015 for the world and for high, middle and low income country groups. Table 23 provides similar lists of the 10 leading causes of death according to the baseline scenario for 2030. For comparison, Table 24 shows the leading causes of death for the world in 2030 under the optimistic, baseline and pessimistic scenarios.

The four leading causes of death in all scenarios are projected to be ischaemic heart disease, cerebrovascular disease (stroke), HIV/AIDS and chronic obstructive pulmonary disease (COPD), although HIV/AIDS moves from third to fourth position in the optimistic scenario. Figure 25 illustrates the changes in rank order of deaths between 2002 and 2030 for the 20 leading causes of death globally. Lower respiratory infections, perinatal conditions, diarrhoeal diseases, malaria and measles are all projected to decline substantially in importance. On the other hand, diabetes mellitus, stomach cancer and oesophagus cancer are all projected to move up three or more places in the rankings.

Figure 25: Change in rank order of deaths for the 20 leading causes, world, 2002-2030

2002				2030			
Disease or injury	% total deaths	Rank	Rank	% total deaths	Disease or injury	Rank	Rank
Ischaemic heart disease	12.6%	1	1	13.1%	Ischaemic heart disease	1	1
Cerebrovascular disease	9.7%	2	2	10.3%	Cerebrovascular disease	2	2
Lower respiratory infections	6.9%	3	4	8.7%	HIV/AIDS	3	4
HIV/AIDS	4.8%	4	3	7.9%	Chronic obstructive pulmonary disease	4	3
Chronic obstructive pulmonary disease	4.8%	5	5	3.5%	Lower respiratory infections	5	5
Perinatal conditions	4.3%	6	6	3.1%	Diabetes mellitus	6	11
Diarrhoeal diseases	3.3%	7	7	3.0%	Trachea, bronchus, lung cancers	7	7
Tuberculosis	2.7%	8	8	2.8%	Road traffic accidents	8	10
Trachea, bronchus, lung cancers	2.2%	9	9	2.4%	Tuberculosis	9	9
Road traffic accidents	2.1%	10	10	2.1%	Perinatal conditions	10	6
Diabetes mellitus	1.7%	11	11	1.8%	Stomach cancer	11	15
Malaria	1.6%	12	12	1.8%	Hypertensive heart disease	12	13
Hypertensive heart disease	1.6%	13	13	1.5%	Self-inflicted injuries	13	14
Self-inflicted injuries	1.5%	14	14	1.3%	Nephritis and nephrosis	14	17
Stomach cancer	1.5%	15	15	1.3%	Liver cancer	15	19
Cirrhosis of the liver	1.4%	16	16	1.2%	Diarrhoeal diseases	16	16
Nephritis and nephrosis	1.2%	17	17	1.2%	Colon and rectum cancers	17	18
Colon and rectum cancers	1.1%	18	18	1.1%	Cirrhosis of the liver	18	16
Liver cancer	1.1%	19	19	1.1%	Violence	19	21
Measles	1.1%	20	20	1.0%	Oesophagus cancer	20	24
Violence	1.0%	21	23	0.80%	Malaria	23	12
Oesophagus cancer	0.8%	24	42	0.40%	Measles	42	20

Table 22: Ten leading causes of death, by income group and sex, 2015 (baseline scenario)

Both sexes			Males			Females		
Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths
<i>World</i>								
1	Ischaemic heart disease	13.2	1	Ischaemic heart disease	13.0	1	Ischaemic heart disease	13.5
2	Cerebrovascular disease	10.0	2	Cerebrovascular disease	8.8	2	Cerebrovascular disease	11.5
3	HIV/AIDS	6.7	3	HIV/AIDS	7.1	3	COPD	6.4
4	COPD	6.3	4	COPD	6.2	4	HIV/AIDS	6.2
5	Lower respiratory infections	4.9	5	Lower respiratory infections	4.8	5	Lower respiratory infections	5.0
6	Perinatal conditions	3.2	6	Road traffic accidents	3.5	6	Diabetes mellitus	3.3
7	Tuberculosis	2.7	7	Trachea, bronchus, lung cancers	3.4	7	Perinatal conditions	3.0
8	Diabetes mellitus	2.7	8	Perinatal conditions	3.3	8	Diarrhoeal diseases	2.0
9	Trachea, bronchus, lung cancers	2.6	9	Tuberculosis	3.3	9	Breast cancer	1.9
10	Road traffic accidents	2.6	10	Diabetes mellitus	2.1	10	Tuberculosis	1.9
<i>High income countries</i>								
1	Ischaemic heart disease	16.4	1	Ischaemic heart disease	16.6	1	Ischaemic heart disease	16.1
2	Cerebrovascular disease	9.1	2	Cerebrovascular disease	7.5	2	Cerebrovascular disease	10.8
3	Trachea, bronchus, lung cancers	5.6	3	Trachea, bronchus, lung cancers	7.2	3	Diabetes mellitus	4.6
4	Diabetes mellitus	4.1	4	COPD	4.5	4	Lower respiratory infections	4.2
5	COPD	4.1	5	Lower respiratory infections	3.9	5	Trachea, bronchus, lung cancers	4.0
6	Lower respiratory infections	4.0	6	Diabetes mellitus	3.7	6	Alzheimer and other dementias*	4.0
7	Colon and rectum cancers	3.3	7	Prostate cancer	3.4	7	COPD	3.6
8	Alzheimer and other dementias*	3.0	8	Colon and rectum cancers	3.4	8	Breast cancer	3.6
9	Stomach cancer	1.9	9	Stomach cancer	2.3	9	Colon and rectum cancers	3.1
10	Breast cancer	1.8	10	Self-inflicted injuries	2.3	10	Hypertensive heart disease	2.0

Table 22 (continued): Ten leading causes of death, by income group and sex, 2015 (baseline scenario)

Both sexes			Males			Females		
Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths
<i>Middle income countries</i>								
1	Cerebrovascular disease	14.3	1	Ischaemic heart disease	12.6	1	Cerebrovascular disease	16.2
2	Ischaemic heart disease	13.2	2	Cerebrovascular disease	12.6	2	Ischaemic heart disease	14.0
3	COPD	9.9	3	COPD	9.0	3	COPD	10.9
4	HIV/AIDS	5.5	4	HIV/AIDS	6.2	4	HIV/AIDS	4.6
5	Trachea, bronchus, lung cancers	3.4	5	Trachea, bronchus, lung cancers	4.5	5	Diabetes mellitus	4.3
6	Diabetes mellitus	3.2	6	Road traffic accidents	3.7	6	Hypertensive heart disease	2.9
7	Stomach cancer	3.1	7	Stomach cancer	3.6	7	Stomach cancer	2.5
8	Road traffic accidents	2.8	8	Liver cancer	2.8	8	Trachea, bronchus, lung cancers	2.2
9	Hypertensive heart disease	2.6	9	Tuberculosis	2.4	9	Lower respiratory infections	2.2
10	Liver cancer	2.1	10	Diabetes mellitus	2.3	10	Breast cancer	1.8
<i>Low income countries</i>								
1	Ischaemic heart disease	12.2	1	Ischaemic heart disease	12.2	1	Ischaemic heart disease	12.3
2	HIV/AIDS	9.5	2	HIV/AIDS	9.7	2	HIV/AIDS	9.3
3	Lower respiratory infections	7.4	3	Lower respiratory infections	7.3	3	Cerebrovascular disease	8.1
4	Cerebrovascular disease	7.0	4	Cerebrovascular disease	6.1	4	Lower respiratory infections	7.4
5	Perinatal conditions	5.3	5	Perinatal conditions	5.6	5	Perinatal conditions	5.0
6	COPD	4.2	6	Tuberculosis	4.9	6	Diarrhoeal diseases	3.8
7	Tuberculosis	3.9	7	COPD	4.6	7	COPD	3.8
8	Diarrhoeal diseases	3.8	8	Road traffic accidents	3.8	8	Tuberculosis	2.9
9	Road traffic accidents	2.7	9	Diarrhoeal diseases	3.8	9	Malaria	2.7
10	Malaria	2.5	10	Malaria	2.4	10	Diabetes mellitus	2.1

Table 23: Ten leading causes of death, by income group and sex, 2030 (baseline scenario)

Both sexes			Males			Females		
Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths
<i>World</i>								
1	Ischaemic heart disease	13.1	1	Ischaemic heart disease	12.4	1	Ischaemic heart disease	13.9
2	Cerebrovascular disease	10.3	2	HIV/AIDS	9.2	2	Cerebrovascular disease	12.2
3	HIV/AIDS	8.7	3	Cerebrovascular disease	8.6	3	HIV/AIDS	8.2
4	COPD	7.9	4	COPD	7.8	4	COPD	8.1
5	Lower respiratory infections	3.5	5	Trachea, bronchus, lung cancers	4.0	5	Diabetes mellitus	3.8
6	Diabetes mellitus	3.1	6	Road traffic accidents	4.0	6	Lower respiratory infections	3.4
7	Trachea, bronchus, lung cancers	3.0	7	Lower respiratory infections	3.5	7	Hypertensive heart disease	2.1
8	Road traffic accidents	2.8	8	Tuberculosis	3.1	8	Breast cancer	2.0
9	Tuberculosis	2.4	9	Diabetes mellitus	2.4	9	Trachea, bronchus, lung cancers	1.9
10	Perinatal conditions	2.1	10	Perinatal conditions	2.4	10	Perinatal conditions	1.9
<i>High income countries</i>								
1	Ischaemic heart disease	15.8	1	Ischaemic heart disease	15.4	1	Ischaemic heart disease	16.1
2	Cerebrovascular disease	9.0	2	Cerebrovascular disease	7.0	2	Cerebrovascular disease	10.8
3	Trachea, bronchus, lung cancers	5.1	3	Trachea, bronchus, lung cancers	6.6	3	Diabetes mellitus	5.1
4	Diabetes mellitus	4.8	4	Diabetes mellitus	4.5	4	Alzheimer and other dementias*	4.5
5	COPD	4.1	5	COPD	4.5	5	Lower respiratory infections	3.7
6	Lower respiratory infections	3.6	6	Prostate cancer	3.9	6	Trachea, bronchus, lung cancers	3.7
7	Alzheimer and other dementias*	3.6	7	Colon and rectum cancers	3.6	7	COPD	3.7
8	Colon and rectum cancers	3.3	8	Lower respiratory infections	3.4	8	Breast cancer	3.3
9	Stomach cancer	1.9	9	Self-inflicted injuries	2.6	9	Colon and rectum cancers	3.0
10	Prostate cancer	1.8	10	Alzheimer and other dementias*	2.5	10	Hypertensive heart disease	1.9

Table 23 (continued): Ten leading causes of death, by income group and sex, 2030 (baseline scenario)

Both sexes			Males			Females		
Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths
<i>Middle income countries</i>								
1	Cerebrovascular disease	13.9	1	Cerebrovascular disease	11.8	1	Cerebrovascular disease	16.1
2	COPD	12.4	2	COPD	11.4	2	Ischaemic heart disease	13.4
3	Ischaemic heart disease	12.4	3	Ischaemic heart disease	11.3	3	COPD	13.3
4	HIV/AIDS	6.3	4	HIV/AIDS	7.2	4	HIV/AIDS	5.3
5	Trachea, bronchus, lung cancers	4.1	5	Trachea, bronchus, lung cancers	5.5	5	Diabetes mellitus	4.9
6	Diabetes mellitus	3.8	6	Stomach cancer	4.0	6	Hypertensive heart disease	3.0
7	Stomach cancer	3.3	7	Road traffic accidents	3.4	7	Trachea, bronchus, lung cancers	2.8
8	Hypertensive heart disease	2.6	8	Liver cancer	2.9	8	Stomach cancer	2.6
9	Road traffic accidents	2.5	9	Diabetes mellitus	2.8	9	Self-inflicted injuries	1.7
10	Liver cancer	2.2	10	Hypertensive heart disease	2.3	10	Breast cancer	1.7
<i>Low income countries</i>								
1	Ischaemic heart disease	13.0	1	HIV/AIDS	12.8	1	Ischaemic heart disease	13.6
2	HIV/AIDS	12.9	2	Ischaemic heart disease	12.4	2	HIV/AIDS	13.0
3	Cerebrovascular disease	7.9	3	Cerebrovascular disease	6.5	3	Cerebrovascular disease	9.4
4	COPD	5.5	4	COPD	6.0	4	COPD	5.0
5	Lower respiratory infections	5.0	5	Lower respiratory infections	5.1	5	Lower respiratory infections	4.8
6	Perinatal conditions	3.8	6	Road traffic accidents	5.0	6	Perinatal conditions	3.5
7	Tuberculosis	3.7	7	Tuberculosis	4.6	7	Tuberculosis	2.6
8	Road traffic accidents	3.6	8	Perinatal conditions	4.1	8	Diabetes mellitus	2.6
9	Diarrhoeal diseases	2.3	9	Diarrhoeal diseases	2.4	9	Diarrhoeal diseases	2.2
10	Diabetes mellitus	2.1	10	Trachea, bronchus, lung cancers	2.3	10	Road traffic accidents	2.0

Table 24: Ten leading causes of death for three scenarios, both sexes combined, world, 2030

Pessimistic scenario			Baseline scenario			Optimistic scenario		
Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths	Rank	Disease or injury	% total deaths
<i>World</i>								
1	Ischaemic heart disease	13.1	1	Ischaemic heart disease	13.1	1	Ischaemic heart disease	14.3
2	Cerebrovascular disease	10.3	2	Cerebrovascular disease	10.3	2	Cerebrovascular disease	11.4
3	HIV/AIDS	8.0	3	HIV/AIDS	8.7	3	COPD	8.2
4	COPD	7.9	4	COPD	7.9	4	HIV/AIDS	5.6
5	Lower respiratory infections	4.3	5	Lower respiratory infections	3.5	5	Road traffic accidents	3.4
6	Diabetes mellitus	3.0	6	Diabetes mellitus	3.1	6	Trachea, bronchus, lung cancers	3.3
7	Trachea, bronchus, lung cancers	2.9	7	Trachea, bronchus, lung cancers	3.0	7	Diabetes mellitus	3.3
8	Tuberculosis	2.5	8	Road traffic accidents	2.8	8	Lower respiratory infections	2.7
9	Road traffic accidents	2.4	9	Tuberculosis	2.4	9	Stomach cancer	2.1
10	Perinatal conditions	2.4	10	Perinatal conditions	2.1	10	Perinatal conditions	2.0

10.4 Decomposition

The results discussed so far have described projected changes in mortality in terms of the absolute (and relative) numbers of deaths expected under the various scenarios. These changes may be due to changes in age-specific disease and injury mortality risks, or due to demographic change which alters the size and age composition of the population, or both. Because mortality risks are strongly age dependent for most causes, changes in the age structure of a population may result in substantial changes in the number of deaths, even when the age-specific risks remain unchanged.

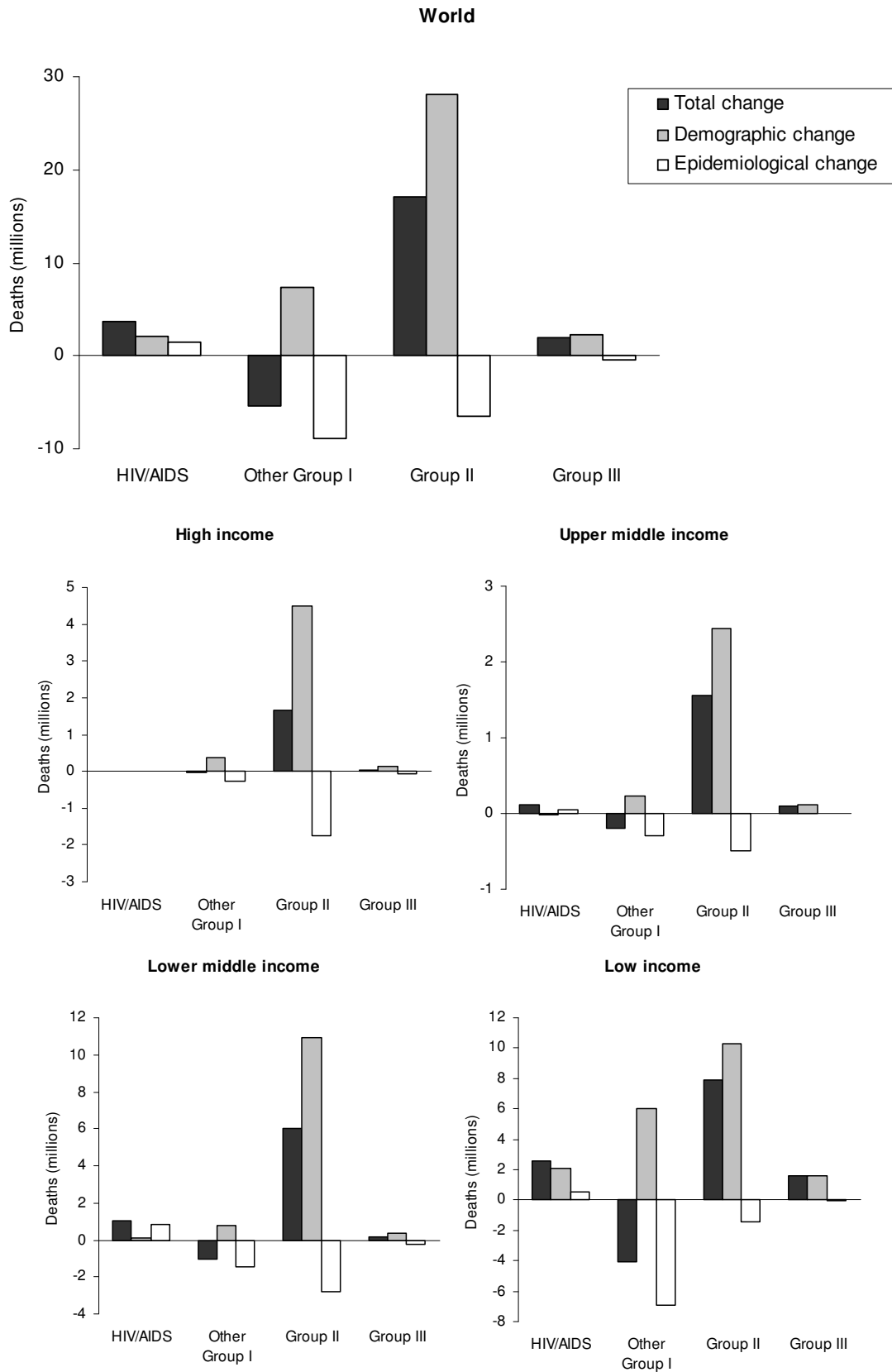
Even if the age-specific death rates for all causes remained constant in all regions, projected population growth and ageing would result in major changes in the composition of causes of death. We further analysed the relative impact of demographic and epidemiological change on the projected numbers of deaths by cause, by calculating two hypothetical alternatives.

In the first, we calculated the expected number of deaths in 2030 given the 2030 projected age-specific rates under the baseline scenario and the 2002 population. The difference between this and the 2002 mortality estimates is a measure of the change in mortality expected solely on the basis of changing age-specific mortality rates, and is labelled *epidemiological change* in Figure 26. Second, we calculated the expected number of deaths in 2030 by taking the 2002 age-specific death rates and applying them to the 2030 projected population. The difference between this and the 2002 mortality estimates is a measure of the change in mortality expected solely on the basis of changing demography (including size and age composition of the population) and is labelled *demographic change* in Figure 26.

In almost all cases, demographic and epidemiological factors are operating in opposing directions in determining mortality in 2030. The major exception is HIV/AIDS, where demographic and epidemiological change are acting in the same direction to increase total HIV/AIDS deaths to 6.5 million deaths in 2030 under the baseline scenario. Demographic change dominates, as the majority of HIV/AIDS deaths are in sub-Saharan Africa, where population growth is highest and where HIV/AIDS incidence rates are assumed to remain largely constant under the baseline scenario.

For Group I conditions other than HIV/AIDS, for which substantial declines in mortality rates are projected, the effect of these declines will be attenuated in most regions by demographic change leading to an increase in the child population most at risk for these conditions. As noted in Section 9, if future fertility rates are higher than projected, then the higher child population numbers will further offset the projected reductions in death rates for Group I conditions. For Group II (non-communicable diseases), demographic changes in all regions will tend to increase deaths substantially, with offsetting reductions in projected death rates in all regions. For Group III (injuries), demographic change similarly dominates the epidemiological change. The latter is small at group level and is small in most regions, because the projected increase in road traffic fatalities is offset by projected decreases in death rates for other unintentional injuries.

Figure 26: Trends in global years of life lost (YLL) per 1,000 population, by broad cause group and income group, 2002-2030

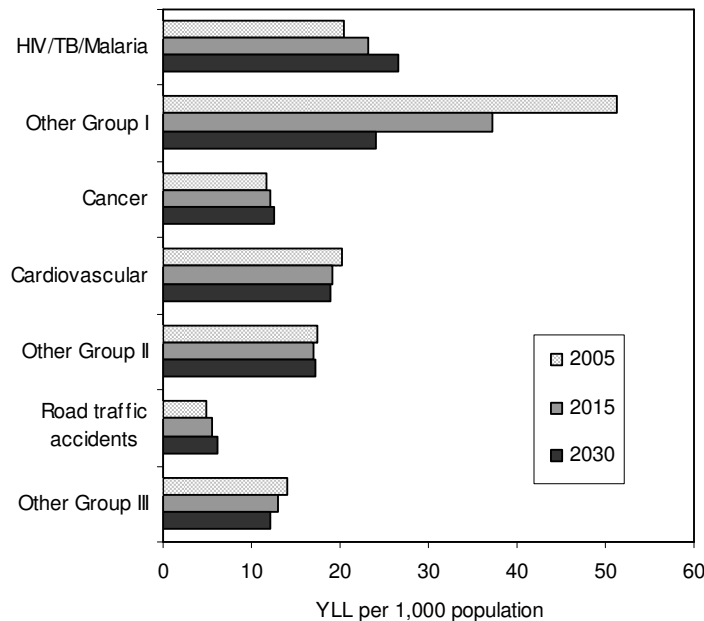


10.4 Burden of disease (DALYs)

The mortality projections were used to calculate years of life lost (YLL) and to project years lived with disability (YLD) as described in Section 7, and hence to project the burden of disease as measured by disability-adjusted life years (DALYs), the sum of YLL and YLD. For most causes, YLDs were projected assuming either constant age-specific YLD rates per capita (non-fatal causes) or constant incidence to death ratios (fatal causes). The resulting DALY projections are thus largely based on the mortality projections, and the additional uncertainty in YLD projections should be kept in mind in examining or using the burden projections.

Figure 27 summarizes the projected trends in global YLL per capita for broad disease groups from 2002 to 2030. YLL give greater weight to deaths at younger age and lower weight to deaths at older ages, so the impact of population growth and ageing on YLL rates is different to that on numbers of deaths. Thus, whereas total deaths and crude death rates for cancers and cardiovascular diseases are projected to increase, YLL rates are projected to increase slightly for cancers, but to decline for cardiovascular diseases.

Figure 27: Trends in global years of life lost (YLL) per 1,000 population, by broad cause group and income group, 2002-2030



Projected global DALYs are projected to increase from 1.48 billion in 2002 to 1.65 billion in 2030, an overall increase of only 11 per cent. Since the population increase is projected to be 22 per cent over the same period, there is actually a decrease in the global per capita burden. Unlike deaths, where the overall global death rate is projected to increase by 7 per cent over the same period, the DALY rate decreases because the increasing number of deaths is offset by the shift in age at death to older ages, associated with fewer lost years of life. Even with the assumption 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 9 per cent from 2002 to 2030.

The proportional contribution of the three major cause groups to the total disease burden is projected to change substantially however. As shown in Figure 28, Group I causes are projected to account for 30 per cent of total DALYs in 2030, compared with over 40 per cent in 2002. In low income countries, the decline is even greater, from 56 per cent in 2002 to 41 per cent in 2030, even including the more than doubling of the HIV/AIDS burden.

In 2030, the non-communicable disease (Group II) burden is projected to increase to 57 per cent, and to represent a greater burden of disease than Group I conditions in all income groups, including low income countries.

Figure 29 summarizes the projected growth in burden of disease (total DALYs) by income group and major cause group from 2002 to 2030. It can be seen that most of the increase in disease burden arises from growth in the Group II burden due to population ageing. This figure also summarizes the decline in the per capita burden of disease by income group and major cause group. The small growth in per capita DALY rates for Group II conditions is more than offset by the decline in the Group I burden per capita.

Table 25 lists the 10 leading causes of DALYs according to the baseline scenario for males, females and both sexes combined as projected for 2015 for the world and for high, middle and low income country groups. Table 26 provides similar lists of the 10 leading causes of burden of disease. For comparison, Table 27 shows the leading causes of DALYs for the world in 2030 under the optimistic, baseline and pessimistic scenarios.

The three leading causes of DALYs in all scenarios are projected to be HIV/AIDS, unipolar depressive disorders and ischaemic heart disease. Road traffic accidents become the fourth leading cause under the optimistic scenario, though perinatal conditions remain the fourth leading cause under the pessimistic scenario. HIV/AIDS becomes the leading cause of burden of disease in middle income countries, as well as low income countries, by 2015. Figure 30 illustrates the changes in rank order of DALYs between 2002 and 2030 for the 20 leading causes globally. Lower respiratory infections, perinatal conditions, diarrhoeal diseases, malaria, measles, protein-energy malnutrition and congenital anomalies are all projected to decline substantially in importance. On the other hand, ischaemic heart disease, diabetes mellitus, lung cancer, COPD, age-related vision disorders and cataracts are all projected to move up three or more places in the rankings. Hearing loss disorders are projected to be among the top ten causes of burden of disease in high and middle income countries, and Alzheimer disease and other dementias and alcohol use disorders among the top ten causes in high income countries in 2030. In low income countries in 2030, malaria and tuberculosis are projected to remain among the top ten causes of burden of disease, as are diarrhoeal diseases and lower respiratory infections.

Figure 28: Change in the distribution of DALYs, by broad cause group and income group, 2002-2030

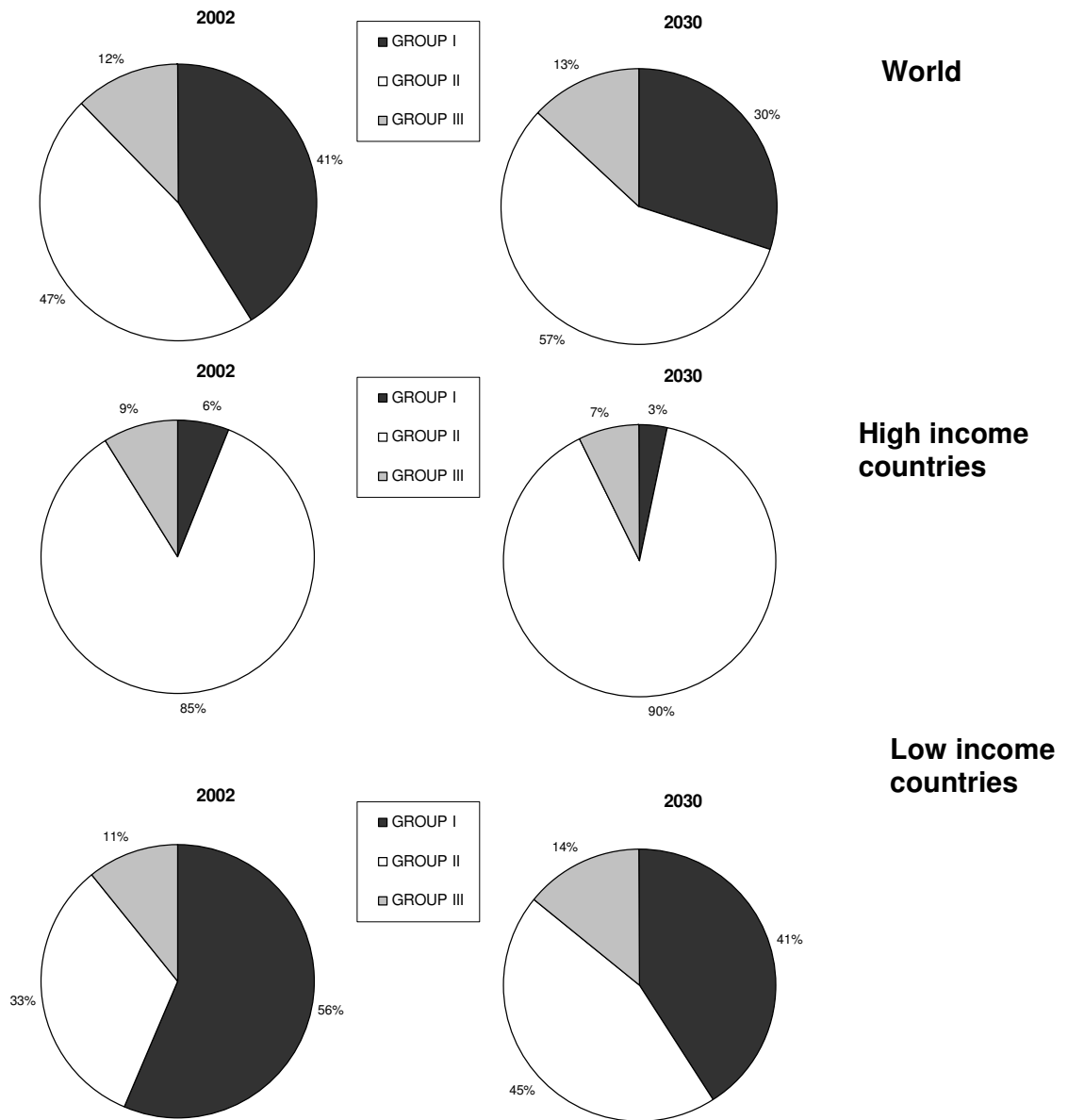


Figure 29: Projected trends in burden of disease (total DALYs and DALYs per 1,000 population) by income group and major cause group, 2002-2030

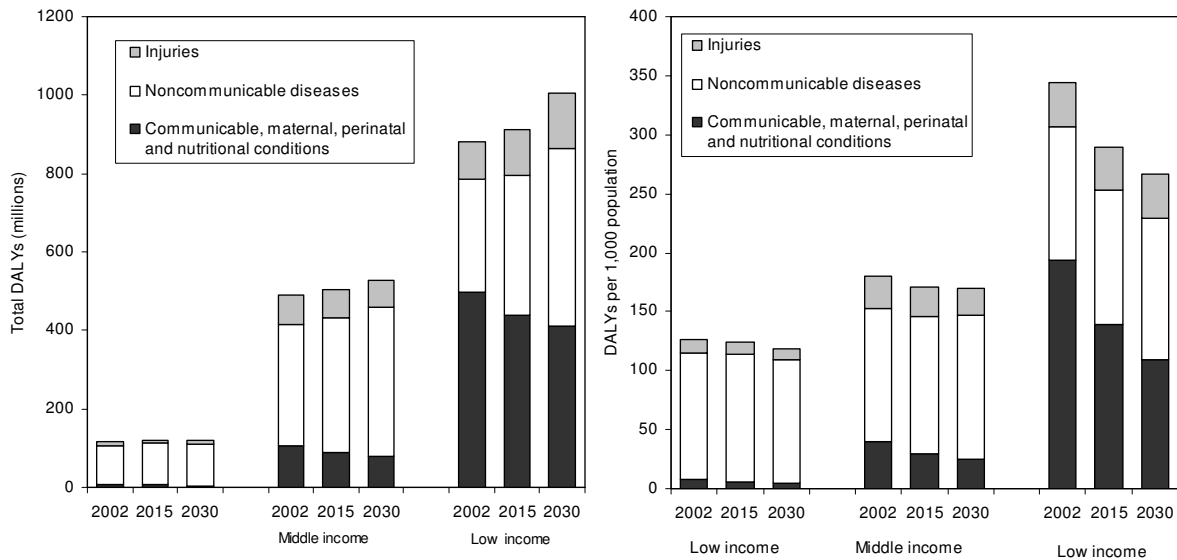


Figure 30: Change in rank order of DALYs for the 20 leading causes, world, 2002-2030

2002			2030		
Disease or injury	% total deaths	Rank	Rank	% total deaths	Disease or injury
Perinatal conditions	6.6%	1	1	10.3%	HIV/AIDS
Lower respiratory infections	6.3%	2	2	5.3%	Unipolar depressive disorders
HIV/AIDS	5.7%	3	3	4.4%	Ischaemic heart disease
Unipolar depressive disorders	4.5%	4	4	3.8%	Chronic obstructive pulmonary disease
Diarrhoeal diseases	4.3%	5	5	3.8%	Perinatal conditions
Ischaemic heart disease	4.0%	6	6	3.7%	Cerebrovascular disease
Cerebrovascular disease	3.3%	7	7	3.6%	Road traffic accidents
Road traffic accidents	2.6%	8	8	2.9%	Cataracts
Malaria	2.3%	9	9	2.8%	Lower respiratory infections
Tuberculosis	2.3%	10	10	2.5%	Tuberculosis
Chronic obstructive pulmonary disease	1.9%	11	11	2.5%	Hearing loss, adult onset
Congenital anomalies	1.8%	12	12	2.5%	Diabetes mellitus
Hearing loss, adult onset	1.7%	13	13	2.0%	Diarrhoeal diseases
Cataracts	1.7%	14	14	1.8%	Violence
Violence	1.4%	15	15	1.4%	Malaria
Measles	1.4%	16	16	1.4%	Vision disorders, age-related
Self-inflicted injuries	1.4%	17	17	1.4%	Self-inflicted injuries
Alcohol use disorders	1.4%	18	18	1.4%	Osteoarthritis
Protein-energy malnutrition	1.1%	19	19	1.3%	Alcohol use disorders
Diabetes mellitus	1.1%	20	20	1.2%	Trachea, bronchus, lung cancers
Osteoarthritis	1.0%	24	21	1.2%	Congenital anomalies
Vision disorders, age-related	0.9%	25	32	0.6%	Measles
Trachea, bronchus, lung cancers	0.8%	31	46	0.5%	Protein-energy malnutrition

Table 25: Ten leading causes of DALYs, by income group and sex, 2015 (baseline scenario)

Both sexes			Males			Females		
Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs
<i>World</i>								
1	HIV/AIDS	7.6	1	HIV/AIDS	8.0	1	HIV/AIDS	7.2
2	Perinatal conditions	5.3	2	Perinatal conditions	5.5	2	Unipolar depressive disorders	6.6
3	Unipolar depressive disorders	5.1	3	Ischaemic heart disease	4.6	3	Perinatal conditions	5.0
4	Lower respiratory infections	4.3	4	Lower respiratory infections	4.4	4	Lower respiratory infections	4.2
5	Ischaemic heart disease	4.2	5	Road traffic accidents	4.3	5	Ischaemic heart disease	3.8
6	Cerebrovascular disease	3.5	6	Unipolar depressive disorders	3.7	6	Cerebrovascular disease	3.6
7	Road traffic accidents	3.2	7	Cerebrovascular disease	3.4	7	Diarrhoeal diseases	3.0
8	Diarrhoeal diseases	3.0	8	Tuberculosis	3.1	8	Cataracts	2.7
9	COPD	2.7	9	Diarrhoeal diseases	3.0	9	COPD	2.5
10	Tuberculosis	2.5	10	COPD	2.9	10	Diabetes mellitus	2.5
<i>High income countries</i>								
1	Unipolar depressive disorders	9.1	1	Ischaemic heart disease	7.1	1	Unipolar depressive disorders	11.9
2	Ischaemic heart disease	6.0	2	Alcohol use disorders	6.9	2	Alzheimer and other dementias*	5.8
3	Diabetes mellitus	4.9	3	Unipolar depressive disorders	6.4	3	Diabetes mellitus	5.7
4	Alcohol use disorders	4.5	4	Diabetes mellitus	4.2	4	Ischaemic heart disease	4.7
5	Cerebrovascular disease	4.3	5	Cerebrovascular disease	4.2	5	Cerebrovascular disease	4.5
6	Alzheimer and other dementias*	4.2	6	Trachea, bronchus, lung cancers	3.9	6	Hearing loss, adult onset	3.8
7	Hearing loss, adult onset	3.7	7	Hearing loss, adult onset	3.6	7	COPD	3.3
8	COPD	3.3	8	COPD	3.3	8	Osteoarthritis	3.2
9	Trachea, bronchus, lung cancers	3.2	9	Self-inflicted injuries	3.0	9	Breast cancer	3.1
10	Osteoarthritis	2.5	10	Alzheimer and other dementias*	2.9	10	Trachea, bronchus, lung cancers	2.4

Table25 (continued): Ten leading causes of DALYs, by income group and sex, 2015 (baseline scenario)

Both sexes			Males			Females		
Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs
<i>Middle income countries</i>								
1	HIV/AIDS	6.8	1	HIV/AIDS	7.5	1	Unipolar depressive disorders	8.3
2	Unipolar depressive disorders	6.2	2	Cerebrovascular disease	5.2	2	HIV/AIDS	5.9
3	Cerebrovascular disease	5.4	3	Road traffic accidents	4.9	3	Cerebrovascular disease	5.6
4	Ischaemic heart disease	4.5	4	Ischaemic heart disease	4.8	4	Ischaemic heart disease	4.1
5	COPD	4.1	5	Unipolar depressive disorders	4.5	5	COPD	3.9
6	Road traffic accidents	3.8	6	COPD	4.3	6	Diabetes mellitus	3.7
7	Perinatal conditions	2.9	7	Violence	4.1	7	Vision disorders, age-related	3.0
8	Diabetes mellitus	2.7	8	Alcohol use disorders	3.7	8	Cataracts	3.0
9	Violence	2.6	9	Perinatal conditions	2.8	9	Perinatal conditions	3.0
10	Hearing loss, adult onset	2.5	10	Hearing loss, adult onset	2.3	10	Hearing loss, adult onset	2.7
<i>Low income countries</i>								
1	HIV/AIDS	9.0	1	HIV/AIDS	9.2	1	HIV/AIDS	8.8
2	Perinatal conditions	7.2	2	Perinatal conditions	7.7	2	Perinatal conditions	6.7
3	Lower respiratory infections	6.4	3	Lower respiratory infections	6.6	3	Lower respiratory infections	6.2
4	Diarrhoeal diseases	4.4	4	Diarrhoeal diseases	4.5	4	Unipolar depressive disorders	5.0
5	Unipolar depressive disorders	3.9	5	Road traffic accidents	4.1	5	Diarrhoeal diseases	4.3
6	Ischaemic heart disease	3.8	6	Tuberculosis	4.1	6	Ischaemic heart disease	3.5
7	Tuberculosis	3.4	7	Ischaemic heart disease	4.1	7	Malaria	3.4
8	Malaria	3.4	8	Malaria	3.3	8	Cataracts	2.9
9	Road traffic accidents	3.0	9	Unipolar depressive disorders	2.9	9	Tuberculosis	2.6
10	Cataracts	2.4	10	Cerebrovascular disease	2.2	10	Cerebrovascular disease	2.4

Table 26: Ten leading causes of DALYs, by income group and sex, 2030 (baseline scenario)

Both sexes			Males			Females		
Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs
<i>World</i>								
1	HIV/AIDS	10.3	1	HIV/AIDS	10.5	1	HIV/AIDS	10.0
2	Unipolar depressive disorders	5.3	2	Road traffic accidents	4.9	2	Unipolar depressive disorders	6.9
3	Ischaemic heart disease	4.4	3	Ischaemic heart disease	4.6	3	Ischaemic heart disease	4.1
4	COPD	3.8	4	COPD	4.1	4	Cerebrovascular disease	4.1
5	Perinatal conditions	3.8	5	Perinatal conditions	4.0	5	Cataracts	3.6
6	Cerebrovascular disease	3.7	6	Unipolar depressive disorders	3.8	6	Perinatal conditions	3.5
7	Road traffic accidents	3.6	7	Cerebrovascular disease	3.4	7	COPD	3.5
8	Cataracts	2.9	8	Tuberculosis	3.1	8	Diabetes mellitus	3.2
9	Lower respiratory infections	2.8	9	Lower respiratory infections	3.0	9	Hearing loss, adult onset	2.7
10	Tuberculosis	2.5	10	Violence	2.8	10	Lower respiratory infections	2.7
<i>High income countries</i>								
1	Unipolar depressive disorders	9.3	1	Alcohol use disorders	7.1	1	Unipolar depressive disorders	11.9
2	Diabetes mellitus	5.5	2	Unipolar depressive disorders	6.8	2	Alzheimer and other dementias*	7.4
3	Alzheimer and other dementias*	5.5	3	Ischaemic heart disease	6.3	3	Diabetes mellitus	6.3
4	Ischaemic heart disease	5.5	4	Diabetes mellitus	4.8	4	Ischaemic heart disease	4.7
5	Alcohol use disorders	4.4	5	Hearing loss, adult onset	4.0	5	Cerebrovascular disease	4.4
6	Hearing loss, adult onset	4.1	6	Cerebrovascular disease	3.7	6	Hearing loss, adult onset	4.1
7	Cerebrovascular disease	4.0	7	Trachea, bronchus, lung cancers	3.6	7	Osteoarthritis	3.6
8	Trachea, bronchus, lung cancers	2.9	8	Alzheimer and other dementias*	3.6	8	Breast cancer	2.7
9	COPD	2.8	9	Self-inflicted injuries	3.6	9	COPD	2.7
10	Osteoarthritis	2.8	10	COPD	3.0	10	Trachea, bronchus, lung cancers	2.1

Table 26 (continued): Ten leading causes of DALYs, by income group and sex, 2030 (baseline scenario)

Both sexes			Males			Females		
Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs
<i>Middle income countries</i>								
1	HIV/AIDS	8.4	1	HIV/AIDS	9.3	1	Unipolar depressive disorders	8.1
2	Unipolar depressive disorders	6.2	2	COPD	5.9	2	HIV/AIDS	7.4
3	COPD	5.8	3	Cerebrovascular disease	5.1	3	Cerebrovascular disease	5.9
4	Cerebrovascular disease	5.5	4	Road traffic accidents	4.6	4	COPD	5.6
5	Ischaemic heart disease	4.4	5	Violence	4.5	5	Diabetes mellitus	4.7
6	Road traffic accidents	3.5	6	Ischaemic heart disease	4.5	6	Ischaemic heart disease	4.1
7	Diabetes mellitus	3.4	7	Unipolar depressive disorders	4.5	7	Cataracts	3.7
8	Cataracts	3.0	8	Alcohol use disorders	3.5	8	Vision disorders, age-related	3.6
9	Vision disorders, age-related	2.9	9	Hearing loss, adult onset	2.6	9	Hearing loss, adult onset	3.0
10	Hearing loss, adult onset	2.8	10	Trachea, bronchus, lung cancers	2.4	10	Osteoarthritis	2.7
<i>Low income countries</i>								
1	HIV/AIDS	12.4	1	HIV/AIDS	12.2	1	HIV/AIDS	12.7
2	Perinatal conditions	5.5	2	Perinatal conditions	5.9	2	Unipolar depressive disorders	5.7
3	Unipolar depressive disorders	4.4	3	Road traffic accidents	5.5	3	Perinatal conditions	5.1
4	Ischaemic heart disease	4.2	4	Lower respiratory infections	4.4	4	Ischaemic heart disease	4.1
5	Lower respiratory infections	4.2	5	Ischaemic heart disease	4.4	5	Lower respiratory infections	4.0
6	Road traffic accidents	3.9	6	Tuberculosis	4.2	6	Cataracts	3.8
7	Tuberculosis	3.5	7	COPD	3.2	7	Cerebrovascular disease	3.1
8	Cataracts	3.1	8	Unipolar depressive disorders	3.1	8	Diarrhoeal diseases	2.7
9	COPD	2.9	9	Diarrhoeal diseases	2.9	9	Tuberculosis	2.6
10	Diarrhoeal diseases	2.8	10	Cerebrovascular disease	2.5	10	COPD	2.5

Table 27: Ten leading causes of DALYs for three scenarios, by income group, both sexes combined, 2030

Pessimistic scenario			Baseline scenario			Optimistic scenario		
Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs	Rank	Disease or injury	% total DALYs
<i>World</i>								
1	HIV/AIDS	9.4	1	HIV/AIDS	10.3	1	HIV/AIDS	7.9
2	Unipolar depressive disorders	4.7	2	Unipolar depressive disorders	5.3	2	Unipolar depressive disorders	6.2
3	Ischaemic heart disease	4.5	3	Ischaemic heart disease	4.4	3	Ischaemic heart disease	4.6
4	Perinatal conditions	4.1	4	COPD	3.8	4	Road traffic accidents	4.5
5	Cerebrovascular disease	4.0	5	Perinatal conditions	3.8	5	Cerebrovascular disease	4.0
6	COPD	3.9	6	Cerebrovascular disease	3.7	6	COPD	3.8
7	Lower respiratory infections	3.8	7	Road traffic accidents	3.6	7	Perinatal conditions	3.6
8	Road traffic accidents	3.0	8	Cataracts	2.9	8	Cataracts	3.4
9	Tuberculosis	2.6	9	Lower respiratory infections	2.8	9	Hearing loss, adult onset	2.9
10	Cataracts	2.5	10	Tuberculosis	2.5	10	Diabetes mellitus	2.5

11. Discussion and conclusions

This paper has summarized the methods, assumptions, input data and results for updated projections of mortality and burden of disease by cause from 2002 to 2030. The methods follow fairly closely the projection methods used by the original Global Burden of Disease study for projections from 1990 to 2020, but with some changes in methodology (summarized in Section 11.1) and with updated inputs and an updated base set of estimates for 2002. Section 11.2 discusses some of the limitations and issues in interpretation of the projections.

The mortality and DALY estimates for 2002 were prepared using methods and data sources documented elsewhere (Mathers et al. 2003a). For regions with limited death registration data, such as the Eastern Mediterranean region, sub-Saharan Africa and parts of Asia and the Pacific, there is considerable uncertainty in estimates of deaths by cause associated with the use of partial information on levels of mortality from sources such as the DHS surveys, and from the use of cause-specific mortality estimates for causes such as HIV/AIDS, malaria, tuberculosis and vaccine-preventable diseases (Mathers et al. 2003a). Much of the uncertainty in estimates of the disability component of DALYs for the GBD is associated with the assessment of systematic errors in primary data. Data sources and an analysis of the uncertainty in GBD estimates for 2002 are examined in more detail in a separate technical paper (Mathers 2005). Detailed tabulations of mortality and DALY estimates for 2002 by region, cause, age and sex are available on the WHO website at www.who.int/evidence/bod.

11.1 Changes in methodology for the new WHO projections

While the new projections have followed the general approach developed by Murray and Lopez (1996), there are a number of methodological improvements and changes. These are summarized below.

1. The new projections were carried out at country level for 192 WHO Member States, using the GBD mortality estimates for 2002 as a base. The resulting country projections are added back into regional groups for presentation of results. In general, results will not be displayed at country level.
2. Whereas the original GDP projections applied a single set of models based on all observed death registration data for projections in all regions, the new projections have used a second set of models for low income countries based on the observed relationships for a low income data set consisting of 3,468 country-years of observation where GDP per capita was less than \$10,000. These models were used for projections for countries with income per capita less than \$3,000 per capita in 2002. For other countries, the models were based on the full data set of 5,210 country-years of historical data.
3. Whereas the original GDP projections treated diabetes as part of a single “Other non-communicable disease” group for which age-specific death rates were projected to decline with development, the new projections treated diabetes as a separate cause. A separate projection model for diabetes mortality was developed using the Comparative Risk Assessment project's analysis of the relative risk of diabetes mortality with increasing overweight (as measured by BMI) and WHO analysis and projection of trends in BMI distributions for WHO Member States from 2000 to 2010. Projected trends in BMI were assumed to flatten between 2010 and 2015 and to be constant beyond 2015.
4. Separate projection models were developed for chronic respiratory diseases using the Comparative Risk Assessment analysis of the chronic respiratory disease mortality risks associated with tobacco smoking, together with projections of smoking intensity. The

- non-smoker rates for all these chronic respiratory diseases were assumed to be declining with socioeconomic growth at one half the rate for “Other non-communicable diseases”.
5. For countries with populations of 5 million or more, and with at least 5 years of recent complete death registration data, cause-age-sex specific trends in mortality rates were estimated for ischaemic heart disease, cerebrovascular disease, tuberculosis, suicide and homicide. The resulting estimates for recent annual trends by cause, age and sex were used to adjust the initial years of projection for these causes for the selected countries. This adjustment ensured that available country-specific information on recent trends in mortality was incorporated into the projections for selected important causes.
 6. The predictions of the projections model were compared with historical trends in child mortality from 1990 to 2002, and as a result, certain regression coefficients were modified for low income countries, reducing the rates at which death rates are expected to decline for these countries.
 7. Projections of DALYs were carried out using a similar approach to that of the original GBD projections. For ischaemic heart disease and stroke, future case fatality rates were assumed to decline with improvements in income per capita. For vision and hearing disorders, prevalence rates and disability weights were assumed to decline with improvements in income per capita. YLD for HIV/AIDS were calculated from projections of HIV incidence rates assuming increasing duration for the period with AIDS as ARV coverage increases.
 8. Population projections also included UN projections for net migration rates.

11.2 Limitations

As discussed above, the data and information requirements for adequate measurements of the global burden of disease are very substantial, and the results have variable but often considerable uncertainty ranges. This applies even more to projections of burden of disease.

The projections of burden are not intended as forecasts of what will happen in the future but as projections of current and past trends, based on certain explicit assumptions. The methods used base the disease burden projections largely on broad mortality projections driven by World Bank projections of future growth in income and WHO projections of increases in human capital in different regions of the world, together with a model relating these to cause-specific mortality trends based on the historical observations in countries with death registration data over the last 50 years. The results depend strongly on the assumption that future mortality trends in poor countries will have the same relationship to economic and social development as has occurred in the higher income countries. If this assumption is not correct, then the projections for low income countries will be over-optimistic in the rate of decline of communicable diseases and the speed of the epidemiological transition.

The predictions of the projections model were compared with historical trends in child mortality from 1990 to 2002, and as a result, certain regression coefficients were modified for low income countries. This reduced the projected rates of decline in Group I conditions for low income countries compared to the original GBD projections, and it is entirely possible, that this adjustment may be too conservative. On the other hand, the many problems facing low income countries in improving and sustaining access to effective health interventions, and in scaling up health systems to cost-effectively address these challenges, may mean that the low income countries do not experience the temporal pace of health improvement at constant levels of income and human capital that have been seen in the high income countries over the last fifty years.

The projections have also not taken explicit account of trends in major risk factors apart from tobacco smoking, and to a limited extent overweight and obesity. If broad trends in risk factors are for worsening of risk exposures with development, rather than the improvements observed in recent decades in many high income countries, then again the projections for low and middle income countries presented here will be too optimistic. There is a need to develop much more comprehensive projection models that take explicit account of available information on trends in a wide range of risk factors. The HIV/AIDS projections in particular assume that transmission probabilities will remain largely unchanged into the future and there will not be substantial reductions in risk factors for HIV.

A projections exercise such as this by its nature involves substantial assumptions about the similarity of future trends to past trends, and about the future trends in broad drivers of health improvement. There are thus wide uncertainty ranges around future projections. Nevertheless, there are some aspects of the projections which clearly involve more uncertainty than others. For example, the projections of HIV/AIDS mortality are strongly affected by the assumptions made about the level of additional prevention effort that occur over the next two decades. Additionally, there are substantial uncertainties about the future trends in chronic respiratory disease mortality for non-smokers, and diabetes mortality for persons not overweight. Also, the evidence on the associations of injury mortality with income and human capital was weaker than for Group I and Group II conditions, and stronger assumptions were thus required for injury projections for some external causes. In the absence of any realistic approach to forecasting future war deaths, rates for these were assumed to remain constant over time in the baseline scenario. This may be too conservative, given the substantial decrease in numbers of wars and civil conflicts over the last decade or two. Finally, the entire set of YLD projections apart from those for HIV/AIDS are based on simplistic assumptions which may prove to be incorrect. It may be the case that case fatality rates for many diseases decline over the next thirty years, so that YLD become an increasing proportion of the total DALYs for these causes. On the other hand, improvements in risk factors and/or health interventions may lead to decreases in burden for some non-fatal conditions.

Despite these uncertainties, projections provide a useful perspective on population health trends and health policies, provided that they are interpreted with a degree of caution. Projections enable us to appreciate better the implications for health and health policy of currently observed trends, and the likely impact of fairly certain future trends, such as the ageing of the population, and the continuation of the epidemiological transition in developing countries. The results presented here provide a comprehensive update of the original Global Burden of Disease projections, and include up-dated projections for income and human capital, an updated base set of estimates, and updated analyses of the associations between mortality trends and income, human capital, time and tobacco smoking.

In using these projections, users should keep in mind that they represent a set of three visions of the future for population health, under an explicit set of assumptions and for specific projections of income, human capital, and of future trends in tobacco smoking, HIV/AIDS transmission and survival, and overweight and obesity. If the future is not like the past, for example through sustained and additional effort to address MDG goals, then the world may well achieve faster progress than projected here, even under the optimistic scenario.

11.3 Conclusions

The uncertainty in regional and global assessments of mortality and disease burden for 2002 must be kept in mind when using the projections of mortality and burden of disease to 2030. The projections of burden are also highly uncertain. The projections are not intended as

forecasts of what will happen in the future but as projections of current and past trends, based on certain explicit assumptions. The results depend strongly on the assumption that future mortality and risk factor trends in poor countries will have the same relationship to economic and social development as has occurred in the higher income countries over the last 50 years. If this assumption is not correct, then the projections for low income countries will be over-optimistic in the rate of decline of communicable diseases and the speed of the epidemiological transition. Improved projections building on available information on trends in risk factors and other health determinants in developing countries will await the further development and application of more sophisticated projection methods to cause-specific mortality projection (Girosi and King 2003).

However, with these caveats, the global burden of disease projections do provide a useful indication of what are the likely overall results of economic growth, the continuation of the epidemiological transition, the future course of epidemics such as the HIV/AIDS epidemic, and the impact of population ageing in developing regions. The production of global and regional estimates and projections in public health should not create the impression that the future course of disease and injury is reliably known, but they do provide a useful idea of future disease and injury trends to assist in the decisions and choices needing to be made now to address the expected disease burden of the future.

Acknowledgements

We wish to acknowledge firstly the financial support for this project provided by Robert Beaglehole, Director of the WHO Department of Chronic Diseases and Health Promotion (NMH/CHP), and also by the WHO Commission on Intellectual Property Rights, Innovation and Public Health (CIPRH).

We wish to gratefully acknowledge the assistance of Hongyi Xu in the preparation of inputs for the projections calculations, and assistance in those calculations, and the assistance of Doris Ma Fat and Mie Inoue in the analysis of historical death registration data and the calculation of life tables. Doris Ma Fat carried out the initial preparation of a database of country deaths data summarized according to the Global Burden of Disease cause categories. Niels Tomijima assisted in the modification of software for the projection of burden of disease, and in the preparation of software for the population projections. Ajay Tandon, formerly of the Global Program on Evidence for Health Policy at WHO, provided the results and documentation for EIP projections of income and human capital.

The WHO and UNAIDS working group prepared HIV projections under various scenarios for scale up of ART provision. We thank Karen Stannecki, Elizabeth Zaniewski, and Peter Ghys, for assistance in obtaining these detailed HIV projections and documentation and in interpreting them. Josh Salomon provided further unpublished results for his projections of HIV mortality for scenarios with additional prevention efforts.

Kate Strong and Tomoko Ono provided projections of body mass index distributions for use in the projections of diabetes mortality, and Kate Strong, Joanne Epping-Jordan and Robert Beaglehole of the Non-communicable Diseases and Mental Health (NMH) cluster also provided useful comments and critiques of results.

We also acknowledge the assistance of Joshua Salomon and Majid Ezzati of the School of Population Health at Harvard University, in relation to the provision of information and advice on previous projections work, and for useful discussions and comments on the methods and assumptions used for the current projections. We also gratefully acknowledge the willingness of Kenji Shibuya and Alan Lopez to provide us with their detailed projection results for lung cancer mortality for the USA, Canada, United Kingdom and Australia.

We also wish to acknowledge the contributions of the many people, both inside and outside WHO, who contributed to the reviews of epidemiological data and the estimation of the burden of disease

for the year 2002. These people are acknowledged in more detail in the documentation of the GBD 2002 .

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Annex Tables

Table A-1. WHO Regions and 14 sub-regions used in GBD project	102
Table A-2. Country income groups used for reporting on projections results.....	103
Table A-3. GBD cause categories and ICD codes.....	104
Table A-4. Parsimonious regression equations for nine major cause-clusters based on the full country panel dataset, 1950-2002.....	109
Table A-5. Parsimonious regression equations for nine major cause-clusters based on the low income country panel dataset, 1950-2002	112
Table A-6. Results of regressions of age-sex-specific mortality for detailed causes on the respective cause cluster, 1950-2002.	115
Table A-7. Results of log-linear Poisson regressions for deaths due to selected causes, by age and sex, for countries with complete death registration data and population over 5 million	122
Table A-8. Deaths by age, sex and cause, by WHO region, baseline scenario 2005.....	130
Table A-9. Deaths by age, sex and cause, by income group, baseline scenario 2005	151
Table A-10. DALYs by age, sex and cause, by WHO region, baseline scenario 2005	165
Table A-11. DALYs by age, sex and cause, by income group, baseline scenario 2005	187
Table A-12. Deaths by age, sex and cause, by WHO region, baseline scenario 2015.....	202
Table A-13. Deaths by age, sex and cause, by income group, baseline scenario 2015	223
Table A-14. DALYs by age, sex and cause, by WHO region, baseline scenario 2015	238
Table A-15. DALYs by age, sex and cause, by income group, baseline scenario 2015	259
Table A-16. Deaths by age, sex and cause, by WHO region, baseline scenario 2030.....	274
Table A-17. Deaths by age, sex and cause, by income group, baseline scenario 2030	295
Table A-18. DALYs by age, sex and cause, by WHO region, baseline scenario 2030	310
Table A-19. DALYs by age, sex and cause, by income group, baseline scenario 2030.....	331
Table A-20. Deaths by age, sex and cause, by WHO region, pessimistic scenario 2030	346
Table A-21. Deaths by age, sex and cause, by income group, pessimistic scenario 2030.....	367
Table A-22. DALYs by age, sex and cause, by WHO region, pessimistic scenario 2030.....	382
Table A-23. DALYs by age, sex and cause, by income group, pessimistic scenario 2030	403
Table A-24. Deaths by age, sex and cause, by WHO region, optimistic scenario 2030	418
Table A-25. Deaths by age, sex and cause, by income group, optimistic scenario 2030.....	439
Table A-26. DALYs by age, sex and cause, by WHO region, optimistic scenario 2030.....	454
Table A-27. DALYs by age, sex and cause, by income group, optimistic scenario 2030	475

Annex Table A-1: WHO Regions and 14 sub-regions used in GBD project.

WHO region	Mortality stratum ¹	WHO Member States
AFRO	D	Algeria, Angola, Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Comoros, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Mauritania, Mauritius, Niger, Nigeria, Sao Tome And Principe, Senegal, Seychelles, Sierra Leone, Togo
AFRO	E	Botswana, Burundi, Central African Republic, Congo, Côte d'Ivoire, Democratic Republic Of The Congo, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Uganda, United Republic of Tanzania, Zambia, Zimbabwe
AMRO	A	Canada, United States Of America, Cuba
AMRO	B	Antigua And Barbuda, Argentina, Bahamas, Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, El Salvador, Grenada, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Saint Kitts And Nevis, Saint Lucia, Saint Vincent And The Grenadines, Suriname, Trinidad And Tobago, Uruguay, Venezuela
AMRO	D	Bolivia, Ecuador, Guatemala, Haiti, Nicaragua, Peru
EMRO	B	Bahrain, Iran (Islamic Republic Of), Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, United Arab Emirates
EMRO	D	Afghanistan, Djibouti, Egypt, Iraq, Morocco, Pakistan, Somalia, Sudan, Yemen
EURO	A	Andorra, Austria, Belgium, Croatia, Czech Republic, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, San Marino, Slovenia, Spain, Sweden, Switzerland, United Kingdom
EURO	B	Albania, Armenia, Azerbaijan, Bosnia And Herzegovina, Bulgaria, Georgia, Kyrgyzstan, Poland, Romania, Slovakia, Tajikistan, The Former Yugoslav Republic Of Macedonia, Turkey, Turkmenistan, Uzbekistan, Yugoslavia
EURO	C	Belarus, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine
SEARO	B	Indonesia, Sri Lanka, Thailand
SEARO	D	Bangladesh, Bhutan, Democratic People's Republic Of Korea, India, Maldives, Myanmar, Nepal
WPRO	A	Australia, Japan, Brunei Darussalam, New Zealand, Singapore
WPRO	B	Cambodia, China, Lao People's Democratic Republic, Malaysia, Mongolia, Philippines, Republic Of Korea, Viet Nam
		Cook Islands, Fiji, Kiribati, Marshall Islands, Micronesia (Federated States Of), Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu

Note 1: The 14 sub-regions of the 6 WHO regions were defined in terms of 5 mortality strata defined in terms of levels of child and adult mortality. Refer to the Statistical Annex of the World Health Report 2004 for further details (World Health Organization 2004).

Annex Table A-2: Country income groups used for reporting on projections results

Income category¹	Countries
High income	Andorra, Aruba, Australia, Austria, Bahamas, Bahrain, Belgium, Bermuda, Brunei Darussalam, Canada, Cayman Islands, Channel Islands, Cyprus, Denmark, Faeroe Islands, Finland, France, French Polynesia, Germany, Greece, Greenland, Guam, Iceland, Ireland, Israel, Italy, Japan, Kuwait, Liechtenstein, Luxembourg, Monaco, Netherlands, Netherlands Antilles, New Caledonia, New Zealand, Northern Mariana Islands, Norway, Portugal, Qatar, Republic of Korea, San Marino, Singapore, Slovenia, Spain, Sweden, Switzerland, United Arab Emirates, United Kingdom, United States of America, United States Virgin Islands
Middle income	Albania, Algeria, American Samoa, Antigua and Barbuda, Argentina, Barbados, Belarus, Belize, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Cape Verde, Chile, China, Colombia, Costa Rica, Croatia, Cuba, Czech Republic, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Fiji, Gabon, Grenada, Guatemala, Guyana, Honduras, Hungary, Iran (Islamic Republic of), Iraq, Isle of Man, Jamaica, Jordan, Kazakhstan, Kiribati, Latvia, Lebanon, Libyan Arab Jamahiriya, Lithuania, Malaysia, Maldives, Malta, Marshall Islands, Mauritius, Mexico, Micronesia (Federated States of), Morocco, Namibia, Occupied Palestinian Territory, Oman, Palau, Panama, Paraguay, Peru, Philippines, Poland, Puerto Rico, Romania, Russian Federation, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Saudi Arabia, Serbia and Montenegro, Seychelles, Slovakia, South Africa, Sri Lanka, Suriname, Swaziland, Syrian Arab Republic, Thailand, The former Yugoslav Republic of Macedonia, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uruguay, Vanuatu, Venezuela (Bolivarian Republic of)
Low income	Afghanistan, Angola, Armenia, Azerbaijan, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic People's Republic of Korea, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Ethiopia, Gambia, Georgia, Ghana, Guinea, Guinea-Bissau, Haiti, India, Indonesia, Kenya, Kyrgyzstan, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mongolia, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Republic of Moldova, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, Sudan, Tajikistan, Timor-Leste, Togo, Uganda, Ukraine, United Republic of Tanzania, Uzbekistan, Viet Nam, Yemen, Zambia, Zimbabwe
Not included	Anguilla, British Virgin Islands, Cook Islands, Falkland Islands (Malvinas), French Guiana, Gibraltar, Guadeloupe, Holy See, Martinique, Montserrat, Nauru, Niue, Pitcairn, Réunion, Saint Helena, Saint Pierre et Miquelon, Tokelau, Turks and Caicos Islands, Tuvalu, Wallis and Futuna Islands, Western Sahara

Note 1: Categories shown in Table 1 are based on the income categories published in the World Bank's "2003 World Development Indicators" Report (World Bank 2003). Countries are divided according to 2001 GNI per capita, calculated using the World Bank Atlas method. The groups are: low income, \$745 or less; lower middle income, \$746 - \$2,975; upper middle income, \$2,976 - \$9,205; and high income, \$9,206 or more.

Annex Table A-3: GBD cause categories and ICD codes

Code	GBD Cause Name	ICD-9 code	ICD-10 code
U000	All Causes		
U001	I. Communicable, maternal, perinatal and nutritional conditions (a)	001-139, 243, 260-269, 279.5, 280-281, 285.9, 320-323, 381-382, 460-465, 466, 480-487, 614-616, 630-676, 760-779	A00-B99, G00-G04, N70-N73, J00-J06, J10-J18, J20-J22, H65-H66, O00-O99, P00-P96, E00-E02, E40-E46, E50, D50-D53, D64.9, E51-64
U002	A. Infectious and parasitic diseases	001-139, 279.5, 320-323, 614-616, 771.3	A00-B99, G00, G03-G04, N70-N73
U003	1. Tuberculosis	010-018, 137	A15-A19, B90
U004	2. Sexually transmitted diseases excluding HIV	090-099, 614-616	A50-A64, N70-N73
U005	a. Syphilis	090-097	A50-A53
U006	b. Chlamydia	-	A55-A56
U007	c. Gonorrhoea	098	A54
U008	Other STDs	099, 614-616	A57-A64, N70-N73
U009	3. HIV/AIDS	279.5 (=042-044)	B20-B24
U010	4. Diarrheal diseases	001, 002, 004, 006-009	A00, A01, A03, A04, A06-A09
U011	5. Childhood-cluster diseases	032, 033, 037, 045, 055, 138, 771.3	A33-A37, A80, B05, B91
U012	a. Pertussis	033	A37
U013	b. Poliomyelitis	045, 138	A80, B91
U014	c. Diphtheria	032	A36
U015	d. Measles	055	B05
U016	e. Tetanus	037, 771.3	A33-A35
U017	6. Meningitis	036, 320-322	A39, G00, G03
U018	7. Hepatitis B	070.2-070.9	B16-B19 (minus B17.1, B18.2)
U019	Hepatitis C	-	B17.1, B18.2
U020	8. Malaria	084	B50-B54
U021	9. Tropical-cluster diseases	085, 086, 120, 125.0, 125.1, 125.3	B55-B57, B65, B73, B74.0-B74.2
U022	a. Trypanosomiasis	086.3, 086.4, 086.5,	B56
U023	b. Chagas disease	086.0, 086.1, 086.2, 086.9	B57
U024	c. Schistosomiasis	120	B65
U025	d. Leishmaniasis	085	B55
U026	e. Lymphatic filariasis	125.0, 125.1	B74.0-B74.2
U027	f. Onchocerciasis	125.3	B73
U028	10. Leprosy	030	A30
U029	11. Dengue	061	A90-A91
U030	12. Japanese encephalitis	062.0	A83.0
U031	13. Trachoma	076	A71
U032	14. Intestinal nematode infections	126-129	B76-B81
U033	a. Ascariasis	127.0	B77
U034	b. Trichuriasis	127.3	B79
U035	c. Hookworm disease (Ancylostomiasis and necatoriasis)	126	B76
U036	Other intestinal infections	127.1, 127.2, 127.4-127.9, 128, 129	B78, B80, B81
U037	Other infectious diseases	003, 005, 020-027, 031, 034, 035, 038-041, 046-049, 050-054, 056-057, 060, 062.1-066, 070.0-070.1, 071-075, 077-079, 080-083, 087-088, 100-104, 110-118, 121-124, 125.2, 125.4, 125.5, 125.6, 125.7, 125.9, 130-136, 139, 323	A02, A05, A20-A28, A31, A32, A38, A40-A49, A65-A70, A74-A79, A81, A82, A83.1-A83.9, A84-A89, A92-A99, B00-B04, B06-B15, B25-B49, B58-B60, B64, B66-B72, B74.3-B74.9, B75, B82-B89, B92-B99, G04

Annex Table A-3 (continued): GBD cause categories and ICD codes

Code	GBD Cause Name	ICD-9 code	ICD-10 code
U038	B. Respiratory infections	460-466, 480-487, 381-382	J00-J06, J10-J18, J20-J22, H65-H66
U039	1. Lower respiratory infections	466, 480-487	J10-J18, J20-J22
U040	2. Upper respiratory infections	460-465	J00-J06
U041	3. Otitis media	381-382	H65-H66
U042	C. Maternal conditions	630-676	O00-O99
U043	1. Maternal haemorrhage	640, 641, 666	O44-O46, O67, O72
U044	2. Maternal sepsis	670	O85-O86
U045	3. Hypertensive disorders of pregnancy	642	O10-O16
U046	4. Obstructed labour	660	O64-O66
U047	5. Abortion	630-639	O00-O07
U048	Other maternal conditions	643-659, 661-665, 667-669, 671-676	O20-O43, O47-O63, O68-O71, O73-O75, O87-O99
U049	D. Conditions arising during the perinatal period	760-779 minus 771.3	P00-P96
U050	1. Low birth weight	764-765	P05-P07
U051	2. Birth asphyxia and birth trauma	767-770	P03, P10-P15, P20-P29
U052	Other perinatal conditions	760-763, 766, 771 (minus 771.3), 772-779	P00-P02, P04, P08, P35-P96
U053	E. Nutritional deficiencies	243, 260-269, 280-281, 285.9	E00-E02, E40-E46, E50, D50-D53, D64.9, E51-E64
U054	1. Protein-energy malnutrition	260-263	E40-E46
U055	2. Iodine deficiency	243	E00-E02
U056	3. Vitamin A deficiency	264	E50
U057	4. Iron-deficiency anemia	280, 285.9	D50, D64.9
U058	Other nutritional disorders	265-269, 281	D51-D53, E51-E64
U059	II. Noncommunicable diseases (a)	140-242, 244-259, 270-279 (minus 279.5), 282-285 (minus 285.9), 286-319, 324-380, 383-459, 470-478, 490-611, 617-629, 680-759	C00-C97, D00-D48, D55-D64 (minus D 64.9) D65-D89, E03-E07, E10-E16, E20-E34, E65-E88, F01-F99, G06-G98, H00-H61, H68-H93, I00-I99, J30-J98, K00-K92, N00-N64, N75-N98, L00-L98, M00-M99, Q00-Q99
U060	A. Malignant neoplasms	140-208	C00-C97
U061	1. Mouth and oropharynx cancers (b)	140-149	C00-C14
U062	2. Oesophagus cancer (b)	150	C15
U063	3. Stomach cancer (b)	151	C16
U064	4. Colon and rectum cancers (b)	153, 154	C18-C21
U065	5. Liver cancer	155	C22
U066	6. Pancreas cancer	157	C25
U067	7. Trachea, bronchus and lung cancers	162	C33-C34
U068	8. Melanoma and other skin cancers (b)	172-173	C43-C44
U069	9. Breast cancer (b)	174, 175	C50
U070	10. Cervix uteri cancer (b)	180	C53
U071	11. Corpus uteri cancer (b)	179, 182	C54-C55
U072	12. Ovary cancer	183	C56
U073	13. Prostate cancer (b)	185	C61
U074	14. Bladder cancer (b)	188	C67
U075	15. Lymphomas and multiple myeloma (b)	200-203	C81-C90, C96
U076	16. Leukemia(b)	204-208	C91-C95
U077	Other malignant neoplasms (b)	152, 156, 158-161, 163-171, 181, 184, 186-187, 189-199	C17, C23, C24, C26-C32, C37-C41, C45-C49, C51, C52, C57-C60, C62-C66, C68-C80, C97
U078	B. Other neoplasms	210-239	D00-D48
U079	C. Diabetes mellitus	250	E10-E14
U080	D. Endocrine disorders	240-242, 244-246, 251-259, 270-279 (minus 274, 279.5), 282-285 (minus 285.9), 286-289	D55-D64 (minus D64.9), D65-D89, E03-E07, E15-E16, E20-E34, E65-E88

Annex Table A-3 (continued): GBD cause categories and ICD codes

Code	GBD Cause Name	ICD-9 code	ICD-10 code
U081	E. Neuro-psychiatric conditions	290-319, 324-359	F01-F99, G06-G98
U082	1. Unipolar depressive disorders	296.1, 311	F32-F33
U083	2. Bipolar affective disorder	296 (minus 296.1)	F30-F31
U084	3. Schizophrenia	295	F20-F29
U085	4. Epilepsy	345	G40-G41
U086	5. Alcohol use disorders	291, 303, 305.0	F10
U087	6. Alzheimer and other dementias	290, 330, 331	F01, F03, G30-G31
U088	7. Parkinson disease	332	G20-G21
U089	8. Multiple sclerosis	340	G35
U090	9. Drug use disorders	304, 305.2-305.9	F11-F16, F18-F19
U091	10. Post-traumatic stress disorder	308-309	F43.1
U092	11. Obsessive-compulsive disorder	300.3	F42
U093	12. Panic disorder	300.2	F40.0, F41.0
U094	13. Insomnia (primary)	307.4	F51
U095	14. Migraine	346	G43
U096	Mental Retardation attributable to lead exposure	317-319	F70-F79
U097	Other neuropsychiatric disorders	292-294, 297-300.1, 300.4-302, 305.1, 306-307 (minus 307.4), 310, 312-316, 324-326, 333-337, 341-344, 347-349, 350-359	F04-F09, F17, F34-F39, F401-F409, F411-F419, F43(minus F43.1), F44-F50, F52-F69, F80-F99, G06-G12, G23-G25, G36, G37, G44-G98
U098	F. Sense organ diseases	360-380, 383-389	H00-H61, H68-H93
U099	1. Glaucoma	365	H40
U100	2. Cataracts	366	H25-H26
U101	3. Vision disorders, age-related	367.4	H524
U102	4. Hearing loss, adult onset	389	H90-H91
U103	Other sense organ disorders	360-364, 367-380 (minus 367.4), 383-388	H00-H21, H27-H35, H43-H61 (minus H524), H68-H83, H92-H93
U104	G. Cardiovascular diseases	390-459	I00-I99
U105	1. Rheumatic heart disease	390-398	I01-I09
U106	2. Hypertensive heart disease	401-405	I10-I13
U107	3. Ischemic heart disease (c)	410-414	I20-I25
U108	4. Cerebrovascular disease	430-438	I60-I69
U109	5. Inflammatory heart diseases	420, 421, 422, 425	I30-I33, I38, I40, I42
U110	Other cardiovascular diseases (c)	415-417, 423-424, 426-429, 440-448, 451-459	I00, I26-I28, I34-I37, I44-I51, I70-I99
U111	H. Respiratory diseases	470-478, 490-519	J30-J98
U112	1. Chronic obstructive pulmonary disease	490-492, 495-496	J40-J44
U113	2. Asthma	493	J45-J46
U114	Other respiratory diseases	470-478, 494, 500-508, 510-519	J30-J39, J47-J98
U115	I. Digestive diseases	530-579	K20-K92
U116	1. Peptic ulcer disease	531-533	K25-K27
U117	2. Cirrhosis of the liver	571	K70, K74
U118	3. Appendicitis	540-543	K35-K37
U119	Other digestive diseases	530, 534-537, 550-553, 555-558, 560-570, 572-579	K20-K22, K28-K31, K38, K40-K66, K71-K73, K75-K92
U120	J. Genito-urinary diseases	580-611, 617-629	N00-N64, N75-N98
U121	1. Nephritis and nephrosis	580-589	N00-N19
U122	2. Benign prostatic hypertrophy	600	N40
U123	Other genitourinary system diseases	590-599, 601-611, 617-629	N20-N39, N41-N64, N75-N98
U124	K. Skin diseases	680-709	L00-L98

Annex Table A-3 (continued): GBD cause categories and ICD codes

Code	GBD Cause Name	ICD-9 code	ICD-10 code
U125	L. Musculoskeletal diseases	710-739, 274	M00-M99
U126	1. Rheumatoid arthritis	714	M05-M06
U127	2. Osteoarthritis	715	M15-M19
U128	3. Gout	274	M10
U129	4. Low back pain	720-724 (minus 721.1, 722.0, 722.4)	M45-M48, M54 (minus M54.2)
U130	Other musculoskeletal disorders	710-713, 716-719, 721.1, 722.0, 722.4, 723, 725-739	M00-M02, M08, M11-M13, M20-M43, M50-M53, M54.2, M55-M99
U131	M. Congenital anomalies	740-759	Q00-Q99
U132	1. Abdominal wall defect	756.7	Q79.2-Q79.5
U133	2. Anencephaly	740.0	Q00
U134	3. Anorectal atresia	751.2	Q42
U135	4. Cleft lip	749.1	Q36
U136	5. Cleft palate	749.0	Q35, Q37
U137	6. Oesophageal atresia	750.3	Q39.0-Q39.1
U138	7. Renal agenesis	753.0	Q60
U139	8. Down syndrome	758.0	Q90
U140	9. Congenital heart anomalies	745-747	Q20-Q28
U141	10. Spina bifida	741	Q05
U142	Other Congenital anomalies	740.1, 740.2, 742-744, 748, 749.2, 750.0, 750.1, 750.2, 750.4-751.1, 751.3-751.9, 752, 753.1-753.9, 754, 755, 756.0-756.6, 756.8, 756.9, 757, 758.1-758.9, 759	Q01-Q04, Q06-Q18, Q30-Q34, Q38, Q392-Q399, Q40-Q41, Q43-Q56, Q61-Q78, Q790, Q791, Q796, Q798, Q799, Q80-Q89, Q91-Q99
U143	N. Oral conditions	520-529	K00-K14
U144	1. Dental caries	521.0	K02
U145	2. Periodontal disease	523	K05
U146	3. Edentulism	-	-
U147	Other oral diseases	520, 521.1-521.9, 522, 524-529	K00, K01, K03, K04, K06-K14
U148	III. Injuries	E800-999	V01-Y89
U149	A. Unintentional injuries (d)	E800-949	V01-X59, Y40-Y86, Y88, Y89
U150	1. Road traffic accidents	E810-819, E826-829, E929.0	(e)
U151	2. Poisonings	E850-869	X40-X49
U152	3. Falls	E880-888	W00-W19
U153	4. Fires	E890-899	X00-X09
U154	5. Drownings	E910	W65-W74
U155	6. Other unintentional injuries	E800-E807, E820-E848, E870-E879, E900-E909, E911-E949	Rest of V, W20-W64, W75-W99, X10-X39, X50-X59, Y40-Y86, Y88, Y89
U156	B. Intentional injuries (d)	E950-978, 990-999	X60-Y09, Y35-Y36, Y870, Y871
U157	1. Self-inflicted injuries	E950-959	X60-X84, Y870
U158	2. Violence	E960-969	X85-Y09, Y871
U159	3. War	E990-999	Y36
U160	Other intentional injuries	E970-E978	Y35

(a) Deaths coded to “Symptoms, signs and ill-defined conditions” (780-799 in ICD-9 and R00-R99 in ICD-10) are distributed proportionately to all causes within Group I and Group II.

(b) Cancer deaths coded to ICD categories for malignant neoplasms of other and unspecified sites including those whose point of origin cannot be determined, and secondary and unspecified neoplasms (ICD-10 C76, C80, C97 or ICD-9 195, 199) were redistributed pro-rata across the footnoted malignant neoplasm categories within each age-sex group, so that the category ‘Other malignant neoplasms’ includes only malignant neoplasms of other specified sites (53).

(c) Ischemic heart disease deaths may be miscoded to a number of so-called cardiovascular “garbage” codes. These include heart failure, ventricular dysrhythmias, generalized atherosclerosis and ill-defined descriptions and

complications of heart disease. Proportions of deaths coded to these causes were redistributed to ischemic heart disease as described in(23). Relevant ICD-9 codes are 427.1, 427.4, 427.5, 428, 429.0, 429.1, 429.2, 429.9, 440.9, and relevant ICD-10 codes are I47.2, I49.0, I46, I50, I51.4, I51.5, I51.6, I51.9, I70.9.

(d) Injury deaths where the intent is not determined (E980-989 of ICD-9 and Y10-Y34, Y872 in ICD-10) are distributed proportionately to all causes below the Group level for injuries.

(e) For countries with 3-digit ICD10 data,for Road traffic accidents use: V01-V04, V06, V09-V80, V87, V89, V99. For countries with 4-digit ICD10 data,for Road traffic accidents use:

V01.1-V01.9, V02.1-V02.9, V03.1-V03.9, V04.1-V04.9, V06.1-V06.9, V09.2, V09.3, V10.4-V10.9, V11.4-V11.9, V12.3-V12.9, V13.3-V13.9, V14.3-V14.9, V15.4-V15.9, V16.4-V16.9, V17.4-V17.9, V18.4-V18.9, V19.4-V19.6, V20.3-V20.9, V21.3-V21.9, V22.3-V22.9, V23.3-V23.9, V24.3-V24.9, V25.3-V25.9, V26.3-V26.9, V27.3-V27.9, V28.3-V28.9, V29.4-V29.9, V30.4-V30.9, V31.4-V31.9, V32.4-V32.9, V33.4-V33.9, V34.4-V34.9, V35.4-V35.9, V36.4-V36.9, V37.4-V37.9, V38.4-V38.9, V39.4-V39.9, V40.4-V40.9, V41.4-V41.9, V42.4-V42.9, V43.4-V43.9, V44.4-V44.9, V45.4-V45.9, V46.4-V46.9, V47.4-V47.9, V48.4-V48.9, V49.4-V49.9, V50.4-V50.9, V51.4-V51.9, V52.4-V52.9, V53.4-V53.9, V54.4-V54.9, V55.4-V55.9, V56.4-V56.9, V57.4-V57.9, V58.4-V58.9, V59.4-V59.9, V60.4-V60.9, V61.4-V61.9, V62.4-V62.9, V63.4-V63.9, V64.4-V64.9, V65.4-V65.9, V66.4-V66.9, V67.4-V67.9, V68.4-V68.9, V69.4-V69.9, V70.4-V70.9, V71.4-V71.9, V72.4-V72.9, V73.4-V73.9, V74.4-V74.9, V75.4-V75.9, V76.4-V76.9, V77.4-V77.9, V78.4-V78.9, V79.4-V79.9, V80.3-V80.5, V81.1, V82.1, V83.0-V83.3, V84.0-V84.3, V85.0-V85.3, V86.0-V86.3, V87.0-V87.8, V89.2, V89.9, V99, Y850.

Annex Table A-4:Parsimonious regression equations for nine major cause-clusters based on the full country panel dataset, 1950-2002.

Cause-cluster	Sex	Age group	Regression coefficients						R ² (%)
			Constant	lnY	lnHC	(lnY) ²	Year	lnSI	
<i>Group I</i>									
	Male	0-4	16.359	-0.754	-0.947		-0.025		79
		5-14	15.126	-0.917	-1.814		-0.020		75
		15-29	13.220	-0.823	-1.429		-0.012		72
		30-44	13.950	-0.898	-1.124		-0.010		69
		45-59	13.759	-0.747	-0.960		-0.016		69
		60-69	12.937	-0.492	-1.064		-0.019		65
		70+	10.176	0.000	-1.222		-0.017		39
	Female	0-4	16.282	-0.786	-0.953		-0.024		78
		5-14	14.763	-0.913	-1.780		-0.019		74
		15-29	14.645	-0.887	-1.502		-0.021		74
		30-44	15.137	-0.865	-1.494		-0.024		74
		45-59	13.056	-0.646	-1.338		-0.020		71
		60-69	12.347	-0.417	-1.406		-0.022		65
		70+	9.240	0.148	-1.535		-0.019		42
<i>Malignant neoplasms</i>									
	Male	0-4	-12.871	3.630	0.396	-0.217	-0.011		26
		5-14	-7.702	2.408	0.064	-0.142	-0.009		23
		15-29	0.815	0.564		-0.037	-0.007		16
		30-44	4.791	-0.089	-0.071		-0.006	0.096	24
		45-59	5.452	-0.056	-0.143		-0.004	0.196	31
		60-69	5.998		-0.091		-0.006	0.175	31
		70+	5.530	0.195	-0.184		-0.007	0.133	37
	Female	0-4	-14.155	3.894	0.325	-0.230	-0.011		26
		5-14	-8.115	2.435		-0.143	-0.008		19
		15-29	-0.384	0.926	-0.150	-0.063	-0.006		34
		30-44	1.503	0.871	-0.131	-0.057	-0.008	0.013	30
		45-59	3.394	0.639	-0.057	-0.038	-0.010	0.037	21
		60-69	3.920	0.621	-0.046	-0.033	-0.010	0.034	19
		70+	6.161	0.194	-0.208		-0.012	0.062	29
<i>Cardiovascular diseases</i>									
	Male	0-4	-4.656	2.071	-0.798	-0.140	0.012		31
		5-14	7.875	-0.480	-1.040		-0.009		62
		15-29	5.697	0.000	-0.593	-0.028			60
		30-44	-0.898	1.597	-0.074	-0.115		0.087	38
		45-59	3.613	0.821		-0.066	-0.005	0.172	34
		60-69	8.312	0.000	0.109	-0.019	-0.008	0.158	33
		70+	6.924	0.545	0.235	-0.046	-0.005	0.072	23
	Female	0-4	-5.246	2.138	-0.677	-0.146	0.013		31
		5-14	8.281	-0.525	-1.007		-0.011		65
		15-29	9.397	-0.582	-0.821		-0.009		72
		30-44	1.721	1.315	-0.376	-0.108	-0.009	0.017	67
		45-59	-2.062	2.409		-0.170	-0.010	0.033	63
		60-69	1.117	1.882	0.186	-0.135	-0.011		58
		70+	7.171	0.531	0.204	-0.045	-0.002	-0.069	36
<i>Digestive diseases</i>									
	Male	0-4	-1.562	2.356	-0.825	-0.173	-0.022		56
		5-14	0.829	1.640	-1.247	-0.140	-0.018		73
		15-29	0.371	1.423	-1.188	-0.118			68
		30-44	-1.653	1.726	-0.923	-0.124	0.013		44
		45-59	-0.676	1.669	-0.767	-0.115	0.010		41
		60-69	1.608	1.355	-0.720	-0.095	0.004		47
		70+	8.429	-0.121	-0.792				42

Annex Table A-4 (continued): Parsimonious regression equations for nine major cause-clusters based on the full country panel dataset, 1950-2002.

Cause-cluster	Sex	Age group	Regression coefficients						R ² (%)
			Constant	lnY	lnHC	(lnY) ²	Year	lnSI	
<i>Digestive diseases</i>									
	Female	0-4	-2.754	2.491	-0.843	-0.181	-0.018		53
		5-14	0.463	1.569	-1.173	-0.134	-0.017		65
		15-29	-1.869	1.941	-1.111	-0.148	-0.007		72
		30-44	7.554	-0.381	-1.028				51
		45-59	3.645	0.698	-0.785	-0.062			47
		60-69	3.447	0.919	-0.770	-0.073			53
		70+	12.834	-1.289	-0.806	0.071			35
<i>Respiratory diseases</i>									
	Male	0-4	10.369	-0.504	-1.896				53
		5-14	7.044	-0.519	-1.190				55
		15-29	8.179	-1.425	-1.069	0.071	0.019		45
		30-44	-4.721	2.028	-0.778	-0.141	0.013	0.047	50
		45-59	-0.140	1.126	-0.446	-0.087	0.007	0.209	30
		60-69	5.801	-0.249	-0.272		0.011	0.201	20
		70+	6.354	-0.230	-0.298		0.020	0.175	30
	Female	0-4	-0.578	2.026	-1.566	-0.156			52
		5-14	4.380	0.153	-1.166	-0.049	0.004		52
		15-29	4.219	-0.367	-0.869		0.014		44
		30-44	4.848	-0.384	-0.765		0.016		43
		45-59	5.756	-0.387	-0.678		0.018	0.141	44
		60-69	6.714	-0.357	-0.747		0.018	0.151	47
		70+	10.369	-0.504	-1.896				53
<i>Other Group II</i>									
	Male	0-4	9.383	-0.286	-0.558		-0.010		57
		5-14	7.815	-0.292	-0.677		-0.012		71
		15-29	7.641	-0.296	-0.670				34
		30-44	-0.369	1.648	-0.324	-0.112	0.004		46
		45-59	0.638	1.607		-0.104	0.000		24
		60-69	4.913	0.851	0.077	-0.057	-0.003		16
		70+	9.983	-0.101			-0.001		11
	Female	0-4	9.207	-0.299	-0.502		-0.010		55
		5-14	7.799	-0.308	-0.734		-0.011		69
		15-29	8.613	-0.378	-0.719		-0.006		71
		30-44	4.478	0.678	-0.479	-0.056	-0.006		62
		45-59	4.857	0.751	-0.209	-0.057	-0.006		49
		60-69	6.625	0.586	-0.139	-0.048	-0.007		48
		70+	10.587	-0.161	-0.121	0.000	-0.002		30
<i>Road traffic accidents</i>									
	Male	0-4	-21.339	5.341	0.294	-0.306	-0.006		15
		5-14	-17.511	4.635	-0.156	-0.262	-0.007		18
		15-29	-17.821	4.580	0.000	-0.247	0.002		19
		30-44	-25.046	6.579	-0.297	-0.384	0.012		26
		45-59	-28.264	7.361	-0.285	-0.428	0.009		29
		60-69	-24.713	6.630	-0.383	-0.381	0.004		24
		70+	-17.562	4.940	-0.348	-0.277	0.003		13
	Female	0-4	-20.599	5.054	0.278	-0.286	-0.006		14
		5-14	-13.515	3.493	-0.082	-0.196	-0.003		8
		15-29	-11.870	2.708	0.078	-0.139	0.008		18
		30-44	-15.493	3.808	-0.134	-0.217	0.012		12
		45-59	-15.914	4.099	-0.167	-0.235	0.007		11
		60-69	-15.160	4.060	-0.247	-0.229	0.003		9
		70+	-15.311	4.196	-0.149	-0.236			7

Annex Table A-4 (continued): Parsimonious regression equations for nine major cause-clusters based on the full country panel dataset, 1950-2002.

Cause-cluster	Sex	Age group	Regression coefficients						R ² (%)
			Constant	lnY	lnHC	(lnY) ²	Year	lnSI	
<i>Other unintentional injuries</i>									
	Male	0-4	-8.376	3.283	0.373	-0.221	-0.008		36
		5-14	-3.043	2.160	-0.189	-0.156	-0.012		58
		15-29	-5.284	2.640	-0.270	-0.177	-0.003		42
		30-44	-8.333	3.238	-0.109	-0.215	0.006		36
		45-59	-8.487	3.247	0.000	-0.214	0.006		31
		60-69	-5.179	2.530	-0.220	-0.165	0.004		29
		70+	1.000						5
	Female	0-4	-6.429	2.817	0.330	-0.198	-0.006		38
		5-14	5.552	0.000	-0.452	-0.034			57
		15-29	4.741	0.000	-0.520	-0.031	0.005		50
		30-44	-1.725	1.341	-0.237	-0.108	0.010		40
		45-59	-2.851	1.600	-0.110	-0.118	0.008		31
		60-69	1.000						29
		70+	1.000						16
<i>Intentional injuries</i>									
	Male	0-4	1.000						33
		5-14	-3.841	1.255	-0.403	-0.095	0.020		33
		15-29	9.706	-1.369	-0.639	0.065	0.022		22
		30-44	5.274	-0.267	-0.458		0.019		19
		45-59	4.408	0.000	-0.196	-0.013	0.009		10
		60-69	1.000						9
		70+	1.000						5
	Female	0-4	1.000						5
		5-14	2.887	-0.396	-0.529	0.000	0.021		40
		15-29	13.165	-2.313	-0.172	0.118	0.005		13
		30-44	10.345	-1.856	0.229	0.101			3
		45-59	1.000						8
		60-69	1.000						6
		70+	1.000						7

Annex Table A-5: Parsimonious regression equations for nine major cause-clusters based on the low income country panel dataset, 1950-2002.

Cause-cluster	Sex	Age group	Regression coefficients						R ² (%)
			Constant	lnY	lnHC	(lnY) ²	Year	lnSI	
<i>Group I</i>									
	Male	0-4	14.463	-0.543	-1.113				65
		5-14	14.610	-0.849	-1.973				65
		15-29	12.697	-0.749	-1.472				58
		30-44	12.263	-0.691	-1.149				49
		45-59	12.197	-0.564	-0.991				50
		60-69	12.670	-0.449	-1.095				54
		70+	12.315	-0.209	-1.290				44
	Female	0-4	14.241	-0.557	-1.148				66
		5-14	14.000	-0.817	-1.970				66
		15-29	13.318	-0.713	-1.662				63
		30-44	13.731	-0.681	-1.680				64
		45-59	12.598	-0.576	-1.531				63
		60-69	12.771	-0.438	-1.552				61
		70+	11.936	-0.117	-1.624				48
<i>Malignant neoplasms</i>									
	Male	0-4	-4.886	1.589	0.392	-0.092			14
		5-14	-4.608	1.612		-0.094			7
		15-29	3.296	-0.061					6
		30-44	5.175	-0.128	-0.081			0.109	22
		45-59	5.819	-0.096	-0.102			0.201	35
		60-69	6.055		-0.067			0.178	34
		70+	2.000	1.081	-0.165	-0.055	-0.009	0.146	31
	Female	0-4	-5.658	1.724	0.322	-0.097			15
		5-14	-4.318	1.452	-0.059	-0.083			6
		15-29	-3.826	1.776	-0.181	-0.116			18
		30-44	-2.608	1.871	-0.145	-0.119			17
		45-59	-2.636	2.132	-0.047	-0.131	-0.010	0.021	17
		60-69	-3.453	2.459		-0.147	-0.011	0.019	19
		70+	-1.005	1.999	-0.190	-0.112	-0.014	0.076	30
<i>Cardiovascular diseases</i>									
	Male	0-4	-15.604	4.774	-0.835	-0.306	0.013		22
		5-14	6.284		-1.070	-0.032	-0.010		54
		15-29	-2.425	1.969	-0.592	-0.147			41
		30-44	6.385	-0.260	-0.221		0.006	0.099	17
		45-59	7.641	-0.248	-0.069		0.000	0.164	20
		60-69	8.906	-0.256			-0.003	0.152	19
		70+	9.772	-0.207	0.192		-0.002	0.073	12
	Female	0-4	-14.572	4.442	-0.702	-0.287	0.013		21
		5-14	8.531	-0.538	-1.044		-0.012		55
		15-29	-2.952	2.454	-0.900	-0.184	-0.009		61
		30-44	-3.924	2.617	-0.500	-0.185	-0.004		48
		45-59	0.084	1.772	-0.079	-0.129	-0.004		26
		60-69	8.495		0.077	-0.019	-0.006		20
		70+	9.261		0.190	-0.013		-0.071	16
<i>Digestive diseases</i>									
	Male	0-4	-10.378	4.523	-0.888	-0.307	-0.020		41
		5-14	-8.357	3.933	-1.295	-0.282	-0.018		63
		15-29	-4.100	2.537	-1.208	-0.186			55
		30-44	-0.693	1.434	-0.956	-0.105	0.016		32
		45-59	6.685	-0.201	-0.786		0.013		29
		60-69	1.403	1.376	-0.712	-0.097	0.006		32
		70+	8.806	-0.162	-0.817				37

Annex Table A-5 (continued): Parsimonious regression equations for nine major cause-clusters based on the low income country panel dataset, 1950-2002.

Cause-cluster	Sex	Age group	Regression coefficients						R ² (%)
			Constant	lnY	lnHC	(lnY) ²	Year	lnSI	
<i>Digestive diseases</i>									
	Female	0-4	-8.986	4.002	-0.929	-0.274	-0.015		38
		5-14	-8.933	3.929	-1.216	-0.280	-0.017		60
		15-29	-8.479	3.552	-1.205	-0.246	-0.004		56
		30-44	-1.514	1.796	-1.101	-0.132	0.003		45
		45-59	-4.351	2.604	-0.867	-0.178	0.005		37
		60-69	-3.199	2.575	-0.797	-0.175			40
		70+	8.431	-0.154	-0.871				35
<i>Respiratory diseases</i>									
	Male	0-4	8.275		-2.010	-0.027			46
		5-14	-10.871	4.119	-1.246	-0.296			53
		15-29	4.311	-0.351	-1.110		0.019		46
		30-44	4.905	-0.312	-0.812		0.014	0.031	33
		45-59	5.695	-0.269	-0.571		0.007	0.199	16
		60-69	14.297	-2.238	-0.431	0.121	0.009	0.207	16
		70+	16.495	-2.555	-0.398	0.142	0.015	0.134	20
	Female	0-4	7.940		-1.724	-0.033			43
		5-14	-12.653	4.656	-1.213	-0.337			58
		15-29	5.651	-0.508	-1.037		0.015		46
		30-44	12.313	-2.193	-0.971	0.110	0.019	-0.029	45
		45-59	11.488	-1.745	-0.841	0.085	0.017	0.037	40
		60-69	7.227	-0.357	-0.879		0.016	0.073	41
		70+	19.552	-3.093	-0.769	0.169	0.019		34
<i>Other Group II</i>									
	Male	0-4	8.903	-0.239	-0.658		-0.007		43
		5-14	7.933	-0.309	-0.748		-0.010		61
		15-29	7.454	-0.273	-0.727		0.001		51
		30-44	6.777	-0.168	-0.397		0.008		23
		45-59	7.398	-0.101			0.003		4
		60-69	8.141	0.023	0.028	-0.007	0.000		2
		70+	9.798	-0.084	-0.034				4
	Female	0-4	8.517	-0.229	-0.617		-0.007		41
		5-14	7.781	-0.307	-0.835		-0.009		60
		15-29	8.228	-0.331	-0.840		-0.004		60
		30-44	1.319	1.428	-0.582	-0.100	-0.003		49
		45-59	1.551	1.536	-0.299	-0.104	-0.003		31
		60-69	5.017	0.958	-0.218	-0.069	-0.004		29
		70+	10.506	-0.144	-0.245				17
<i>Road traffic accidents</i>									
	Male	0-4	-1.600	0.353	0.124		0.004		13
		5-14	-13.564	3.608	-0.276	-0.200			13
		15-29	-10.318	2.673	-0.170	-0.130	0.009		22
		30-44	-17.181	4.550	-0.423	-0.259	0.019		25
		45-59	-15.010	3.979	-0.418	-0.220	0.018		26
		60-69	-7.175	2.174	-0.540	-0.108	0.014		22
		70+	0.464	0.403	-0.540		0.013		16
	Female	0-4	-2.122	0.376	0.117		0.005		15
		5-14	-7.536	1.945	-0.243	-0.103	0.005		8
		15-29	-2.918	0.419	-0.123		0.018		23
		30-44	-1.470	0.247	-0.366		0.023		27
		45-59	-0.624	0.236	-0.409		0.019		21
		60-69	-0.059	0.276	-0.484		0.014		15
		70+	0.511	0.264	-0.346		0.011		9

Annex Table A-5 (continued): Parsimonious regression equations for nine major cause-clusters based on the low income country panel dataset, 1950-2002.

Cause-cluster	Sex	Age group	Regression coefficients						R ² (%)
			Constant	lnY	lnHC	(lnY) ²	Year	lnSI	
<i>Other unintentional injuries</i>									
	Male	0-4	5.553	-0.293	0.257				7
		5-14	6.628	-0.335	-0.332		-0.006		28
		15-29	-1.357	1.161	-0.341	-0.111	0.000		15
		30-44	-7.251	2.882	-0.187	-0.191	0.011		14
		45-59	-8.878	3.250	0.000	-0.213	0.010		12
		60-69	-4.818	2.352	-0.251	-0.152	0.008		10
		70+	1.000						
	Female	0-4	6.123	-0.385	0.229				11
		5-14	6.998	-0.475	-0.595				41
		15-29	4.424	0.000	-0.644	-0.027	0.009		35
		30-44	-4.979	2.070	-0.364	-0.149	0.014		25
		45-59	-5.366	2.130	-0.207	-0.147	0.013		18
		60-69	1.000						
		70+	1.000						
<i>Intentional injuries</i>									
	Male	0-4	1.000						
		5-14	-15.954	4.258	-0.584	-0.278	0.022		33
		15-29	4.003	0.000	-0.871	-0.017	0.027		25
		30-44	-7.348	2.770	-0.629	-0.183	0.025		22
		45-59	-8.132	2.976	-0.305	-0.191	0.014		11
		60-69	1.000						
		70+	1.000						
	Female	0-4	1.000						
		5-14	1.420		-0.792	-0.023	0.023		40
		15-29	-5.731	2.336	-0.311	-0.166	0.008		17
		30-44	2.551			-0.012	0.007		5
		45-59	1.000						
		60-69	1.000						
		70+	1.000						

Annex Table A-6: Results of regressions of age-sex-specific mortality for detailed causes on the respective cause cluster based on the full country panel dataset, 1950-2002. Results are shown only when the $r^2 \geq 0.25$ and the p value for beta is 0.001 or less.

Cause-cluster	Sex	Age group	R ² (%)	Constant	Beta
<i>Group I</i>					
Infectious and parasitic diseases	Male	0-4	88	-4.787	1.493
		5-14	92	-0.728	0.997
		15-29	91	-0.872	1.126
		30-44	93	-0.846	1.117
		45-59	90	-0.991	1.098
		60-69	82	-1.242	1.088
		70+	61	-0.752	0.887
Infectious and parasitic diseases	Female	0-4	89	-4.500	1.473
		5-14	92	-0.787	1.001
		15-29	90	-0.894	0.996
		30-44	92	-0.853	1.005
		45-59	92	-0.874	1.063
		60-69	86	-0.968	1.020
		70+	68	-1.028	0.899
Respiratory infections	Male	0-4	83	-4.625	1.476
		5-14	86	-0.808	0.936
		15-29	69	-0.644	0.763
		30-44	62	-0.485	0.741
		45-59	77	-0.354	0.826
		60-69	77	-0.018	0.834
		70+	90	-0.292	0.972
Respiratory infections	Female	0-4	85	-4.489	1.484
		5-14	86	-0.744	0.927
		15-29	77	-0.909	0.741
		30-44	76	-0.635	0.699
		45-59	83	-0.455	0.820
		60-69	85	-0.351	0.893
		70+	94	-0.237	0.970
Maternal conditions	Female	15-29	80	-1.593	1.097
30-44		80	-2.130	1.194	
45-59		63	-4.783	1.122	
Perinatal conditions	Male	0-4	73	1.619	0.609
Perinatal conditions	Female	0-4	66	1.745	0.556
Nutritional deficiencies	Male	0-4	59	-7.705	1.567
		5-14	76	-1.961	0.858
		15-29	49	-2.045	0.775
		30-44	41	-2.768	0.852
		45-59	55	-3.396	1.061
		60-69	68	-4.276	1.288
		70+	65	-5.227	1.360
Nutritional deficiencies	Female	0-4	59	-7.151	1.517
		5-14	77	-1.948	0.871
		15-29	73	-2.440	0.922
		30-44	80	-2.941	1.064
		45-59	83	-2.976	1.143
		60-69	80	-3.235	1.178
		70+	67	-3.733	1.156

Annex Table A-6 (continued): Results of regressions of age-sex-specific mortality for detailed causes on the respective cause cluster based on the full country panel dataset, 1950-2002. Results are shown only when the $r^2 \geq 0.25$ and the p value for beta is 0.001 or less.

Cause-cluster	Sex	Age group	R ² (%)	Constant	Beta
<i>Malignant neoplasms</i>					
Mouth and oropharynx cancers	Male	30-44	35	-3.887	1.270
		45-59	40	-3.556	1.102
Oesophagus cancer	Male	30-44	33	-3.625	1.032
		45-59	39	-3.443	1.051
Stomach cancer	Female	15-29	35	-3.672	1.416
Colon and rectum cancers	Male	15-29	26	-2.820	0.893
		30-44	41	-1.563	0.723
		45-59	51	-2.362	0.949
		60-69	60	-4.523	1.306
		70+	65	-6.086	1.511
Colon and rectum cancers	Female	15-29	35	-3.244	1.066
		45-59	34	-3.256	1.141
		60-69	43	-4.061	1.299
		70+	55	-4.089	1.307
Liver cancer	Female	15-29	37	-4.580	1.321
Pancreas cancer	Male	30-44	39	-2.843	0.900
		45-59	52	-2.851	0.957
		60-69	52	-3.790	1.106
		70+	57	-4.129	1.128
Pancreas cancer	Female	45-59	49	-5.473	1.401
		60-69	56	-4.601	1.270
		70+	63	-4.108	1.186
Trachea, bronchus and lung cancers	Male	30-44	52	-2.512	1.210
		45-59	78	-3.493	1.414
		60-69	77	-4.490	1.500
		70+	62	-3.858	1.316
Trachea, bronchus and lung cancers	Female	15-29	35	-3.701	1.172
		60-69	32	-3.292	1.169
		70+	33	-2.036	0.936
Melanoma and other skin cancers	Male	60-69	28	-5.409	1.112
		45-59	32	-8.409	1.772
		60-69	39	-7.872	1.538
Breast cancer	Female	15-29	27	-2.236	0.756
		45-59	31	-1.467	1.000
		60-69	35	-2.791	1.151
		70+	44	-3.168	1.143
Cervix uteri cancer	Female	30-44	34	-4.968	1.726
Corpus uteri cancer	Female	15-29	28	-4.455	1.515
Ovary cancer	Female	30-44	28	-3.164	1.072
		45-59	44	-4.772	1.420
		60-69	47	-5.865	1.510
		70+	49	-6.407	1.459
		15-29	27	-4.864	0.977
Prostate cancer	Male	70+	39	-4.678	1.370
		45-59	43	-3.822	0.977
Bladder cancer	Male	60-69	44	-4.062	1.084
		70+	43	-3.785	1.085
		60-69	26	-3.368	0.831
Bladder cancer	Female	70+	33	-2.406	0.793
		0-4	51	-2.537	1.226
		5-14	46	-2.112	1.146
Lymphomas and multiple myeloma	Male	30-44	29	-1.101	0.687
		70+	56	-6.194	1.352

Annex Table A-6 (continued): Results of regressions of age-sex-specific mortality for detailed causes on the respective cause cluster based on the full country panel dataset, 1950-2002. Results are shown only when the $r^2 \geq 0.25$ and the p value for beta is 0.001 or less.

Cause-cluster	Sex	Age group	R ² (%)	Constant	Beta
<i>Malignant neoplasms (continued)</i>					
Lymphomas and multiple myeloma	Female	0-4	37	-2.297	1.020
		5-14	32	-2.258	0.946
		15-29	29	-1.745	0.834
		30-44	27	-2.609	0.845
		60-69	32	-3.712	1.066
		70+	59	-7.336	1.585
Leukaemia	Male	0-4	65	-0.855	1.000
		5-14	60	-0.718	0.957
		15-29	41	-0.896	0.779
		60-69	31	-1.967	0.726
		70+	45	-5.786	1.273
		Leukaemia	Female	0-4	67
5-14	62			-0.754	0.986
15-29	52			-1.427	0.948
30-44	32			-2.001	0.748
70+	28			-4.085	1.045
Other malignant neoplasms	Male			0-4	57
		5-14	43	-0.463	0.718
		15-29	61	-0.959	1.023
		30-44	59	-1.238	1.030
		45-59	50	-0.487	0.839
		60-69	33	0.473	0.699
Other malignant neoplasms	Female	0-4	61	-0.436	0.830
		5-14	44	-0.427	0.742
		15-29	64	-1.123	1.021
		30-44	50	-2.409	1.218
		45-59	44	-2.968	1.283
		60-69	40	-2.444	1.173
		70+	43	-1.627	1.034
<i>Cardiovascular diseases</i>					
Rheumatic heart disease	Male	0-4	35	-3.024	0.782
		5-14	42	-1.671	0.841
		15-29	33	-2.940	1.140
		30-44	45	-4.811	1.305
		45-59	48	-6.540	1.375
		60-69	37	-5.425	1.054
Rheumatic heart disease	Female	0-4	28	-2.758	0.714
		5-14	42	-1.581	0.843
		15-29	44	-2.365	1.105
		30-44	42	-3.176	1.173
		45-59	44	-3.654	1.082
		60-69	28	-2.513	0.754
Hypertensive heart disease	Male	0-4	41	-3.566	0.903
		5-14	47	-3.050	0.707
		15-29	52	-3.703	1.102
		30-44	44	-4.046	1.178
		45-59	32	-4.120	1.136
		Hypertensive heart disease	Female	0-4	48
5-14	41			-2.750	0.663
15-29	71			-3.738	1.244
30-44	69			-4.622	1.500
45-59	59			-5.135	1.445
60-69	37			-4.845	1.285

Annex Table A-6 (continued): Results of regressions of age-sex-specific mortality for detailed causes on the respective cause cluster based on the full country panel dataset, 1950-2002. Results are shown only when the $r^2 \geq 0.25$ and the p value for beta is 0.001 or less.

Cause-cluster	Sex	Age group	R ² (%)	Constant	Beta
<i>Cardiovascular disease (continued)</i>					
Ischaemic heart disease	Male	0-4	56	-3.280	1.062
		5-14	47	-2.579	0.907
		15-29	54	-1.455	0.959
		30-44	61	-0.850	1.004
		45-59	62	-1.027	1.053
		60-69	55	-1.416	1.088
		70+	37	-1.773	1.089
Ischaemic heart disease	Female	0-4	60	-3.565	1.139
		5-14	47	-2.657	0.886
		15-29	64	-2.212	1.057
		30-44	60	-1.291	0.936
		45-59	59	-0.814	0.934
		60-69	54	-0.862	0.976
		70+	30	-1.541	1.043
Cerebrovascular disease	Male	0-4	63	-1.357	0.802
		5-14	76	-1.260	0.906
		15-29	71	-1.238	0.883
		30-44	73	-1.607	0.986
		45-59	65	-2.313	1.119
		60-69	63	-2.563	1.152
		70+	59	-1.535	1.020
Cerebrovascular disease	Female	0-4	63	-1.501	0.819
		5-14	76	-1.202	0.821
		15-29	71	-0.785	0.726
		30-44	79	-0.664	0.837
		45-59	82	-1.530	1.068
		60-69	77	-2.016	1.118
		70+	59	-1.068	0.978
Other cardiac diseases	Male	0-4	96	-0.199	0.986
		5-14	91	-0.478	0.966
		15-29	70	-0.512	0.858
Other cardiac diseases	Female	0-4	49	-0.545	0.781
		5-14	96	-0.171	0.983
		15-29	91	-0.510	0.978
		30-44	80	-0.649	0.916
		30-44	68	-1.109	0.952
		45-59	31	0.090	0.655
<i>Digestive diseases</i>					
Peptic ulcer	Male	0-4	68	-3.407	0.847
		5-14	56	-3.029	0.890
		15-29	70	-2.377	1.040
		30-44	45	-2.400	0.943
		45-59	41	-1.703	0.820
		60-69	37	-0.910	0.744
		70+	36	-0.309	0.727
Peptic ulcer	Female	0-4	40	-2.715	0.532
		15-29	71	-2.799	1.054
		30-44	56	-2.843	0.975
		45-59	47	-2.403	0.871
		60-69	43	-1.738	0.821
		70+	44	-1.691	0.921

Annex Table A-6 (continued): Results of regressions of age-sex-specific mortality for detailed causes on the respective cause cluster based on the full country panel dataset, 1950-2002. Results are shown only when the $r^2 \geq 0.25$ and the p value for beta is 0.001 or less.

Cause-cluster	Sex	Age group	R² (%)	Constant	Beta		
<i>Digestive diseases (continued)</i>							
Cirrhosis of the liver	Male	5-14	36	-1.584	0.634		
		15-29	50	-1.260	0.875		
		30-44	79	-1.062	1.005		
		45-59	89	-0.730	1.044		
		60-69	90	-0.895	1.090		
Cirrhosis of the liver	Female	70+	83	-1.732	1.208		
		5-14	52	-2.703	1.247		
		15-29	35	-1.422	0.573		
		30-44	48	-1.195	0.802		
		45-59	67	-1.067	0.920		
Appendicitis	Male	60-69	77	-0.651	0.984		
		70+	82	-0.928	1.078		
		5-14	74	-1.406	1.126		
		15-29	28	-1.107	0.901		
		30-44	72	-1.638	0.824		
Appendicitis	Female	60-69	57	-2.739	0.937		
		70+	25	-3.435	0.754		
		5-14	28	-4.298	0.927		
		15-29	31	-4.144	0.945		
		30-44	66	-1.629	0.781		
Other digestive diseases	Male	45-59	73	-2.736	1.122		
		60-69	45	-3.935	1.081		
		70+	37	-4.757	1.100		
		0-4	43	-5.754	1.292		
		5-14	36	-4.817	1.035		
Other digestive diseases	Female	15-29	99	-0.122	1.004		
		30-44	89	-0.490	0.969		
		45-59	85	-0.519	0.883		
		60-69	76	-0.740	0.859		
		70+	62	-0.442	0.788		
Other digestive diseases	Male	0-4	45	0.397	0.692		
		5-14	50	-0.303	0.922		
		15-29	99	-0.142	1.009		
		30-44	90	-0.490	1.004		
		45-59	85	-0.509	0.912		
Other digestive diseases	Female	60-69	69	-0.629	0.857		
		70+	57	-0.187	0.744		
		<i>Respiratory diseases</i>					
		Other respiratory diseases	Male	0-4	84	0.007	0.772
				5-14	81	-0.642	0.993
15-29	82			-0.779	1.226		
30-44	85			-0.962	1.172		
45-59	62			-1.405	1.106		
Other respiratory diseases	Female	60-69	27	-0.647	0.871		
		0-4	84	-0.001	0.753		
		5-14	83	-0.595	0.943		
		15-29	84	-0.776	1.159		
		30-44	83	-0.965	1.130		
Other respiratory diseases	Male	45-59	66	-1.671	1.204		
		60-69	51	-1.995	1.178		
		70+	51	-2.830	1.281		

Annex Table A-6 (continued): Results of regressions of age-sex-specific mortality for detailed causes on the respective cause cluster based on the full country panel dataset, 1950-2002. Results are shown only when the $r^2 \geq 0.25$ and the p value for beta is 0.001 or less.

Cause-cluster	Sex	Age group	R² (%)	Constant	Beta	
<i>Other Group II</i>						
Endocrine disorders	Male	0-4	39	-3.682	1.131	
Endocrine disorders	Female	0-4	44	-4.228	1.249	
		15-29	31	-3.298	0.984	
		30-44	37	-6.435	1.484	
Neuro-psychiatric conditions		Male	0-4	40	-1.542	0.789
	Female	5-14	56	-1.323	0.883	
		15-29	47	-1.102	0.803	
		30-44	44	-2.821	1.039	
Neuro-psychiatric conditions		Female	0-4	41	-1.576	0.787
	Male	5-14	53	-1.111	0.791	
		15-29	65	-1.480	0.823	
		30-44	53	-2.952	0.997	
Genito-urinary diseases		Male	0-4	45	-5.760	1.363
	Female	5-14	60	-5.337	1.717	
		15-29	57	-5.946	1.740	
		30-44	57	-6.471	1.549	
		45-59	35	-6.084	1.300	
Genito-urinary diseases	Female	0-4	45	-5.771	1.367	
	Male	5-14	63	-4.676	1.585	
		15-29	75	-5.737	1.828	
		30-44	68	-8.100	2.005	
		45-59	51	-7.524	1.611	
Musculo-skeletal diseases	Male	60-69	30	-4.452	1.074	
	Female	0-4	39	-5.960	0.947	
		5-14	44	-4.558	0.865	
Musculo-skeletal diseases	Female	5-14	33	-3.239	0.621	
Congenital anomalies	Male	0-4	33	1.581	0.542	
Congenital anomalies	Female	0-4	29	1.673	0.509	
<i>Other unintentional injuries</i>						
Poisonings	Male	0-4	45	-3.538	1.191	
		30-44	33	-3.345	1.148	
		45-59	44	-4.928	1.483	
		60-69	37	-4.755	1.417	
Poisonings	Female	0-4	46	-3.233	1.170	
		30-44	37	-2.908	1.234	
		45-59	47	-3.988	1.533	
		60-69	30	-4.049	1.423	
Falls	Male	0-4	50	-1.968	0.743	
		5-14	47	-2.714	0.929	
		30-44	32	-2.356	0.817	
		45-59	40	-1.294	0.692	
		60-69	37	-0.614	0.637	
	Female	70+	28	-0.007	0.593	
Falls		Female	0-4	41	-1.758	1.100
		5-14	55	-2.202	0.780	
		30-44	35	-2.796	0.871	
		45-59	36	-2.079	0.744	
	70+	26	-0.884	0.539		
Fires	Male	0-4	51	-2.195	0.952	
		5-14	33	-2.589	0.770	
		30-44	51	-3.147	0.879	
		45-59	56	-3.477	0.983	
	60-69	48	-3.310	0.997		

Annex Table A-6 (continued): Results of regressions of age-sex-specific mortality for detailed causes on the respective cause cluster based on the full country panel dataset, 1950-2002. Results are shown only when the $r^2 \geq 0.25$ and the p value for beta is 0.001 or less.

Cause-cluster	Sex	Age group	R ² (%)	Constant	Beta
<i>Other unintentional injuries (continued)</i>					
Fires	Female	0-4	55	-2.094	0.961
		5-14	29	-2.113	0.771
		30-44	30	-2.554	0.896
		45-59	44	-2.729	0.913
		60-69	37	-3.129	1.056
Drownings	Male	0-4	66	-1.677	1.005
		5-14	67	-2.383	1.280
		15-29	40	-3.347	1.231
		30-44	70	-3.757	1.275
		45-59	68	-3.433	1.164
Drownings	Female	60-69	66	-3.902	1.235
		0-4	64	-1.870	1.014
		5-14	65	-2.849	1.459
		15-29	33	-3.897	1.445
		30-44	68	-4.075	1.415
Other unintentional injuries	Male	45-59	67	-3.683	1.217
		60-69	36	-3.368	1.079
		0-4	83	-1.029	1.034
		5-14	73	-1.726	1.116
		15-29	52	-2.240	1.181
Other unintentional injuries	Female	30-44	76	-1.660	1.091
		45-59	77	-1.474	1.060
		60-69	72	-1.818	1.130
		70+	42	-1.328	0.979
		0-4	85	-1.008	1.043
Other unintentional injuries	Female	5-14	68	-2.009	1.220
		15-29	39	-2.059	1.144
		30-44	71	-2.111	1.256
		45-59	72	-1.797	1.154
		60-69	61	-2.100	1.216
<i>Intentional injuries</i>					
Self-inflicted injuries	Male	5-14	38	-0.413	0.692
		15-29	27	1.103	0.534
		30-44	36	0.765	0.665
		45-59	37	0.777	0.691
		60-69	56	0.313	0.853
		70+	51	-0.850	0.838
Self-inflicted injuries	Female	5-14	65	-0.106	0.842
		15-29	51	-0.063	0.817
		30-44	58	-0.205	0.936
		45-59	73	-0.418	1.061
		60-69	79	-0.504	1.082
		70+	90	0.043	0.886
Homicide	Male	0-4	57	-0.721	0.947
		5-14	63	-2.629	1.385
		15-29	57	-2.605	1.325
		30-44	44	-2.439	1.217
		45-59	37	-2.881	1.296
Homicide	Female	60-69	81	0.082	0.785
		0-4	70	-0.456	0.813
		5-14	51	-1.290	1.006
		15-29	41	-1.237	0.989
		30-44	27	-8.052	2.039
War	Male	45-59	46	-11.311	3.022
		60-69	30	-11.546	2.664
		70+	38	-0.413	0.692

Annex Table A-7: Results of log-linear Poisson regressions for deaths due to selected causes, by age and sex, for countries with complete death registration data and population over 5 million. Results are shown only when the p value for beta is 0.001 or less.

WHO Region			Beta						WHO Region			Beta					
Country	Sex	Age	TB	IHD	Stroke	Suicide	Homicide	Country	Sex	Age	TB	IHD	Stroke	Suicide	Homicide		
<i>AMRO Region</i>								Chile	M	0-4						1	
Argentina	M	0-4	0.92				1			5-14						1	
		5-14	0.93				1			15-29	0.9			0.99		1	
		15-29	0.94	0.97	0.97	1.06	1.05			30-44	0.93		0.98	1	0.98		
		30-44	0.94	0.97	0.97	1.02	1.01			45-59	0.94	0.99	0.96	1	0.95		
		45-59	0.94	1.02	0.98	1.01	1			60-69	0.95	0.98	0.96	0.97	0.94		
		60-69	0.96	1.03	0.98	1	1			70-79	1	0.98	0.98	1	0.93		
		70-79	0.96	1.04	0.98	1	1			80+	1	0.98	0.98	1	0.93		
		80+	0.96	1.04	0.98	1	1	Chile	F	0-4						1	
Argentina	F	0-4	0.94				1			5-14						1	
		5-14	0.94				1			15-29	0.89			1	1		
		15-29	0.94	0.94	0.97	1	1			30-44	0.9		0.98	1	1		
		30-44	0.93	0.97	0.96	0.98	1			45-59	0.94	0.98	0.96	1	1		
		45-59	0.95	1.03	0.97	1	1			60-69	1	0.98	0.95	1	1		
		60-69	0.96	1.04	0.97	0.96	1			70-79	1.03	0.96	0.98	1	1		
		70-79	0.96	1.02	0.97	0.96	1			80+	1.03	0.96	0.98	1	1		
		80+	0.96	1.02	0.97	0.96	1	Colombia	M	0-4	0.92					1.07	
Brazil	M	0-4	0.89				1.04			5-14	0.88					1	
		5-14	0.93				1.04			15-29	0.94	0.96	0.96	1.05	1		
		15-29	0.96	0.97	0.96	1.01	1.04			30-44	0.95	0.97	0.97	1.05	0.98		
		30-44	0.98	0.97	0.95	1.01	1.01			45-59	0.95	0.97	0.96	1.04	0.98		
		45-59	0.98	0.99	0.96	1.01	1.01			60-69	0.96	1	0.98	1.06	1		
		60-69	1	1.01	0.97	1.02	1.01			70-79	0.96	1	0.98	1.07	1		
		70-79	1	1	0.98	1	1.01			80+	0.96	1	0.98	1.07	1		
		80+	1	1	0.98	1	1.01	Colombia	F	0-4	0.9					1.07	
Brazil	F	0-4	0.9				1.03			5-14	0.92					1	
		5-14	0.94				1.05			15-29	0.94	0.96	0.96	1.07	1		
		15-29	0.96	0.97	0.96	0.99	1.03			30-44	0.92	0.96	0.96	1.06	0.99		
		30-44	0.98	0.98	0.96	1	1.02			45-59	0.92	0.96	0.95	1.06	1		
		45-59	0.98	1	0.97	1	1.02			60-69	0.96	1	0.99	1	1		
		60-69	1	1.01	0.97	0.97	1			70-79	0.95	0.99	0.98	1	1		
		70-79	1	0.99	0.97	1	1			80+	0.95	0.99	0.98	1	1		
		80+	1	0.99	0.97	1	1	Cuba	M	0-4						1	
Canada	M	0-4					1			5-14						1	
		5-14					1			15-29				1	0.94		
		15-29		0.95	0.94	0.98	1			30-44		0.96	0.96	0.98	0.98	0.97	
		30-44	1	0.96	0.96	1	0.98			45-59		0.98	0.98	0.98	0.98	0.95	
		45-59	0.91	0.95	0.96	1	0.95			60-69		0.98	0.99	0.96	0.93		
		60-69	0.95	0.95	0.97	0.98	1			70-79	0.94	0.98		0.96	1		
		70-79	0.96	0.97	0.98	0.98	1			80+	0.94	0.98		0.96	1		
		80+	0.96	0.97	0.98	0.98	1	Cuba	F	0-4						1	
Canada	F	0-4					1			5-14						1	
		5-14					1			15-29				0.88	0.96		
		15-29			0.94	1	0.94			30-44		0.94	0.96	0.91	1		
		30-44	1		0.96	1	0.96			45-59		0.97	0.97	0.92	1		
		45-59	1	0.95	0.96	1	0.94			60-69		0.98	0.99	0.93	1		
		60-69	1	0.95	0.97	0.97	1			70-79		0.98		0.92	1		
		70-79	0.97	0.97	0.99	0.97	1			80+		0.98		0.92	1		
		80+	0.97	0.97	0.99	0.97	1										

Annex Table A-7 (continued)

WHO Region			Beta					Homi- cide
Country	Sex	Age	TB	IHD	Stroke	Suicide		
Ecuador	M	0-4	0.92				1	
		5-14	0.94				1	
		15-29	0.98	1.03			1.05	
		30-44	0.97		0.97		1.04	
		45-59	0.95	1.03	0.96		1.03	
		60-69	0.95	1.05	0.95		1	
		70-79	0.97	1.04	0.96		1	
		80+	0.97	1.04	0.96		1	
Ecuador	F	0-4	0.92				1	
		5-14	0.92				1	
		15-29	0.95				1.04	
		30-44	0.94		0.96		1	
		45-59	0.94	1	0.96		1	
		60-69	0.97	1.04	0.96		1	
		70-79	0.94	1.02	0.95		1	
		80+	0.94	1.02	0.95		1	
El Salvador	M	0-4						
		5-14						
		15-29			0.92	0.95		
		30-44	1		0.92	0.95	0.98	
		45-59	1	1.06	0.93	1		
		60-69	0.87	1.06	0.93	1		
		70-79	0.94	1.08	0.91	0.9		
		80+	0.94	1.08	0.91	0.9		
El Salvador	F	0-4						
		5-14						
		15-29			0.85	0.93		
		30-44	1		0.92	0.93	1	
		45-59	0.88	1.05	0.9	1		
		60-69	0.91	1.08	0.9	1		
		70-79	0.85	1.05	0.88	1		
		80+	0.85	1.05	0.88	1		
Guatemala	M	0-4	0.91					
		5-14	0.89					
		15-29	0.93		1.09		1	
		30-44	0.92		1.06		1	
		45-59	0.9		1.04		1.01	
		60-69	0.89		1.03			
		70-79	0.92		1.04			
		80+	0.92		1.04			
Guatemala	F	0-4	0.91					
		5-14	0.9					
		15-29	0.9		1.05		0.97	
		30-44	0.9		1.03		0.97	
		45-59	0.9		1.03		1	
		60-69	0.9		1.03			
		70-79	0.88		1.03			
		80+	0.88		1.03			
Mexico	M	0-4	0.86				0.96	
		5-14	0.88			0.95	0.97	
		15-29	0.94			0.99	1.05	0.95
		30-44	0.93	1		0.99	1.03	0.95
		45-59	0.92	1		0.99	1.02	0.94
		60-69	0.93	1.01		0.99	1	0.94
		70-79	0.93	1.02		0.99	1	0.95
		80+	0.93	1.02		0.99	1	0.95
Mexico	F	0-4	0.83				0.97	
		5-14	0.89			0.95	0.97	
		15-29	0.92	0.98		0.95	1.05	0.98
		30-44	0.91	0.99		0.96	1.03	0.97
		45-59	0.92	1.01		0.98	1.03	0.96
		60-69	0.93	1.02		0.99	1	0.96
		70-79	0.93	1.02		0.99	1	0.96
		80+	0.93	1.02		0.99	1	0.96
USA	M	0-4					1	
		5-14					0.97	
		15-29	0.9			0.98	0.98	0.98
		30-44	0.89	0.99		0.98	1	0.95
		45-59	0.91	0.98		0.98	0.99	0.95
		60-69	0.92	0.98		0.98	0.97	0.95
		70-79	0.93	0.99		0.99	0.97	0.95
		80+	0.93	0.99		0.99	0.97	0.95
USA	F	0-4					1	
		5-14					0.97	
		15-29	0.91			0.97	0.98	0.96
		30-44	0.9	1.01		0.99	0.99	0.97
		45-59	0.92	0.98		0.98	0.99	0.97
		60-69	0.92	0.98		0.99	0.96	0.96
		70-79	0.95	1		0.99	0.96	0.95
		80+	0.95	1		0.99	0.96	0.95
Venezuela	M	0-4					1	
		5-14					1.04	
		15-29				0.97	1.03	1.09
		30-44	0.97	1.01		0.99	1.03	1.08
		45-59	0.96	0.99		0.98	1	1.06
		60-69	0.97	1		0.99	1	1.04
		70-79	0.96	1		0.98	1	1.08
		80+	0.96	1		0.98	1	1.08
Venezuela	F	0-4					1	
		5-14					1.06	
		15-29				0.97	1	1.07
		30-44	0.96	1		0.99	1	1.04
		45-59	0.93	1		0.97	1	1.11
		60-69	0.96	1		0.98	1	1
		70-79	0.96	1		0.98	1	1
		80+	0.96	1		0.98	1	1

Annex Table A-7 (continued)

WHO Region			Beta					Homicide
Country	Sex	Age	TB	IHD	Stroke	Suicide		
<i>EURO Region</i>								
Austria	M	0-4						
		5-14						
		15-29					0.98	
		30-44	0.92	0.97	0.96	0.97	0.93	
		45-59	0.9	0.97	0.96	0.98		
		60-69	0.88	0.96	0.95	0.98		
		70-79	0.9	0.99	0.95	0.98		
		80+	0.9	0.99	0.95	0.98		
Austria	F	0-4						
		5-14						
		15-29					0.96	
		30-44	1	1	1	0.97	1	
		45-59	1	0.98	0.98	0.97		
		60-69	1	0.96	0.95	0.96		
		70-79	0.92	1	0.96	0.97		
		80+	0.92	1	0.96	0.97		
Belarus	M	0-4						
		5-14						
		15-29	1.14				1.06	1.01
		30-44	1.1	1.02	1.03	1.04	1.05	
		45-59	1.07	1.02	1.02	1.04	1.07	
		60-69	1.04	1.04	1.03	1.05	1.07	
		70-79	0.97	1	1	1.05	1.06	
		80+	0.97	1	1	1.05	1.06	
Belarus	F	0-4						
		5-14						
		15-29					1.03	1.07
		30-44	1.1	1.04	1.03	1.02	1.03	
		45-59	1	1.02	1.02	1	1.06	
		60-69	1	1.03	1.02	1	1.06	
		70-79	0.96	1	1	1	1.06	
		80+	0.96	1	1	1	1.06	
Bulgaria	M	0-4						
		5-14						
		15-29					1	0.97
		30-44	1	0.99	0.98	1	1	
		45-59	1	1	0.99	1.01	1	
		60-69	1	0.99	0.99	1	1	
		70-79	1	0.98	0.98	0.99	1	
		80+	1	0.98	0.98	0.99	1	
Bulgaria	F	0-4						
		5-14						
		15-29					1	1
		30-44	1	1	0.98	1	1	
		45-59	1	1	0.98	1	1	
		60-69	1	0.99	0.98	0.97	1	
		70-79	1	0.97	0.98	0.98	0.95	
		80+	1	0.97	0.98	0.98	0.95	
<i>Other Regions</i>								
Czech Republic	M	0-4						
		5-14						
		15-29				0.94	1	1
		30-44	1	0.93	0.93	0.99	1	
		45-59	1	0.96	0.95	1	1	
		60-69	0.93	0.96	0.95	0.96	1	
		70-79	0.93	0.97	0.96	0.96	0.92	
		80+	0.93	0.97	0.96	0.96	0.92	
Czech Republic	F	0-4						
		5-14						
		15-29					0.96	0.95
		30-44	1	0.94	0.95	0.96	1	
		45-59	1	0.96	0.95	0.96	1	
		60-69	0.91	0.96	0.94	0.94	1	
		70-79	0.93	0.97	0.97	0.93	1	
		80+	0.93	0.97	0.97	0.93	1	
Denmark	M	0-4						
		5-14						
		15-29					0.98	1
		30-44			0.94		0.96	1
		45-59	1	0.93	0.97	0.95	1	
		60-69	1	0.94	0.98	0.95		
		70-79	1	0.96	0.99	0.97		
		80+	1	0.96	0.99	0.97		
Denmark	F	0-4						
		5-14						
		15-29					0.94	1
		30-44			1		0.91	1
		45-59	1	0.92	0.97	0.92	1	
		60-69	1	0.94	0.98	0.92		
		70-79	1	0.96	0.99	0.93		
		80+	1	0.96	0.99	0.93		
Finland	M	0-4						
		5-14						
		15-29					0.97	1
		30-44			0.94	0.96	0.98	0.97
		45-59	0.91	0.94	0.96	0.97	1	
		60-69	0.92	0.95	0.96	0.98		
		70-79	1	0.98	0.96	0.97		
		80+	1	0.98	0.96	0.97		
Finland	F	0-4						
		5-14						
		15-29					1	1
		30-44			1	1	1	1
		45-59	1	0.95	0.97	1	1	
		60-69	1	0.93	0.95	1		
		70-79	0.97	0.99	0.97	1		
		80+	0.97	0.99	0.97	1		

Annex Table A-7 (continued)

WHO Region			Beta					Homicide		
Country	Sex	Age	TB	IHD	Stroke	Suicide				
France	M	0-4								
		5-14								
		15-29					0.98	0.96		
		30-44	0.94	0.98	0.97	0.99	0.98	0.96		
		45-59	0.92	0.97	0.96	0.98	0.98	0.96		
		60-69	0.94	0.97	0.96	0.97	0.97	1		
		70-79	0.97	0.98	0.95	0.97	0.97	1		
80+	0.97	0.98	0.95	0.97	0.97	1				
France	F	0-4								
		5-14								
		15-29					0.97	0.96		
		30-44	0.91	1	0.97	0.98	0.98	0.96		
		45-59	0.9	0.96	0.96	0.98	0.98	1		
		60-69	0.94	0.96	0.96	0.97	0.97	1		
		70-79	1	0.98	0.96	0.96	0.96	0.96		
80+	1	0.98	0.96	0.96	0.96	0.96				
Germany	M	0-4								
		5-14								
		15-29					0.98	0.95		
		30-44	0.93	0.97	0.97	0.98	0.98	0.93		
		45-59	0.9	0.96	0.96	0.98	0.98	0.93		
		60-69	0.86	0.95	0.95	0.98	0.98	0.93		
		70-79	0.9	0.97	0.94	0.96	0.96	0.93		
80+	0.9	0.97	0.94	0.96	0.96	0.93				
Germany	F	0-4								
		5-14								
		15-29					0.97	0.95		
		30-44	0.91	1	0.96	0.97	0.97	0.95		
		45-59	0.91	0.96	0.96	0.96	0.96	0.97		
		60-69	0.9	0.95	0.94	0.96	0.96	0.98		
		70-79	0.93	1	0.96	0.95	0.95	1		
80+	0.93	1	0.96	0.95	0.95	1				
Greece	M	0-4								
		5-14								
		15-29					1	1		
		30-44	1	1			1	1		
		45-59	0.93	1	0.98		1	1		
		60-69	0.9	0.98	0.98		1			
		70-79	0.91	0.98	0.98		0.96			
80+	0.91	0.98	0.98		0.96					
Greece	F	0-4								
		5-14								
		15-29					1	1		
		30-44	1	1			1	1		
		45-59	1	1	0.97		0.96	1		
		60-69	1	0.98	0.96		1			
		70-79	0.9	0.99	0.98		0.94			
80+	0.9	0.99	0.98		0.94					
Hungary	M	0-4								
		5-14								
		15-29					0.93	0.94	0.97	0.95
		30-44	0.97	0.96	0.97	0.98	0.98	1		
		45-59	0.95	0.98	0.97	0.98	0.98	1		
		60-69	0.92	0.99	0.98	0.97	0.97	0.95		
		70-79	0.93	1.01	0.98	0.97	0.97	0.95		
80+	0.93	1.01	0.98	0.97	0.97	0.95				
Hungary	F	0-4								
		5-14								
		15-29					0.95	0.94	1	
		30-44	1	0.98	0.96	0.95	0.95	1		
		45-59	0.94	0.98	0.97	0.96	0.96	1		
		60-69	0.91	0.99	0.97	0.94	0.94	1		
		70-79	0.93	1.01	0.98	0.95	0.95	1		
80+	0.93	1.01	0.98	0.95	0.95	1				
Israel	M	0-4								
		5-14								
		15-29						1.03		
		30-44						1		
		45-59	1	0.93	0.95		1			
		60-69	1	0.94	0.96		1			
		70-79	1	0.97	0.96		1			
80+	1	0.97	0.96		1					
Israel	F	0-4								
		5-14								
		15-29						1		
		30-44						1		
		45-59	1	0.9	0.92		0.94			
		60-69	1	0.93	0.94		1			
		70-79	1	0.97	0.95		0.95			
80+	1	0.97	0.95		0.95					
Italy	M	0-4								
		5-14								
		15-29					0.97	1.01	0.95	
		30-44	0.93	0.95	0.96		1	0.92		
		45-59	0.89	0.96	0.95		0.99	0.93		
		60-69	0.9	0.96	0.95		0.98	0.95		
		70-79	0.94	0.99	0.96		0.97	0.96		
80+	0.94	0.99	0.96		0.97	0.96				
Italy	F	0-4								
		5-14								
		15-29						1	1	
		30-44	1	0.96	0.97		1	1		
		45-59	0.93	0.96	0.95		0.97	1		
		60-69	0.92	0.96	0.94		0.97	1		
		70-79	0.96	0.99	0.97		0.96	0.95		
80+	0.96	0.99	0.97		0.96	0.95				

Annex Table A-7 (continued)

WHO Region			Beta					Homi-
Country	Sex	Age	TB	IHD	Stroke	Suicide	cide	
Kazakhstan	M	0-4	1.11		1.12		1.1	
		5-14	1.09				1.05	
		15-29	1.07			1.07	1.02	
		30-44	1.06	1.03	1.04	1.07	1.03	
		45-59	1.05	1.02	1.02	1.07	1.06	
		60-69	1.02	1.03	1.02	1.08	1.07	
		70-79	1	1.01	1	1.04	1.08	
		80+	1	1.01	1	1.04	1.08	
Kazakhstan	F	0-4	1.09		1.19		1.1	
		5-14	1.09				1.1	
		15-29	1.09			1.05	1.05	
		30-44	1.1	1.05	1.03	1.06	1.05	
		45-59	1.06	1.02	1.01	1	1.07	
		60-69	1.03	1.03	1.02	1.02	1.11	
		70-79	1	1.02	1.01	1	1.1	
		80+	1	1.02	1.01	1	1.1	
Netherlands	M	0-4						
		5-14						
		15-29				1	1	
		30-44		0.97	0.97	1	1	
		45-59	1	0.95	0.98	1	1	
		60-69	0.89	0.95	0.98	0.98		
		70-79	0.96	0.97	0.98	0.97		
		80+	0.96	0.97	0.98	0.97		
Netherlands	F	0-4						
		5-14						
		15-29				1	1.06	
		30-44		1	1	0.98	1	
		45-59	1	0.96	1	1	1	
		60-69	1	0.97	0.99	0.97		
		70-79	0.96	0.98	0.99	0.97		
		80+	0.96	0.98	0.99	0.97		
Poland	M	0-4						
		5-14						
		15-29			0.98	1.01	0.98	
		30-44	0.98	0.95	0.99	1	0.97	
		45-59	0.95	0.98	0.99	1.01	0.98	
		60-69	0.94	1.02	1.02	1.01		
		70-79	0.93	1.08	1.03	1		
		80+	0.93	1.08	1.03	1		
Poland	F	0-4						
		5-14						
		15-29			0.96	1	1	
		30-44	0.96	0.95	0.99	0.99	0.96	
		45-59	0.94	0.98	0.99	1.01	0.97	
		60-69	0.92	1.02	1	1	0.97	
		70-79	0.95	1.1	1.03	1	0.94	
		80+	0.95	1.1	1.03	1	0.94	
Portugal	M	0-4						
		5-14						
		15-29					0.98	1
		30-44			1		1	1
		45-59	0.95	0.98	0.96	0.97	0.96	
		60-69	0.94	0.98	0.96	1	0.95	
		70-79	0.98	1	0.96	1		
		80+	0.98	1	0.96	1		
Portugal	F	0-4						
		5-14						
		15-29					0.93	1
		30-44		0.97			0.97	1
		45-59	1	0.98	0.95	0.97	1	
		60-69	0.95	0.97	0.95	1	1	
		70-79	1	1	0.96	1		
		80+	1	1	0.96	1		
Romania	M	0-4						
		5-14						
		15-29					1.01	0.95
		30-44		0.99			1.02	0.97
		45-59	1.02	1.01	1	1.03	0.97	
		60-69	1.05	1.02	1.01	1.02		
		70-79	1.07	1.02	1	1		
		80+	1.07	1.02	1	1		
Romania	F	0-4						
		5-14						
		15-29					0.96	1
		30-44	1.02	1			0.97	0.96
		45-59	1.04	1.01	0.99	1	1	
		60-69	1.06	1.01	1	1		
		70-79	1.09	1.01	1	1		
		80+	1.09	1.01	1	1		
Russian Federation	M	0-4	1.09		1.11		1.13	
		5-14	1.09		1.06		1.05	
		15-29	1.1	1.03	1.03	1.03	1.01	
		30-44	1.08	1.02	1.05	1.01	1.02	
		45-59	1.07	1.01	1.01	1	1.05	
		60-69	1.03	1.03	1.03	1	1.05	
		70-79	0.98	1	1	0.99	1.04	
		80+	0.98	1	1	0.99	1.04	
Russian Federation	F	0-4	1.11		1.09		1.12	
		5-14	1.12		1.05		1.05	
		15-29	1.12	1.04	1.01	1.02	1.04	
		30-44	1.13	1.04	1.04	1	1.02	
		45-59	1.1	1.01	1.01	0.97	1.03	
		60-69	1.02	1.01	1.01	0.97	1.04	
		70-79	0.96	1	1.01	0.98	1.03	
		80+	0.96	1	1.01	0.98	1.03	

Annex Table A-7 (continued)

WHO Region			Beta					Homicide	
Country	Sex	Age	TB	IHD	Stroke	Suicide			
Slovakia	M	0-4							
		5-14							
		15-29						1	
		30-44			0.94	0.95		1	
		45-59		1	0.95	0.94		1	
		60-69		1	0.98	0.97			
		70-79		0.85	1.01	0.99			
		80+	0.85	1.01	0.99				
Slovakia	F	0-4							
		5-14							
		15-29						1	
		30-44			1	0.91		1	
		45-59		1	0.94	0.92		1	
		60-69		1	0.97	0.94			
		70-79		0.91	1.02	0.98			
		80+	0.91	1.02	0.98				
Spain	M	0-4							
		5-14							
		15-29		0.89				1	
		30-44		0.89	0.98	0.97	1.02	1	
		45-59		0.91	0.99	0.96	0.99	1	
		60-69		0.91	0.99	0.96	1		
		70-79		0.94	1.01	0.96	0.99		
		80+	0.94	1.01	0.96	0.99			
Spain	F	0-4							
		5-14							
		15-29		0.92				1	
		30-44		0.93	1	0.98	1.02	1	
		45-59		0.94	0.99	0.96	1	1	
		60-69		0.93	0.99	0.95	0.98		
		70-79		0.96	1.02	0.96	0.98		
		80+	0.96	1.02	0.96	0.98			
Sweden	M	0-4							
		5-14							
		15-29					0.97	1	
		30-44			0.95	0.96	0.97	1	
		45-59		1	0.95	0.98	0.97	1	
		60-69		1	0.95	0.98	0.98		
		70-79		0.96	0.97	1	0.98		
		80+	0.96	0.97	1	0.98			
Sweden	F	0-4							
		5-14							
		15-29					0.97	1	
		30-44			0.95	0.96	0.95	1	
		45-59		1	0.98	0.98	0.98	1	
		60-69		1	0.95	0.98	0.97		
		70-79		1	0.98	1	0.98		
		80+	1	0.98	1	0.98			
Switzerland	M	0-4							
		5-14							
		15-29						0.96	1
		30-44				0.96	0.97	0.97	1
		45-59		1	0.96	0.97	0.99	1	
		60-69		1	0.95	0.96	0.98		
		70-79		0.93	1	0.97	1		
		80+	0.93	1	0.97	1			
Switzerland	F	0-4							
		5-14							
		15-29						0.97	1
		30-44			1	0.95	0.96	1	
		45-59		1	0.98	0.97	0.98	1	
		60-69		1	0.97	0.97	0.98		
		70-79		0.95	1.01	0.97	1		
		80+	0.95	1.01	0.97	1			
Ukraine	M	0-4						1.03	
		5-14						1	
		15-29		1.15	1.01			1.03	1.01
		30-44		1.1	1.02	1.02	1.02	1.02	1.02
		45-59		1.07	1.02	1	1.02	1.02	1.05
		60-69		1.02	1.04	1	1.02	1.02	1.05
		70-79		0.98	1.01	0.98	1.02	1.02	1.04
		80+	0.98	1.01	0.98	1.02	1.02	1.04	
Ukraine	F	0-4						1.05	
		5-14						1.07	
		15-29		1.13	1.03			1	1.03
		30-44		1.13	1.03	1.01	1.02	1.02	1.02
		45-59		1.07	1.02	0.99	1	1.02	1.04
		60-69		1	1.02	0.99	0.99	1.02	1.05
		70-79		0.95	1.01	0.98	0.99	1.02	1.05
		80+	0.95	1.01	0.98	0.99	1.02	1.05	
UK	M	0-4							
		5-14							
		15-29						0.99	1
		30-44			0.96	0.98	1	1	
		45-59		0.97	0.94	0.97	0.99	1	
		60-69		0.92	0.95	0.96	0.97		
		70-79		0.96	0.97	0.98	0.96		
		80+	0.96	0.97	0.98	0.96			
UK	F	0-4							
		5-14							
		15-29						1	0.97
		30-44			0.97	0.98	1	1	
		45-59		0.94	0.94	0.98	0.97	1	
		60-69		0.94	0.94	0.96	0.94		
		70-79		0.98	0.97	0.99	0.95		
		80+	0.98	0.97	0.99	0.95			

Annex Table A-7 (continued)

WHO Region			Beta					Homicide
Country	Sex	Age	TB	IHD	Stroke	Suicide		
Uzbekistan	M	0-4						
		5-14						
		15-29	1.15		0.91	1.04	0.96	
		30-44	1.11	0.98	0.95	1.01	0.95	
		45-59	1.05	1	0.99	1	0.97	
		60-69	1.03	1.03	1	1		
		70-79	1	1	0.99	1		
80+	1	1	0.99	1				
Uzbekistan	F	0-4						
		5-14						
		15-29	1.09		0.9	1.03	1	
		30-44	1.07	1	0.93	1	1	
		45-59	1	1	0.98	0.96	1	
		60-69	1	1.03	1.01	0.96		
		70-79	1	1.02	1.02	0.95		
80+	1	1.02	1.02	0.95				
<i>WPRO Region</i>								
Australia	M	0-4						
		5-14						
		15-29				1	1	
		30-44		0.98	0.97	1.02	1	
		45-59		0.94	0.95	1	1	
		60-69	0.93	0.94	0.95	0.98		
		70-79	0.95	0.96	0.97	0.98		
80+	0.95	0.96	0.97	0.98				
Australia	F	0-4						
		5-14						
		15-29				1	0.96	
		30-44		1	0.97	1	1	
		45-59		0.93	0.95	1	1	
		60-69	1	0.93	0.94	0.96		
		70-79	1	0.97	0.98	0.97		
80+	1	0.97	0.98	0.97				
<i>WHO Region</i>								
Japan	M	0-4						0.97
		5-14						0.96
		15-29			1.08		1.04	0.96
		30-44	0.94	1.05	0.97	1.03	0.96	
		45-59	0.94	1.06	0.97	1.05	1	
		60-69	0.93	1.04	0.98	1.05	1.03	
		70-79	0.97	1.01	0.97	0.99	1	
80+	0.97	1.01	0.97	0.99	1			
Japan	F	0-4						0.95
		5-14						0.96
		15-29					1.02	0.96
		30-44	0.9	1.04	0.97	1.01	0.96	
		45-59	0.89	1.05	0.97	1	1	
		60-69	0.94	1.03	0.96	1	1	
		70-79	1	1.01	0.97	0.96	1	
80+	1	1.01	0.97	0.96	1			
Republic of Korea	M	0-4	0.81			0.9		1
		5-14	0.74			0.86		1
		15-29	0.84	0.96	0.9	0.97	0.93	
		30-44	0.89	1	0.94	1.02	0.98	
		45-59	0.89	1.05	0.93	1.04	1	
		60-69	0.9	1.05	0.93	1.05	1	
		70-79	0.96	1.05	0.95	1.07	1	
80+	0.96	1.05	0.95	1.07	1			
Republic of Korea	F	0-4	0.82			0.91		1
		5-14	0.77			0.87		1
		15-29	0.84	0.95	0.91	0.99	1	
		30-44	0.85	1	0.92	1.01	1.03	
		45-59	0.87	1.03	0.91	1.03	1.03	
		60-69	0.89	1.04	0.93	1.04	1	
		70-79	0.97	1.05	0.96	1.08	1	
80+	0.97	1.05	0.96	1.08	1			

