Estimates of healthy life expectancy for 191 countries in the year 2000: methods and results

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1. Introduction

In the World Health Report 2000, the World Health Organization (WHO) reported for the first time on the average levels of population health for its 191 member countries using a summary measure that combines information on mortality and disability[1]. The primary summary measure of population health used was Disability-Adjusted Life Expectancy, or DALE, which measures the equivalent number of years of life expected to be lived in full health[2]. New estimates of healthy life expectancy for the year 2000 are published this year in the World Health Report 2001[3] using improved methods and incorporating cross-population comparable survey data from 63 surveys in 55 countries. Following feedback from Member States and to better reflect the inclusion of all states of health in the calculation of healthy life expectancy, the name of the indicator used to measure healthy life expectancy was changed from disability-adjusted life expectancy (DALE) to health-adjusted life expectancy (HALE).

The regular assessment of levels of population health is a key component of the public policy process. It shows: variations in levels of health across populations – where the greatest health burden lies internationally; variations in health within populations, by age and sex for example – where the greatest burden lies sub-nationally; changes in levels of health over time for populations and by age and sex – whether health levels are improving; and is a crucial piece of information required to identify the major causes of poor health in populations and in sub-groups – what diseases or risk factors are responsible for observed levels of poor health.

Without being able to measure health, the most important outcome of the health system, it is impossible to know if health policies are working – if levels of health are improving and inequalities are being reduced. Health policy is not aimed only at reducing mortality. Substantial resources are devoted to reducing the incidence of conditions that cause ill health but not death and to reducing their impact on people's lives. So it is important to capture both fatal and non-fatal health outcomes in any measure of population health. For this reason, the World Health Organization uses healthy life expectancy as a summary measure of level of population health that captures the full health experience of the population and not just mortality. As a summary measure of the average level of health in a population, healthy life expectancy has two advantages over other summary measures. The first is that it is relatively easy to explain the concept of an equivalent "healthy" life expectancy to a non-technical audience. The second is that healthy life expectancy is measured in units (expected years of life) that are meaningful to and within the common experience of non-technical audiences (unlike other indicators such as mortality rates or incidence rates).

In the last two decades, considerable international effort has been put into the development of summary measures of population health that integrate information of mortality and non-fatal health outcomes[4-8]. There are two main classes of summary measures: health gaps and health expectancies. The Disability-Adjusted Life Year (DALY) is the best known health gap measure and quantifies the gap between a population's actual health and some defined goal[9]. HALE belongs to the family of health expectancies, summarizing the total life expectancy into equivalent years of "full health" by taking into account the distribution of health states (disability) in the population. Murray and Lopez[10] published healthy life expectancy (DALE) estimates for the eight regions of the world based on the estimates of severity-weighted disability prevalence developed in the Global Burden of Disease study[11-15]. Healthy life expectancy has also been calculated for Australia[16] based on a national burden of disease study. Healthy life expectancy has been calculated for Canada and Australia using population survey data on disability at four levels of severity together with severity weights[17-19]. More recently, Canada has produced estimates of health-adjusted life expectancy based on population prevalence data for health states together with measured utility weights[20]. The United States of America has adopted a public health policy goal to increase healthy life expectancy (referred to as expected years of healthy life or YHL) and has used healthy life expectancy to measure progress towards this goal[21-24].

Disability-free life expectancy (DFLE) has been recommended as a summary measure of population health and reported for OECD countries for some years in its health database[25-26]. WHO considers that HALE is preferable as a summary measure of population to indicators such as DFLE which incorporate a dichotomous weighting scheme. Because time spent in any health state categorized as disabled is assigned arbitrarily a weight of zero (equivalent to death), DFLE is not sensitive to differences in the severity distribution of disability in populations. In contrast, HALE adds up expectation of life for different health states with adjustment for severity distribution and thus is sensitive to changes over time or differences between countries in the severity distribution of health states[7, 8].

DFLE estimates based on self-reported health status information are not comparable across countries due to differences in survey instruments and cultural differences in reporting of health[27, 28]. Analyses of over 50 national health surveys for the calculation of healthy life expectancy in the World Health Report 2000 identified severe limitations in the comparability of self-report health status data from different populations, even when identical survey instruments and methods were used[29]. We have demonstrated how these comparability problems relate not only to differences in survey design and methods, but much more fundamentally to unmeasured differences in expectations and norms for health[30]. For example, the cut-points of scales for a given domain such as mobility may have very different meanings across different cultures, across socio-economic groups within a society, across age groups or between men and women. During the last two years, WHO has embarked on large-scale efforts to improve the methodological and empirical basis for the measurement of population health, and has initiated a data collection strategy consisting of household and/or postal or telephone surveys in representative samples of the general populations using a standardised instrument together with new statistical methods for correcting biases in self-reported health[31].

In constructing estimates of healthy life expectancy for 191 countries for the year 2000, we have sought to address these methodological challenges regarding comparability of health status data across populations and cultures. Calculation of HALE for WHO Member States requires three inputs. First, life expectancy at each age is calculated in the standard way. Second, estimates of the prevalence of various states of health at each age are required. Finally, a method of valuing this time compared to full health must be developed. This paper describes the methods and data sources used for each of these components.

Because comparable health status prevalence data are not yet available for all countries, a three-stage strategy was used to estimate severity-weighted health state prevalences for countries in a way that maximises cross-country comparability:

- firstly, data from the Global Burden of Disease 2000 study[32] were used to estimate severity-adjusted disability prevalences by age and sex for all 191 countries;
- secondly, data on health state prevalences and health state valuations from the WHO Multi-country Household Survey Study on Health and Responsiveness[31] were used to make independent estimates of severity-adjusted disability prevalences by age and sex for 55 countries;

- finally, for the survey countries, 'posterior' prevalences were calculated using Bayesian methods to combine the survey prevalences with the 'prior' GBD2000-based prevalences. The relationship between the GBD2000-based prevalences and the survey prevalences among the survey countries was then used to adjust the GBD2000-based prevalences for the non-survey countries.

Some commentators have argued that the data demands and complexity of the calculations make healthy life expectancy an impractical measure for use as a summary measure of population health[33]. Although the concept of healthy life expectancy is relatively simple to understand, health encompasses multiple domains and mortality risks, and with the additional requirement to ensure comparability of estimates across countries, any acceptable methods used to compute healthy life expectancy will inevitably be complex.

The analytical and conceptual elements underlying summary measures of population health such as healthy life expectancy are certainly more substantial than for measures of mortality such as life expectancy, but complexity is not a reason to ignore progress in measuring health in a more appropriate way. Some conceptually simple measures such as income per capita, which are widely used, are in fact extremely complicated to calculate. The intricacies of national income accounts are known only to a few yet the measure of overall economic performance is widely used. We believe that in order to report on levels of health for WHO Member States, it is important to use a summary measure that is conceptually simple to understand, and methods that capture all important aspects of health and result in estimates that are comparable across Member States.

This draft paper provides an overview of the data and methods used to calculate the healthy life expectancies reported in the WHR 2001[1]. It will be replaced by a more comprehensive final paper in November 2001.

2. Methods for constructing life tables for 2000

As a first step towards the estimation of HALE, it is crucial to develop for each WHO Member State the best possible assessment for the year 2000 of overall mortality levels by age and sex in order to construct a period life table. Since publication of the WHR 2000[1], there has been intensive contact between WHO and Member States in an effort to verify the best sources of recent data on vital registration and cause of death, and new life tables for the year 2000 have been constructed for all 191 WHO Member States[34].

To aid in the mortality analyses used as inputs to the HALE estimation process, the six WHO regions of the world are divided into 5 mortality strata on the basis of their level of child (5q0) and adult male mortality (45q15). The matrix defined by the six WHO Regions and the 5 mortality strata leads to 14 subregions, since not every mortality stratum is represented in every Region. These subregions are defined in Annex Table 1 of Murray et al[32]. The available sources of mortality data for the 14 mortality subregions are summarised in Table 1. Complete or incomplete vital registration data together with sample registration systems cover 76% of global mortality. Survey data and indirect demographic techniques provide information on levels of child and adult mortality for the remaining 24% of estimated global mortality.

These data sources were used as follows to estimate global mortality. For countries with good quality vital registration systems, no demographic adjustments were made. Using the latest available life table as a standard (typically 1998 or 1999), the Brass Logit technique was applied to these data to obtain a time series of α and β parameter estimates from 1980. Suitable time series techniques were then used to forecast the corresponding parameter estimates of α and β for the year 2000, and hence the 2000 life table[34]. In the 30% of countries with incomplete or sample vital registration systems, demographic techniques[1] were used to estimate the level of completeness of death recording and to adjust the data accordingly. The Brass logit technique was then applied to the time series of corrected data. In the few cases where time series data were not available, life tables were constructed using information on estimates of adult (${}_{45}q_{15}$) and child (${}_{5}q_{0}$) mortality in conjunction with the new modified-logit life table system based on the Brass logit system[34].

Finally, for the 63 countries lacking vital registration data, the levels of adult mortality were estimated from projected trends in child mortality using the modified logit system [35]. This system is an extension of the ordinary Brass two-parameter system to include two additional age-specific correction factors (called γ and θ) which correct for the increasing non-linearity of logits with increasing distance from the standard *(21)*. HIV/AIDS mortality was estimated separately for these countries and added to the model age patterns allowing for competing mortality risks.

New information provided by Member States on vital registration and child and adult mortality rates has resulted in substantial changes in estimates of life expectancy for some Member States for the year 2000 compared to estimates published for 1999 in the WHR 2000.

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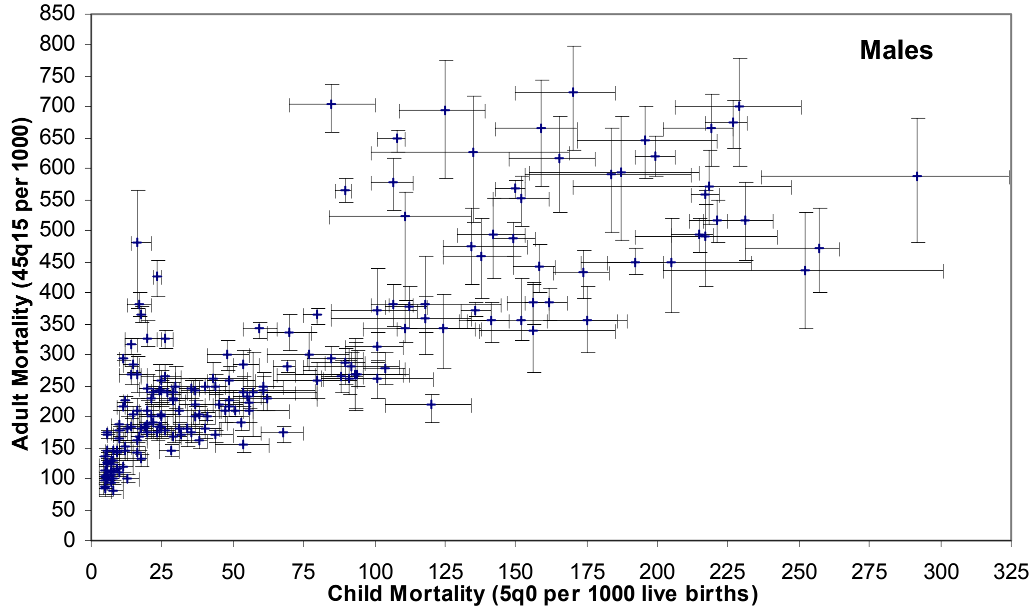
1 The methods for assessing completeness of reporting that were used are (i) Bennet Horiuchi method, (ii) the Simple Growth Balance method and (iii) the generalized Growth Balance method.

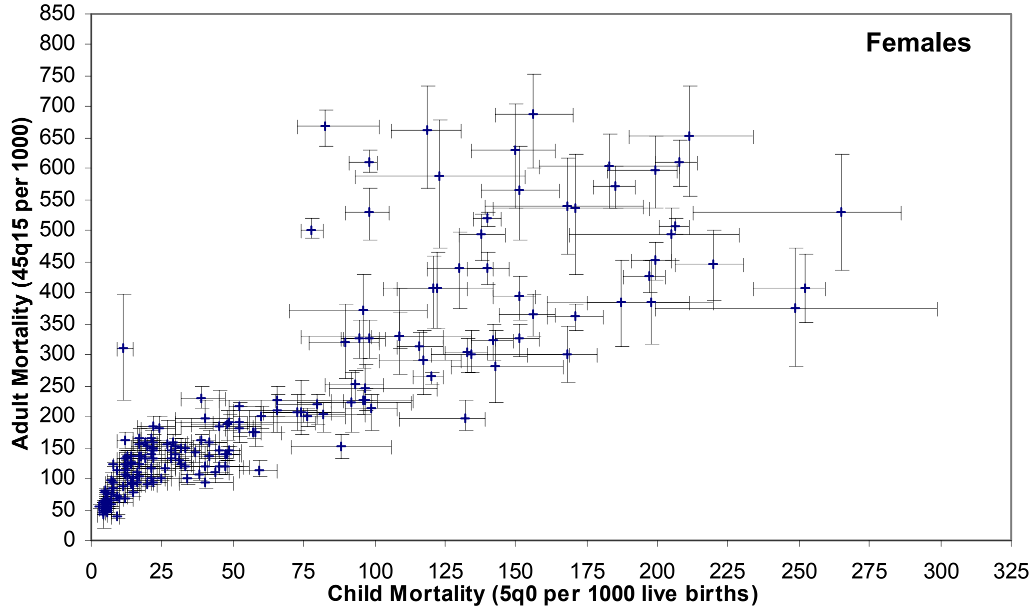
Table 1. Mortality data sources (% of recent deaths covered) for WHO subregions for the year 2000.

Subregion	Complete vital statistics (coverage of 90%+)	Incomplete vital statistics	Sample registration and surveillance systems	Surveys and indirect demographic methods	No recent data	Total deaths 2000 (WHO estimates)
Afro D	0%	4%	0%	89%	7%	100%
Afro E	0%	10%	9%	58%	23%	100%
Amro A	100%	0%	0%	0%	0%	100%
Amro B	39%	61%	0%	0%	0%	100%
Amro D	0%	65%	0%	14%	21%	100%
Emro B	1%	75%	0%	24%	0%	100%
Emro D	0%	60%	0%	26%	14%	100%
Euro A	100%	0%	0%	0%	0%	100%
Euro B	51%	49%	0%	0%	0%	100%
Euro C	96%	4%	0%	0%	0%	100%
Searo B	6%	19%	0%	76%	0%	100%
Searo D	0%	2%	92%	4%	2%	100%
Wpro A	100%	0%	0%	0%	0%	100%
Wpro B	0%	15%	84%	1%	0%	100%
Total	**24%**	**15%**	**36%**	**19%**	**5%**	**100%**

Some of the most recent data available from countries used in the construction of the new life tables are summarized in Figure 1. It plots, by country, adult (${}_{45}q_{15}$) versus child (${}_{5}q_{0}$) mortality for males and females showing, for example, that some countries with low levels of child mortality have much higher than expected levels of adult male mortality. The bars show the estimated 95% uncertainty intervals for adult and child mortality. Annex Table 1 of the World Health Report 2001 gives full details of the estimates and their uncertainty. Annex Table 1 also provides estimates of life expectancy at birth together with uncertainty intervals.

Figure 1. Adult mortality versus child mortality for 191 WHO Member States for the year 2000.





3. Methods for estimating GBD-based priors

3.1 Regional estimates of health state prevalence estimates

Burden of disease analysis uses a disease-specific approach to estimate the disability and loss of healthy years of life associated with a comprehensive and exhaustive set of health conditions. In particular, DALYs are calculated as the sum of years of life lost due to mortality (YLL) and equivalent years of healthy life "lost" due to disability (YLD). YLD for a particular health condition (disease or injury) are calculated by estimating the number of new cases (incidence) of the condition occuring in the time period of interest. For each new case, the number of years of healthy life lost is obtained by multiplying the average duration of the condition (to remission or death) by a severity weight that quantifies the equivalent loss of healthy years of life due to living with the health condition[9].

The GBD 2000 project is estimating YLD for a comprehensive set of 135 disease and injury categories involving analysis of many more disease stages, severity levels and sequelae[32]. These estimates are being made by age, sex and for 17 epidemiological subregions. While GBD 2000 results are being reported for the 14 mortality subregions described above, YLDs are being estimated for 17 epidemiological subregions, chosen to maximise epidemiological homogeneity[32].

For some conditions, numbers of incident cases are available directly from disease registers or epidemiological studies but for most conditions, only prevalence data are available. In these cases, a software program called DISMOD© is used to model incidence and duration from estimates of prevalence, remission, case fatality and background mortality. Many different sources of information are used to calculate YLD. An iterative process and extensive consultation with relevant experts is required to ensure consistency of epidemiological estimates. For this year's World Health Report, burden of disease estimates have been updated for many of the cause categories based on the wealth of data available on major diseases and injuries available to WHO technical programmes and through collaboration with Member States and scientists worldwide. Examples are the extensive data sets on tuberculosis, maternal conditions, injuries, diabetes, cancer, and sexually transmitted infections. Further details of GBD 2000 data and methods are given by Murray et al[32].

As part of the GBD 2000 project, undiscounted and non-age-weighted prevalence YLD have been estimated directly from prevalence estimates for each cause sequela by age and sex as follows:

$$YLD_c^{Prev} = Prev_c \times DW_c$$

where $Prev_c$ is the point prevalence of cases, *and* DW_c is the disability weight (in the range 0-1).

In order to estimate disability prevalence at population level, it is also necessary to estimate the YLD associated with residual categories of disease and injury such as 'Other chronic respiratory diseases' or 'Other malignant neoplasms'. We followed the procedure developed by the GBD 1990 [Murray and Lopez[2], page 211] to estimate YLD for all of these residual categories.

Summation of prevalence YLD over all causes would result in overestimation of disability prevalence because of comorbidity between conditions. We correct for comorbidity between major cause groups as described below to obtain estimates of all-cause YLD by age and sex for each WHO subregion.

This burden of disease based approach to the calculation of HALE has a number of advantages over the health survey approach:

- it ensures consistency with the health gap measure (DALYs) of the burden of disease
- it ensures inclusion of all causes of disability (including those resulting in forms of disability poorly reported in health surveys eg. substance abuse, intellectual disability)
- it avoids problems of self-report biases.

However, there are currently two major limitations with this approach:

- problems with comorbidities, and
- the data demands for calculating YLD for a comprehensive set of conditions.

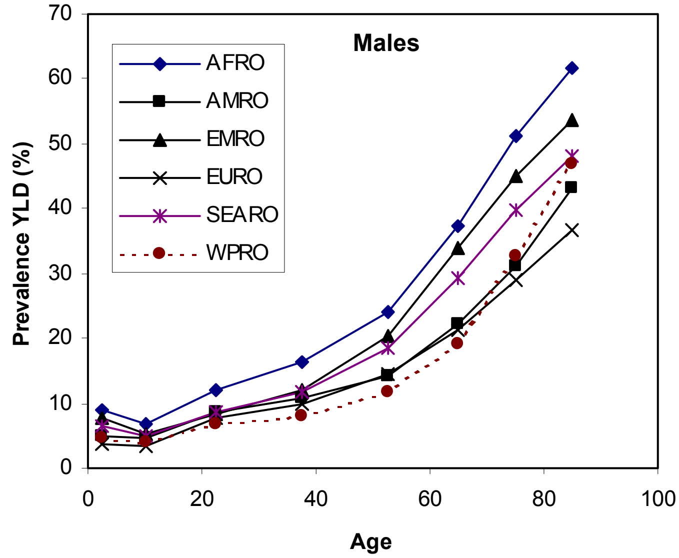
Comorbidity refers to the not uncommon situation where a person has two or more health problems that result in disability (either dependently or independently of each other). It makes little sense to simply add the independently determined disability weights for conditions that are found to coexist as this can lead to the illogical possibility of having a combined weight of more than one (i.e. more disabling than death), particularly in the case of two heavily weighted conditions. Both the GBD 1990 and the Australian Burden of Disease Study made adjustments for comorbidity assuming that conditions occurred independently (ie. the probability of having 2 conditions was the product of the average probabilities for having each condition) and adjusted the disability weights for comorbid conditions assuming a multiplicative model. A similar approach is taken here, but some dependent comorbidity is also taken into account, as described below in Section 3.3.

Figure 2 compares the overall age-sex specific prevalence YLD rates (adjusted for comorbidity) for the six WHO regions based on GBD 2000 Version 1 estimates for the year 2000. Table 2 gives age-sex specific prevalence YLD rates for the 17 epidemiological subregions for the year 2000.

3.2 Country-specific cause of death estimates

Causes of death for the 17 subregions and the world have been estimated based on data from national vital registration systems that capture about 17 million deaths annually. In addition, information from sample registration systems, population laboratories and epidemiological analyses of specific conditions have been used to improve estimates of the cause of death patterns[36-39]. WHO is intensifying efforts with Member States to obtain and verify recent vital registration data on causes of death.

Cause of death data have been carefully analysed to take into account incomplete coverage of vital registration in countries and the likely differences in cause of death patterns that would be expected in the uncovered and often poorer sub-populations. Techniques to undertake this analysis have been developed based on the global burden of disease study[11] and further refined using a much more extensive database and more robust modelling techniques[40].



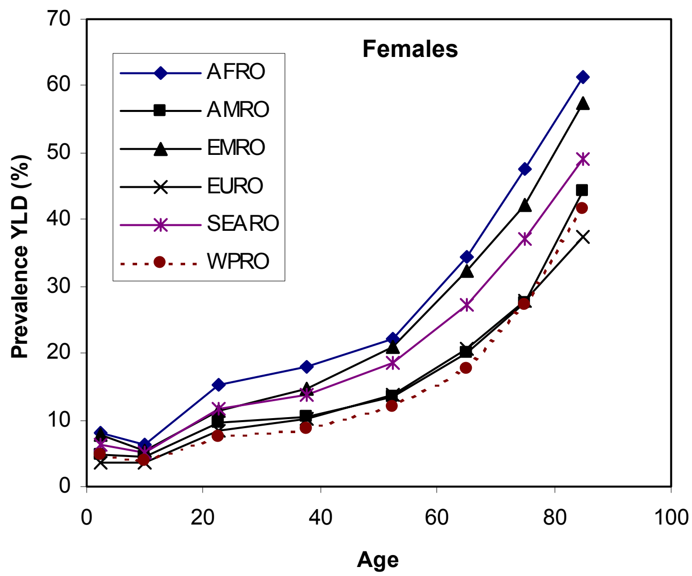


Figure 2. Overall prevalence YLD rates (%) for WHO Regions, 2000.

Special attention has been paid to problems of misattribution or miscoding of causes of death in cardiovascular diseases, cancer, injuries and general ill-defined categories. A correction algorithm for reclassifying ill-defined cardiovascular codes has been developed[38]. Cancer mortality by site has been evaluated using both vital registration data and population based cancer incidence registries. The latter have been analysed using a complete age, period cohort model of cancer survival in each region[39].

As a general rule, vital registration data, suitably corrected for ill-defined coding and probable systematic biases in certifying deaths to non-specific vascular, cancer and injury codes were used to estimate the cause of death pattern. Vital registration data to do so was available for about 65 countries. In a further 20 countries or so, cause of death models were used to correct

Table 2. Overall prevalence YLD rates (%) for WHO epidemiological subregions for the year 2000.

Sex	Subregion	0-4	5-14	15-29	30-44	45-59	60-69	70-79	80-89	Age-std (a)
Males										
	AFRO D	9.0	6.6	11.0	15.0	23.9	37.7	50.6	60.0	15.4
	AFRO E	9.0	6.9	12.8	17.7	23.9	36.9	51.7	63.4	16.5
	AMRO A	2.3	2.8	8.0	8.8	10.3	16.8	26.7	40.5	8.1
	AMRO B	6.1	5.3	8.9	12.0	18.1	28.2	37.4	49.1	11.9
	AMRO D	6.0	5.4	9.3	13.0	19.9	29.3	39.2	49.9	12.6
	EMRO B	5.4	3.8	6.5	9.8	16.5	30.3	40.9	46.7	10.4
	EMRO D	8.4	5.7	9.2	13.0	22.3	35.3	46.6	56.4	13.7
	EURO A	2.0	2.3	6.1	7.4	9.0	13.8	23.1	33.4	6.7
	EURO B1	4.5	3.5	6.7	9.2	13.5	19.2	25.5	35.6	8.7
	EURO B2	7.8	5.3	8.9	12.3	22.5	31.1	41.6	52.6	13.0
	EURO C	4.7	3.8	9.2	12.8	18.7	24.2	32.8	44.9	11.4
	SEARO B	6.0	4.5	7.7	10.2	17.2	26.9	38.6	52.8	10.9
	SEARO D	6.5	5.0	8.8	11.9	19.0	29.9	40.2	47.2	12.1
	WPRO A	2.8	2.9	5.2	6.6	7.8	12.0	18.7	30.3	6.0
	WPRO B1	4.7	3.9	6.7	7.8	11.9	20.0	35.5	52.7	8.7
	WPRO B2	5.5	4.4	7.6	9.9	16.1	25.5	38.1	53.9	10.5
	WPRO B3	6.0	4.6	8.4	12.5	22.6	34.1	41.7	45.1	12.7
	World	6.3	4.7	8.3	10.4	15.1	23.2	33.4	44.0	10.5
Females										
	AFRO D	8.2	6.2	13.9	16.6	22.3	35.1	48.0	61.4	16.8
	AFRO E	8.0	6.5	16.2	19.2	22.3	34.0	47.2	61.3	17.7
	AMRO A	2.2	2.8	8.4	8.6	10.7	16.2	24.5	43.7	8.7
	AMRO B	5.7	5.1	9.8	11.9	15.7	23.9	32.1	46.0	11.9
	AMRO D	5.7	5.3	10.6	13.1	17.5	25.8	34.7	48.3	12.9
	EMRO B	5.5	3.9	8.5	11.5	16.8	27.6	35.3	48.0	11.8
	EMRO D	8.4	6.0	12.6	15.9	22.6	34.0	44.8	61.6	16.1
	EURO A	1.9	2.4	6.9	7.7	9.2	14.2	22.4	36.1	7.4
	EURO B1	4.3	3.8	9.4	10.8	13.4	18.2	23.6	36.5	10.0
	EURO B2	7.7	5.4	11.2	13.2	19.0	25.5	32.3	44.0	13.3
	EURO C	4.4	3.9	8.8	10.9	13.8	18.7	24.4	36.9	10.0
	SEARO B	5.6	4.5	9.9	11.1	15.4	23.5	32.6	45.4	11.6
	SEARO D	6.3	5.2	12.2	14.5	19.4	28.3	38.2	50.0	14.1
	WPRO A	2.5	2.9	6.1	6.8	7.9	11.6	17.4	32.7	6.6
	WPRO B1	4.8	4.0	7.2	8.4	12.3	18.2	29.3	45.1	9.4
	WPRO B2	5.4	4.4	9.6	10.9	14.7	22.9	33.1	48.4	11.4
	WPRO B3	5.8	4.8	10.7	13.5	19.4	28.8	35.1	41.9	13.2
	World	6.0	4.8	10.2	11.4	14.7	21.4	29.1	42.1	11.4

(a) Total rate age-standardised to World Standard Population.

vital registration data by age and sex to yield more plausible patterns across Groups I, II and III. The distribution of specific causes within groups was then based on the recorded cause of death patterns from vital registration data. The resulting estimates were then systematically corrected on the basis of other epidemiological evidence from registries, community studies and disease surveillance systems.

For China and India, cause patterns of mortality were based on existing mortality registration systems, namely the Disease Surveillance Points system (DSP) and the Vital Registration System of the Ministry of Health in China, and the Medical Certificate of Cause of Death (MCCD) for urban India and the Annual Survey of Causes of Death (SCD)) for rural areas of India. For all other countries lacking vital registration data, cause of death models were used to firstly estimate the maximim likelihood distribution of deaths across the broad categories of communicable, non-communicable and injuries, based on estimated total mortality rates and income[40]. A regional model pattern of specific causes of death was then constructed based on local vital registration and *verbal autopsy* data and this proportionate distribution was then applied within each broad cause group. Finally, the resulting estimates were then adjusted based on other epidemiological evidence from specific disease studies.

GBD 2000 Version 1 estimates of death by cause, age and sex for the 14 mortality subregions are summarized in the WHR 2001 Annex Table 3[1] and in Murray et al.[32].

3.3 Country-specific estimates of health state prevalences

Where feasible, country-specific prevalence YLD estimates have been made for a number of causes (including childhood immunisable diseases, malnutrition, HIV/AIDS, cancers and diabetes). For other causes, regional YLD estimates have been used, together with country-specific and regional cause of death information, to develop country-specific estimates of severity-weighted prevalence YLD by age and sex. The five methods used are described below. The causes for which each method was used are listed in Table 3. The average per cent of total prevalence YLD (all cause) estimated using each of these methods is shown by region in Table 4.

1. Country-specific prevalence data

For the causes listed in the first column of Table 3, prevalence YLD estimates have been made directly for Member States using available data on the prevalence of the condition. For the Group I conditions, databases of country-level studies developed by WHO programs and UNAIDS were used to estimate country-level prevalences. Methods used to estimate the prevalence of malignant neoplasms at country level, based on national incidence, mortality and survival data, are described by Mathers et al.[39] Diabetes prevalence was based on the country-level prevalence estimates published by King et al.[41]. Variations in the prevalence of unipolar depressive disorders in some European countries, Australia, New Zealand and Japan were estimated directly from relevant population studies. For other countries in the A regions, country-specific prevalences P_c for males and females aged 15-59 were estimated using a regression model on suicide rates as follows:

$$P_c = P_R + 0.0919 * (S_C - S_R)$$

where P_R is the regional depression prevalence, S_C and S_R are the country and regional suicide rates (ages 15-59 both sexes combined). For other regions, it was assumed that the variation of depression prevalence with suicide rate was half that of A countries, and the range of variation was restricted from a minimum of one half the regional average to a maximum of twice the regional average.

Table 3. Average per cent of total prevalence YLD estimated by each method, for WHO Member States within each epidemiological subregion.

Cause-specific method used for estimation of country-level prevalence YLD				
Country-specific prevalence data	**Inc. YLD/YLL ratios short duration causes**	**Inc. YLD/YLL ratios long duration causes**	**Prevalence YLD regression models**	**Regional prevalence YLD rates**
Pertussis	Tuberculosis	Endocrine disorders	Maternal conditions	STDs excluding HIV
Diphtheria	HIV/AIDS	Other respiratory diseases	Perinatal conditions	Poliomyelitis
Measles	Hepatitis B	Other digestive diseases	Unipolar depressive disorders*	Trypanosomiasis
Tetanus	Hepatitis C	Other genitourinary system diseases	Parkinson disease	Chagas disease
Meningitis	Malaria	Road traffic accidents	Ischaemic heart disease	Schistosomiasis
Onchocerciasis	Lower respiratory infections	Poisonings	Cerebrovascular disease	Leishmaniasis
Trachoma	Rheumatic heart disease	Falls	COPD	lymphatic filariasis
PE Malnutrition	Hypertensive heart disease	Fires	Congenital anomalies	Leprosy
Iodine deficiency	Inflammatory heart disease	Other unintentional injuries		Dengue
Malignant neoplasms	Other cardivoascular	Self-inflicted injuries		Japanese encephalitis
Diabetes mellitus	Peptic ulcer disease	Violence		Intestinal nematode infections
Unipolar depressive disorders*	Cirrhosis of the liver	War		Upper respiratory infections
Alcohol use disorders	Appendicitis	Other intentional injuries		Otitis media
Drug use disorders	Nephritis and nephrosis			Iron-deficiency anaemia
Asthma				Other nutritional causes
				Other neoplasms
				Bipolar disorder
				Schizophrenia
				Epilepsy
				Alzheimer/dementias
				Multiple sclerosis
				PTSD
				Obsessive-compulsive disorder
				Panic disorder
				Insomnia (primary)
				Migraine
				Other neuropsychiatric
				Sense organ diseases
				Benign prostatic hypertrophy
				Skin diseases
				Musculoskeletal diseases
				Oral conditions
				Drownings

- Some country data plus regression model based on suicide rates

2. Inc. YLD/YLL ratios - short duration causes

For specific disease and injury causes where mortality is responsible for a significant proportion of the total burden (incidence YLD/YLL ratio less than 5), regional estimates of incidenceYLD/YLL ratios by age and sex together with country-level estimates of YLL were used to estimate country-level YLD. This process ensures that country-specific knowledge on the epidemiology of the disease (as reflected in the country-level mortality estimates of that disease) is used to adjust the regional-level patterns of disability due to that cause.

For causes where the sequelae causing most YLD are of short duration (ie. less than around 10-15 years), prevalence YLD are approximately equal to undiscounted, non-ageweighted incidence YLD within the age bands used in the GBD 2000. For these causes, country-level prevalence YLD were estimated within each age-sex group a,s as follows:

$$PREVYLD_{c,a,s} = PREVYLD_{R,a,s} \times \left(YLL[0,0]_{c,a,s} / YLL[0,0]_{R,a,s}\right)$$

3. Inc. YLD/YLL ratios - long duration causes

For causes where the sequelae causing most YLD are of longer duration (as is typical for injuries), prevalence YLD at a given age derive from incident YLD at that age and at earlier ages. For these causes, country-level prevalence YLD were estimated using a lifetable method from the undiscounted, non-ageweighted incidence YLD at previous ages, calculated as follows:

$$YLD[0,0]_{c,a,s} = YLD[0,0]_{R,a,s} \times \left(YLL[0,0]_{c,a,s} / YLL[0,0]_{R,a,s}\right)$$

4. Prevalence YLD regression models

For certain causes, regression models were developed for prevalence YLD on cause-specific mortality and selected other variables using the dataset provided by estimates for the 17 epidemiological regions of the GBD 2000.

For perinatal causes, regression based on a selected set of developing regions gave a slope of 0.7 PREVYLD per 100,000 against perinatal mortality per 100,000 for 0-4 year olds. To avoid problems resulting from statistical fluctuations in countries with small numbers of perinatal deaths, the perinatal mortality rate for each country was adjusted to the 80% confidence limit (upper or lower) closest to the regional perinatal mortality rate before applying this regression relationship. The final country/regional PREVYLD ratio was also capped in the range (1/3,3). This ratio was then applied to regional perinatal prevalence YLD rates for each age group to estimate the country YLD rates.

For maternal causes, a similar regression procedure was followed for developed and developing regions giving slopes of 61 and 4.41 PREVYLD per 100,000 respectively against maternal mortality per 100,000 for 15-44 year old women. To avoid problems resulting from statistical fluctuations in countries with small numbers of maternal deaths, the maternal mortality rate for each country was adjusted to the 80% confidence limit (upper or lower) closest to the regional maternal mortality rate before applying the regression relationship. The final country/regional PREVYLD ratio was also capped in the range (1/3,3). This ratio was then applied to regional maternal prevalence YLD rates for each age group to estimate the country YLD rates.

For Parkinson disease, ischaemic heart disease, cerebrovascular disease and chronic obstructive pulmonary disease (COPD), regression models were fitted for prevalence YLD at a given age, including in the models those variables which were significant out of the following set: age-sex specific mortality rates for the cause at that age and all earlier ages, all-cause mortality for that age and for earlier ages, life expectancy at various ages.

5. Regional prevalence YLD rates

For specific disease and injury causes where mortality is not responsible for a significant proportion of the total burden (incidence YLD/YLL ratio is 5 or higher), or where there is insufficient evidence to predict variations in YLD rates from variations in mortality rates, regional estimates of YLD rates per 1,000 population by age and sex were used together with country-level population distribution estimates to estimate prevalence YLD for each country.

Table 4. Average per cent of total prevalence YLD estimated by each method, for WHO Member States within each epidemiological subregion.

	Cause-specific method used for estimation of country-level prevalence YLD				
Subregion	Country-specific prevalence data	Incidence YLD/YLL ratios	Prevalence YLD regression models	Regional prevalence YLD rates	All methods
AFRO D	10	52	6	32	100
AFRO E	9	56	6	29	100
AMRO A	18	23	15	44	100
AMRO B	11	39	14	37	100
AMRO D	11	42	10	37	100
EMRO B	8	49	10	33	100
EMRO D	8	49	9	34	100
EURO A	14	20	20	46	100
EURO B1	7	36	18	39	100
EURO B2	5	49	13	33	100
EURO C	12	36	16	36	100
SEARO B	8	40	13	40	100
SEARO D	7	42	14	36	100
WPRO A	16	24	16	43	100
WPRO B1	7	35	23	35	100
WPRO B2	8	39	16	37	100
WPRO B3	6	46	10	38	100

Estimation of country-level prevalence YLD for specific causes for the year 2000 is based on considerably more country-level prevalence data, and on improved methods for the direct estimation oaf prevalence YLD compared to the methods based on incidence YLD rates and ratios used for the estimation of DALE for 1999 in the WHR 2000[42].

Adjustment for comorbidity. As discussed in Section 3.1, the total prevalent YLD per 100 population can be thought of as a severity-weighted disability prevalence measured as a percentage of the population of that age. However, summation over all conditions of the prevalence YLD for a Member State would result in overestimation of disability prevalence because of comorbidity between conditions. We correct for independent comorbidity between the major condition groups listed in Table 5 as follows:

$$PREVYLD_{a,s} = 1 - \prod_{g} \left(1 - PREVYLD_{g,a,s}\right)$$

where $PREVYLD_{s,a,g}$ is the prevalence YLD per 100 population for age *a,* sex *s* and cause group *g*. It is assumed that there is no comorbidity between specific conditions within these groups, with the following exceptions:

(a) Vitamin A deficiency: 50% assumed to be comorbid with protein-energy malnutrition

(b) Iron-deficiency anaemia: 25% assumed to be cormorbid with protein-energy malnutrition

(c) Diabetes: relative risk of cardiovascular disease assumed to be 4.0

(d) COPD (age <70): region-specific comorbidity with cardiovascular disease estimated from smoking prevalence data separately for males and females aged > 70 and males and females aged 70+.

The resulting PREVYLD per 100 population for age *a,* sex *s* gives the severity-weighted prevalence of disability by age and sex.

Table 5. Major cause groups for which independent comorbidity assumed.

Cause groups		
Tuberculosis+HIV	Maternal conditions	Digestive diseases
STDs excluding HIV	Perinatal conditions*	Genito-urinary diseases
Diarrhoeal diseases	Nutritional deficiencies	Skin diseases
Childhood-cluster diseases	Malignant and other neoplasms	Rheumatoid arthritis
Meningitis*	Endocrine disorders	Osteoarthritis
Hepatitis B+C	Mental disorders	Gout
Malaria	Neurological conditions	Back pain
Tropical-cluster diseases and nematodes	Vision disorders	Other musculoskeletal disorders
Trachoma	Hearing loss plus other sense disorders	Congenital anomalies
Other infectious diseases	Cardiovascular diseases/diabetes/COPD	Oral conditions
Respiratory infections	Asthma plus other respiratory	Injuries

Figures 3 and 4 illustrate the range of variation across regions and within regions in the age-standardised YLD prevalence estimates for the 191 WHO Member States.

Estimation of country-level prevalence YLD for all causes for the year 2000 takes into account some dependent comorbidity, whereas independent comorbidity was assumed between all cause groups in the calculation of GBD priors for DALE for 1999.[42]

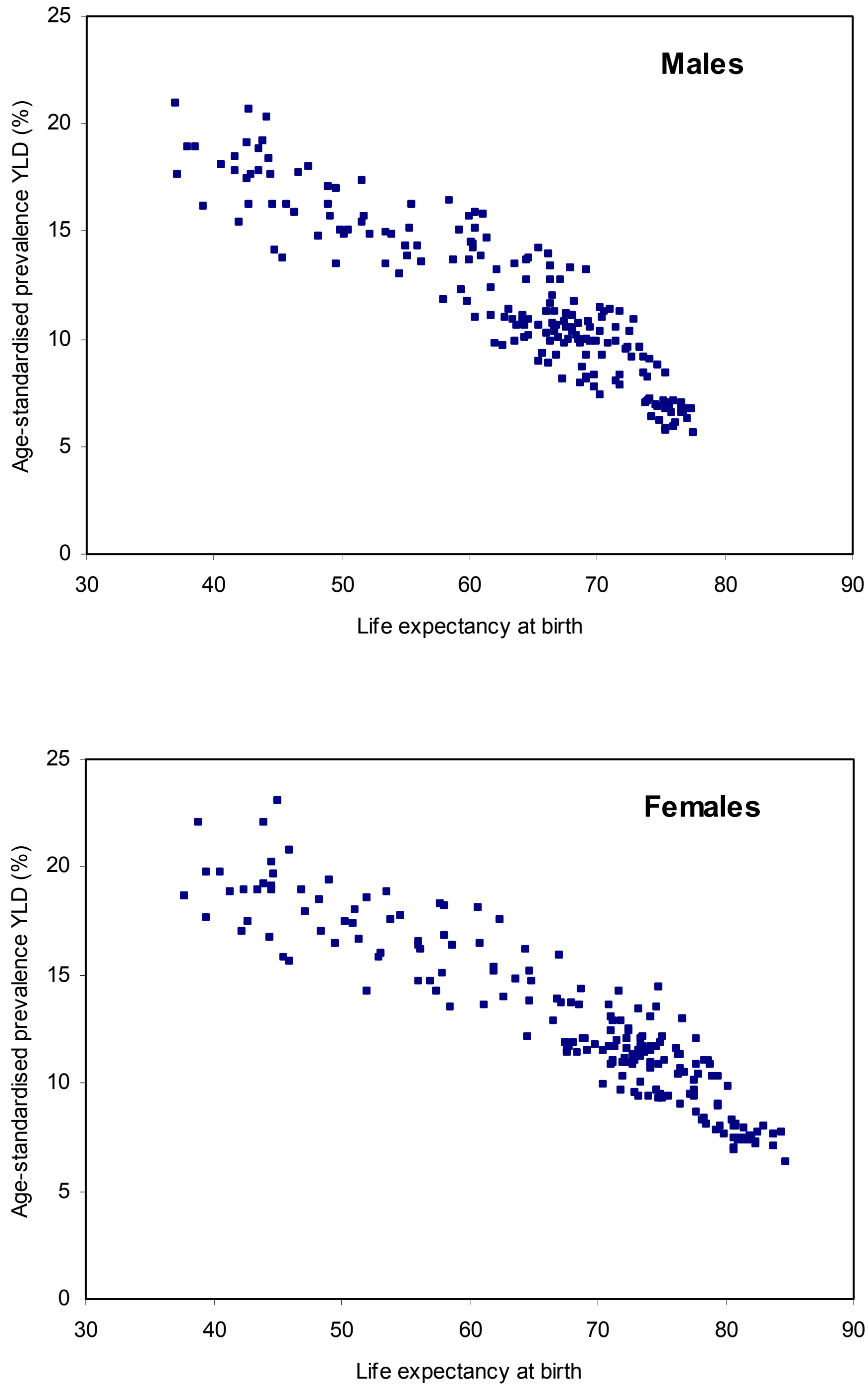


Figure 3. Estimated age-standardised prevalence YLD rate versus life expectancy at birth, by sex, WHO Member States, 2000.

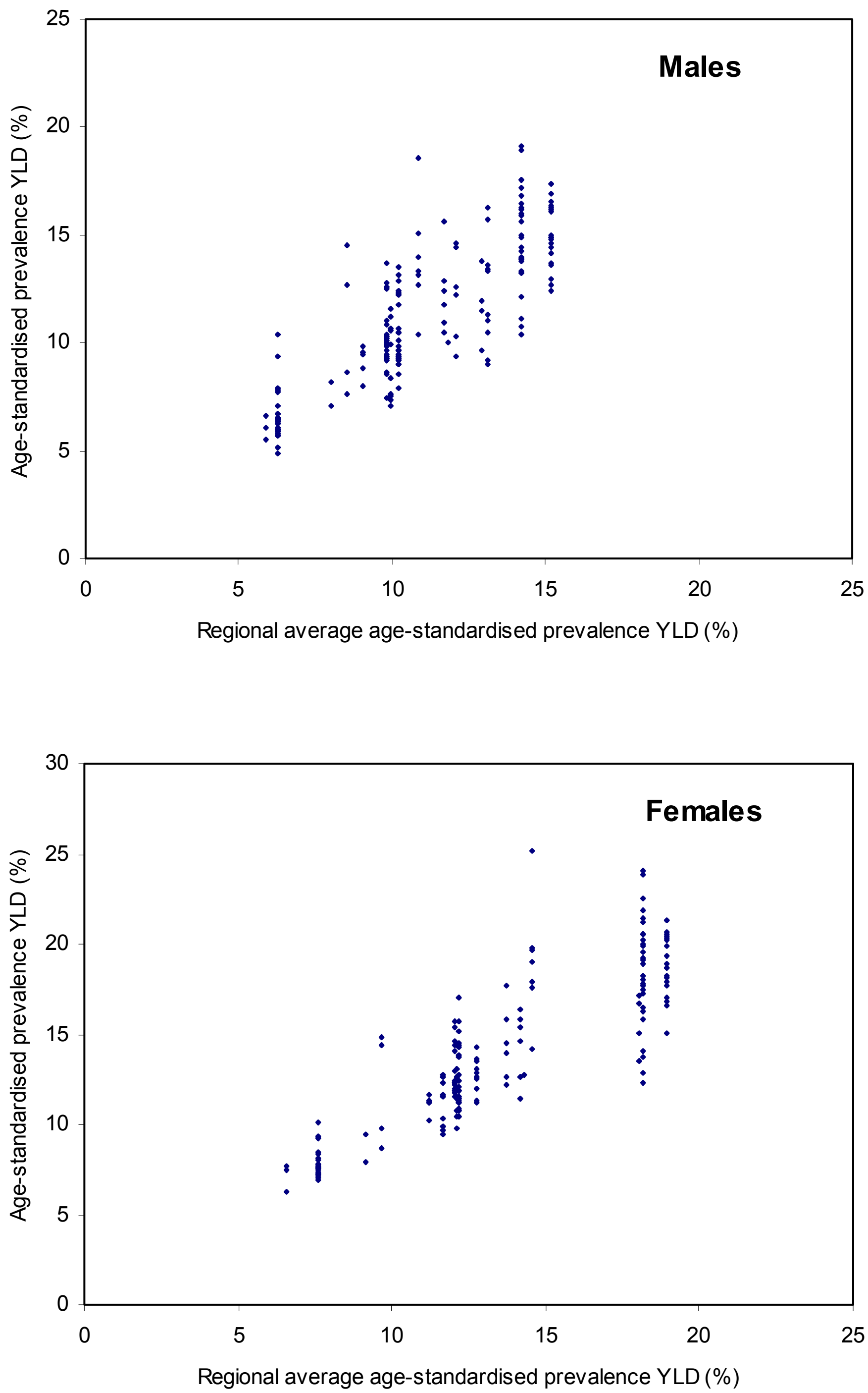


Figure 4. Estimated age-standardised prevalence YLD: country versus regional rate, by sex, WHO Member States, 2000.

4. Using health survey data to improve estimation

4.1 The WHO Household Health survey program

In order to address the challenge of cross-population comparability of population health data, WHO launched a survey study in 1999 involving household and/or postal or telephone surveys in representative samples of the general populations of around 70 countries[31]. The health module was based on selected domains of the International Classification of Functioning, Disability and Health (ICF) and developed through a series of carefully designed steps, which seeks information from a representative sample of respondents on their current states of health according to 6 core domains. These domains were identified from an extensive review of the currently available health status measurement instruments and are shown in Table 6.

Table 6. Core domains of health used in WHO Health Status Survey Module for measurement and valuation of health states

Health Domains	
1. Mobility	4. Pain and discomfort
2. Self-care [a]	5. Affect (anxiety/depression)
3. Usual activities [a a]	6. Cognition

For each of these domains, respondent's reported their status on a five item scale (eg. For the mobility domain respondents were asked how much difficulty they had moving around. Response categories were: None, Mild, Moderate, Severe, Extreme/cannot do). The household survey modules may be found on the WHO website at http://www.who.int/evidence/surveys.

Survey developers have emphasized the importance of establishing the validity of instruments and their reliability[2]. Comparability of results adds a third dimension to survey instrument development. The difference between comparability on the one hand and validity and reliability on the other hand can be illustrated with two thermometers, one of which is Celsius, the other is Fahrenheit. Both thermometer measures give valid and reliable measurements of

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2 *Validity* is the extent to which a survey instrument measures what is intended to measure. It refers to the quality of the instrument as to how actually the instrument is able to capture the real nature what is measured. This can be measured for an item, a series of items or overall instrument level. *Reliability* is the extent to which repeated use of the instrument would give the same result. Reliability is the consistency of the measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects. In short, it is the repeatability of the measurement. A measure is considered reliable if a person's score on the same test given twice is similar. One can think of reliability as measurement invariance or conversely the extent to which a measurement is subject to random measurement error. Validity is the extent to which a measurement correcting for random measurement error is correlated to the true level. In other words, validity can be understood as unbiasedness. Validity is the strength of our conclusions, inferences or propositions. It is the best available approximation to the truth or falsity of a given inference, proposition or conclusion. Construct validity is the degree to which inferences we have made from our study can be generalized to the underlying concepts in the first place. For example, if we are measuring mobility as an outcome, can our definition (operationalization) of that term in our study be generalized to the rest of the world's concept of mobility?

temperature. However, 26 degrees on one thermometer is not comparable to 26 degrees on the other thermometer.

Comparability is fundamental to the use of survey results for calculating summary measures of population health but has been under-emphasized in instrument development. The problem of comparability can be conceptualized in terms of response category cut-point shifts across populations, and across sub-groups within a population. Even when reliability and within population validity have been well established, the meaning that different populations attach to the labels used for each of the response categories in self-reported questions can vary greatly. For each domain, there is some true or latent scale for that domain and the latent scale is, by definition, unobserved. If we imagine, for example, that there is an underlying domain for mobility and consider a self-reported survey question that asks respondents whether they have difficulty walking up stairs. For such question, the response categories are labeled "no difficulty", "mild difficulty", "moderate difficulty", "severe difficulty", and "extreme/cannot do". The identical response of "mild difficulty" in walking up stairs could indeed map to different levels of mobility in different populations. The survey results would be reliable and valid within each population but the results cannot be compared across populations without adjustment.

To overcome the problem of cross-population comparability, the WHO survey instrument includes case vignettes and some measured tests on selected domains that are intended to calibrate the description that respondents provide of their own health. WHO is developing several statistical methods for correcting biases in self-reported health using these data, based on the hierarchical ordered probit (HOPIT) model[30]. The calibrated responses are used to estimate the true prevalence of different states of health by age and sex for 63 surveys in 55 Member States (see Table 7). Just over one half (34) of these surveys were household interview surveys, two were telephone surveys, and the remainder postal surveys. Thirty five of the surveys were carried out in 31 European countries, 22 surveys in 19 developing countries, and the remainder in Canada, USA, Australia and New Zealand. The sampled populations were adults aged 18 years and over.

The hierarchical ordered probit model (HOPIT)

Given a reliable and valid measured test for a domain, the response category cut-points for the self-reported items on these domains can then be estimated using several models. We have developed a variant of the ordered probit model to estimate cut-points. This model, the hierarchical ordered probit (HOPIT), can also be used to estimate if cut-points vary by population and also by socio-demographic characteristics of individuals within a population.

The hierarchical ordered probit (HOPIT) model is a variant of the standard ordered probit model. Standard ordered probit models are useful when the dependent variable is categorical, with higher values on the categorical variable implying higher values of some underlying latent variable. However, there is no presumption that the underlying differences in the latent variable are the same for two sets of adjacent categories. So, if the variable takes values 1,2, and 3, then 2 is higher than 1 and 3 is higher than 2, but not necessarily by the same degree. The ordered probit model estimates the probabilities of responding in each of the categories as a function of explanatory variables. In addition, the ordered probit model estimates cut-points that characterize the mapping from the underlying latent variable to the observed categorical responses. The key innovation of the HOPIT model is that, in contrast to the standard ordered probit model, the response category cut-points are themselves allowed to be functions of socio-demographic characteristics[30].

Table 6. Population surveys conducted using WHO Survey Instrument 1999-2000

Region	*Country*	*Type of survey*	*Sample size*
AFRO	Nigeria	Household	5108
AMRO	Canada	Postal	816
	Canada	Telephone	778
	United States of America	Postal	1792
	Argentina	Brief face to face	1555
	Chile	Postal	2078
	Colombia	Household	8158
	Costa Rica	Brief face to face	1508
	Mexico	Household	4813
	Trinidad and Tobago	Postal	2583
	Venezuela	Brief face to face	1495
EMRO	Bahrain	Brief face to face	1609
	Cyprus	Postal	1311
	Jordan	Brief face to face	1604
	Oman	Brief face to face	1719
	United Arab Emirates	Brief face to face	1686
	Egypt	Household	4490
	Egypt	Postal	2778
	Morocco	Brief face to face	1506
EURO	Austria	Postal	2773
	Belgium	Brief face to face	1100
	Croatia	Brief face to face	3000
	Costa Rica	Brief face to face	1508
	Czech Republic	Postal	2038
	Denmark	Postal	3014
	Finland	Brief face to face	1021
	Finland	Postal	2692
	France	Brief face to face	1003
	France	Postal	1525
	Germany	Brief face to face	1123
	Greece	Postal	1803
	Iceland	Brief face to face	489
	Ireland	Brief face to face	711
	Italy	Brief face to face	1002
Region	*Country*	*Type of survey*	*Sample size*
EURO	Luxembourg	Telephone	719
	Malta	Brief face to face	500
	Netherlands	Brief face to face	1085
	Netherlands	Postal	3794
	Portugal	Brief face to face	1001
	Spain	Brief face to face	1000
	Sweden	Brief face to face	1000
	Switzerland	Postal	962
	United Kingdom	Postal	976
	Georgia	Household	9847

Table 6 (continued). Population surveys conducted using WHO Survey Instrument 1999-2000

Region	*Country*	*Type of survey*	*Sample size*
	Poland	Postal	1751
	Slovakia	Household	1183
	Turkey	Household	5207
	Turkey	Postal	5013
	Kyrgyzstan	Postal	2209
	Estonia	Brief face to face	1000
	Hungary	Postal	2996
	Latvia	Brief face to face	1512
	Lithuania	Postal	3513
	Russian Federation	Brief face to face	1601
	Ukraine	Postal	1562
SEARO	Indonesia	Household	9994
	Indonesia	Postal	5074
	Thailand	Postal	2382
	India	Household	5196
WPRO	Australia	Postal	1185
	New Zealand	Postal	3401
	China	Household	9486
	China	Postal	2078
	Republic of Korea	Postal	705

Two strategies can be used in order to set a comparable scale on which cut-point differences can be estimated using the HOPIT model. These are: (a) vignettes, and (b) measured tests. A vignette is a description of a fixed level of ability on a given domain (such as mobility). Respondents are asked to evaluate the description with regard to the same self-report question and on the same categorical scale. By fixing the level of ability, any differences in responses to vignettes are attributed to response category cut-point shifts. A similar strategy underlies the use of measured tests, such the Snellen's eye chart exam for the domain of vision: measured tests allow for a comparable scale on which estimated cut-points based on self-report responses can be estimated for different socio-demographic groups.

Figure 5 illustrates the HOPIT analysis for females aged 30-44 years. It provides scatterplots the mean y* estimates for females aged 30-44 years in each survey versus the mean of self-reported domain scores, where scores range from 1 (worst response category) to 5 (best response category).

A standardized health survey module together with statistical methods to improve comparability of self-report data across Member States has been used to estimate severity-weighted prevalences from health surveys for the year 2000. This differs from the approach used to calculate DALE for 1999, where latent factor analysis methods were used to extract a common health factor from existing non-comparable surveys.

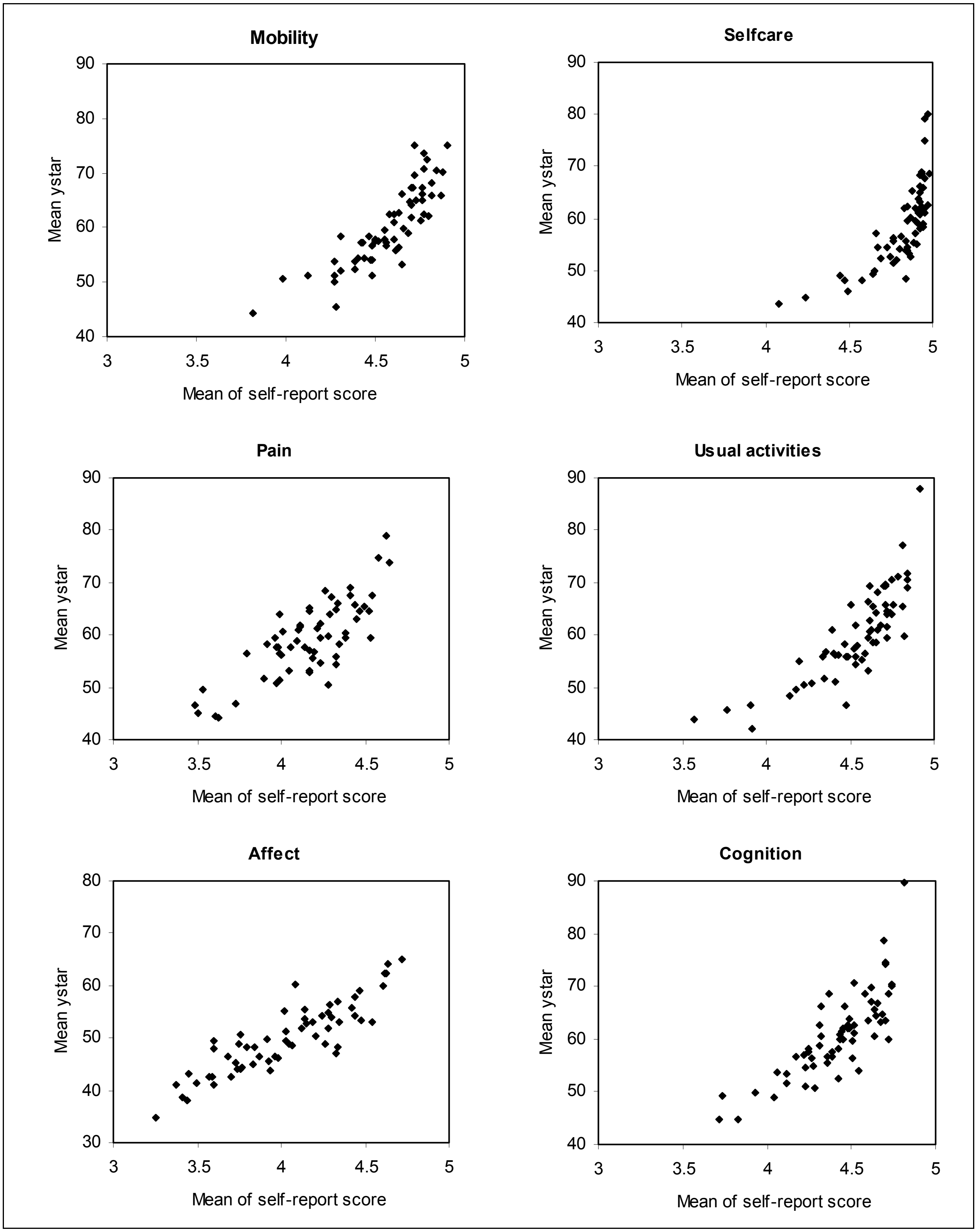


Figure 5. HOPIT analysis for females aged 30-44 years: scatterplot of mean ystar versus mean of self-reported domain score, 6 domains, 63 surveys

4.2 Valuing health states

In order to use time as a common currency for quantifying reductions in healthy life through premature mortality and years lived in various states of sub-optimal health, we must assign numerical values to time lived in any health state that is worse than ideal health. The health state valuations (or *disability weights*) used in DALY and HALE calculations represent societal assessments of levels of health in different states. They range from 0 (representing a state of ideal health) to 1 (representing states equivalent to being dead). Health state valuations quantify the reduction in health associated with a particular health state. In other words, they provide cardinal measures of the preferences of societies that people should have better states of health rather than worse ones. It is important to emphasize that these weights do not measure the quality of life of people with disabilities and do not measure the value of a person to society.

The methods used for the valuation of health states have been subject to intensive debate and development for well over a decade. There is a rich literature in health economics and psychometrics regarding various conceptual, methodological and empirical issues on the measurement of health state valuations. WHO's current approach draws on this experience, and in particular follows from discussions during an international meeting of experts on summary measures held in December 1999, and the subsequent recommendations of a Committee of Experts on Measurement and Classification for Health. The two major goals of ongoing efforts are (a) to extend the empirical basis for health state valuations, in particular to address the scarcity of data on health state valuations from representative community-based samples; and (b) to improve the methodological basis for measuring health state valuations based on strengthening the conceptual links between the required quantities of interest for calculating summary measures of population health and existing measurement techniques.

Disability weights used in DALY estimates were derived initially at a meeting in Geneva with participants from many countries[9]. These weights have since been replicated in many different settings,[43] but to explore more fully if these weights vary systematically between and within different populations, WHO has conducted household (face to face and/or postal) surveys in more than 70 countries, with further surveys in preparation. One of the main objectives for the ongoing WHO work on standardized descriptions of health states for use in population surveys is to facilitate reliable and valid measurements of valuations of time spent in health states in populations across the world, so that the weights reflect the valuations people place on different states of health.

There is a growing consensus among health economists that health state valuations should reflect the preferences of the general population when they are to be used as part of a process of broad health policy assessment, priority setting or resource allocation[44-45]. Health experts were used in the original GBD valuation exercise for convenience reasons due to the practical difficulties in ensuring that lay persons fully understood the impact and severity distribution of the conditions being valued. The Disability Weights Project for Diseases in the Netherlands[46] attempted to address this problem by defining the distribution of health states associated with a health condition by using the modified EuroQol health profile to describe the health states. Few differences were seen in the average PTO preferences assigned by a lay panel (people with an academic background but no medical knowledge) compared with those of two panels of physicians. The Dutch study concluded that it makes little difference whether the valuation panel is composed of health care experts or lay people, as long as accurate functional health state descriptions are included in the specifications of the health problems being valued. Nevertheless, it is important to continue to examine this question more fully in a range of different settings, which is one of the key components of the ongoing research agenda at WHO.

One key methodological challenge for measurement of health state valuations is that responses to existing measurement techniques depend not only on assessments of the health levels in different states, but also on other values such as attitudes toward risk and uncertainty, distributional concerns, or preferences for immediate rather than future outcomes (which economists refer to as time preference). A related issue is that many of the standard measurement methods are highly abstract and cognitively demanding tasks that have demonstrated poor reliability and validity in the general community. In order to address both of these problems, data collection efforts must combine practical and feasible instruments that can be administered in populations with wide ranges of levels of educational attainment with analytical strategies for estimating the quantities of interest from responses to these survey questionnaires.

During the last year, WHO has embarked on large-scale efforts to improve the methodological and empirical basis for the valuation of health states. In collaboration with Member States, WHO has initiated a two-tiered data collection strategy involving the general population surveys described above, combined with more detailed surveys among respondents with high levels of educational attainment in the same sites[47].

In the general population surveys, individuals provide descriptions for a series of hypothetical health states along six core domains of health, followed by valuations of these states using a thermometer-type (visual analog) scale. The visual analog scale provides a relatively simple measurement tool for assessing the health levels associated with the hypothetical states. In several previous pilot studies in diverse settings, the visual analog scale was the only existing measurement technique that was consistently comprehensible to respondents, and that had satisfactory levels of reliability in test-retest experiments. The scaling properties of the visual analog scale have been challenged, however, and there is evidence that the health decrements associated with mild states may be overstated by visual analog responses due to scale distortions. The second arm of the data collection strategy is designed to adjust for these distortions in the estimation of health state valuations derived from the visual analog.

The more detailed surveys include more abstract and cognitively demanding valuation tasks (including the standard gamble, time trade-off and person trade-off) that have limited reliability in general population surveys but have been applied widely in industrialized countries among convenience samples of educated respondents. The objective of these detailed surveys is to provide a better understanding of how the visual analog scale relates to other valuation techniques in order to estimate the underlying health state valuations that inform responses to all different measurement methods. By formalizing the relationships between the different valuation techniques and the underlying quantity of interest based on previous theoretical and empirical findings, statistical methods may be used to recover these underlying valuations and simultaneously to characterize the nature of the scale distortion in visual analog scale responses (as well as to quantify other values such as risk aversion, distributional concerns and time preference). The product of this analysis is a function that may be used to adjust visual analog responses to the appropriate scale for valuations.

The other major analytical task is to estimate the relationship between levels on the different domains of health and the scalar valuations that are required for each health state. Because it is often easier to collect information on the levels of health domains than it is to elicit valuations directly, it is useful to be able to predict valuations indirectly based on a particular health state profile consisting of specified domain levels. In order to develop this mapping function between domain levels and valuations, we have used the descriptions of each hypothetical health state provided by the respondents in the main surveys in conjunction with their valuations of these states. The domain descriptions were first translated from ordinal responses to interval-scale ratings using the statistical approach based on the HOPIT model as described above. We then fit a regression model of the visual analog responses as a function of all six domains, as well as all possible (one-way, two-way, three-way, four-way, five-way and six-way) interactions of these domains. In order to capture the natural constraints of the visual analog responses (between 0 and 1), we used the logit transformation of the responses as the dependent variable. Once the regression equation was estimated, we applied the function to the individual-level survey data in order to estimate the overall severity-weighted prevalence of health states for the 61 surveys in 55 countries.

Health state valuations used to estimate severity-weighted prevalences from health surveys for the year 2000 are based on valuations derived from representative population samples in WHO Member States using a multimethods approach.

4.3 Health state prevalences for 55 Member States

Figure 6 compares the average age-sex specific severity-weighted prevalences of health states for the 61 surveys with the corresponding average prevalence YLD from the GBD 2000 based estimates for those countries. Averages are compared for developed and developing countries separately. Figure 7 compares the average calibrated severity-weighted prevalences for developed and developing countries and also, for the developed countries, the A regions versus EURO B and C (predominantly the former Soviet countries of Eastern Europe). Survey respondents in these latter countries reported substantially worse health than for the A regions. This is consistent with the high adult mortality rates in many of these countries.

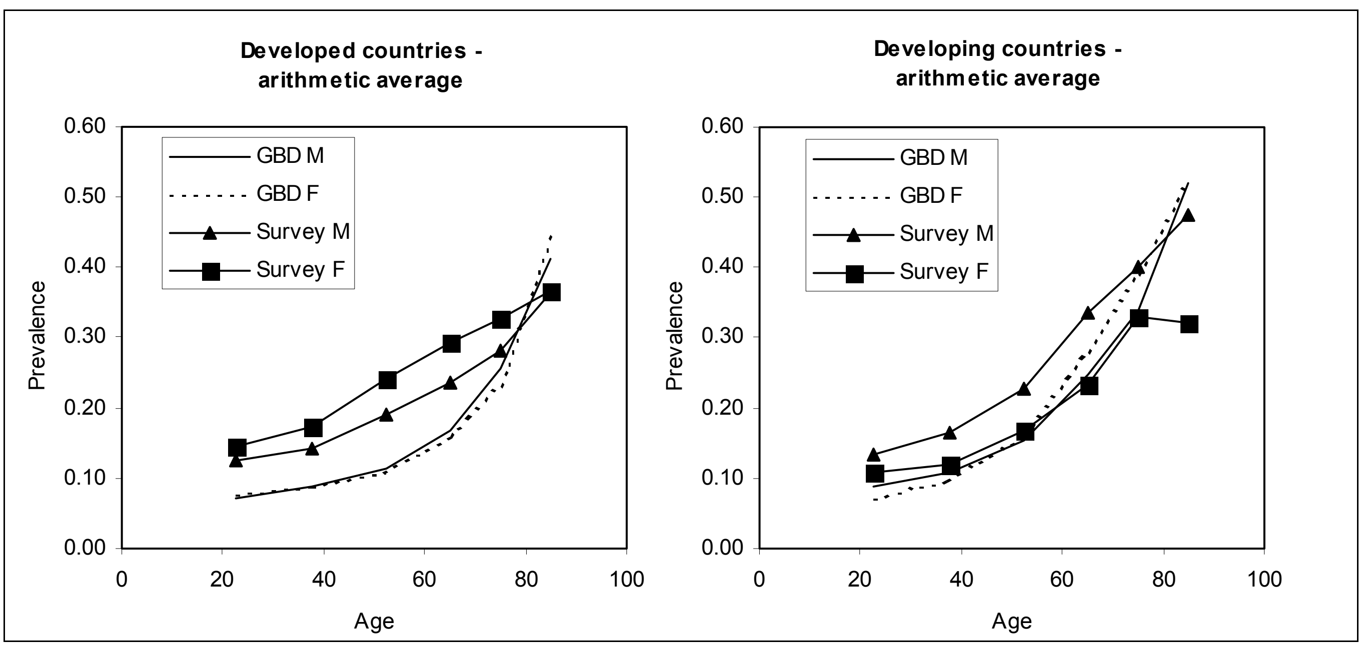


Figure 6. Comparison of severity-weighted average prevalences from surveys and GBD priors, developed and developing countries.

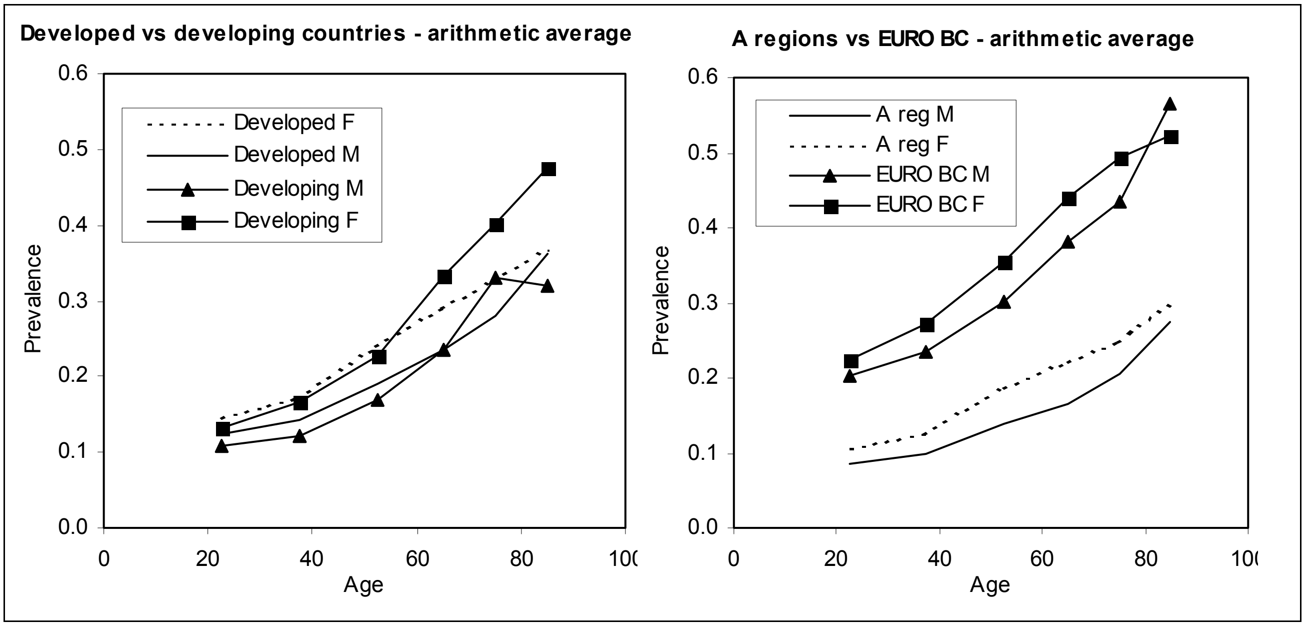


Figure 7. Comparison of severity-weighted average prevalences from surveys for developed and developing countries (left) and for A regions versus Euro B and Euro C regions (right).

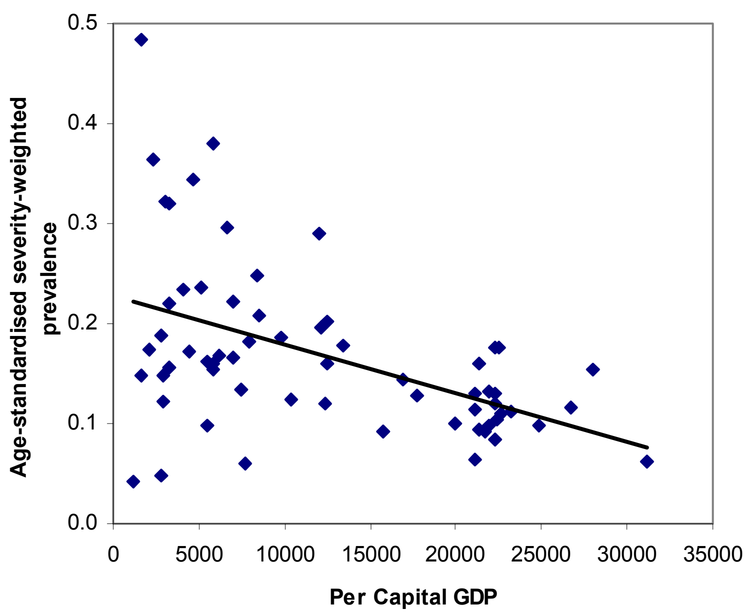


Figure 8. Age-standardised average severity-weighted prevalences versus per capita Gross Domestic Product (PPP 1998), 63 surveys in the WHO 2000 - 2001 household survey study.

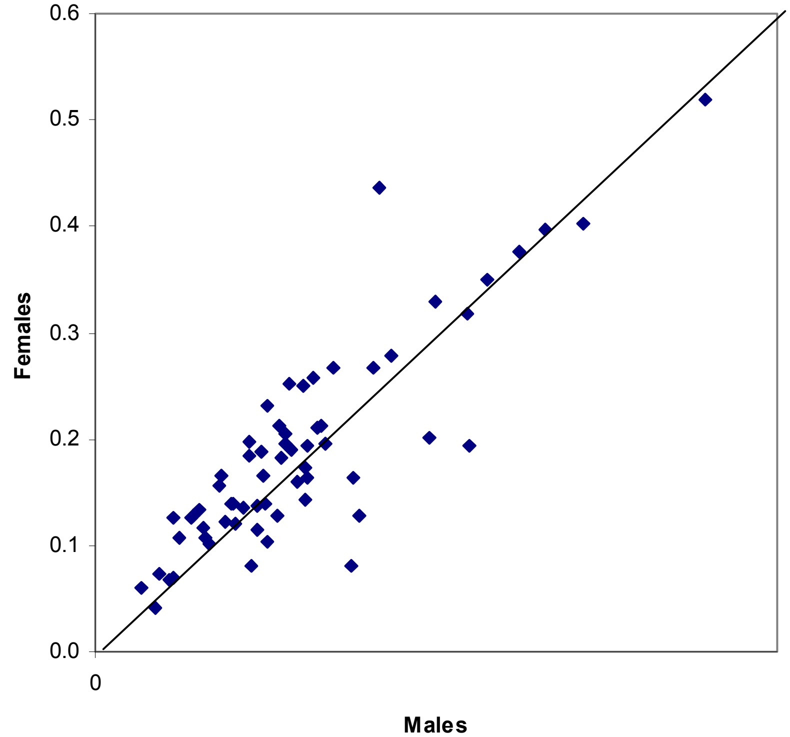


Figure 9. Age-standardised average severity-weighted prevalences for females versus males, 63 surveys in the WHO 2000 - 2001 household survey study

Figure 8 shows the age-standardised average severity-weighted prevalences versus per capita GDP (PPP 1998) for the 55 Member States where surveys were conducted. Unlike many cross-national surveys collecting self-report data on health, there is a clear trend to higher levels of average health status with increasing per capita GDP.

Figure 9 shows the female versus male age-standardised average severity-weighted prevalences for the 55 Member States where surveys were conducted. There were 3 surveys where male age-standardised prevalences were significantly higher than females: Australia, Venezuela and Costa Rica. All three of these surveys were postal surveys and two of them, Australia and Venezuela, had low response rates (less than 40%). This raised concerns about non-response bias for these particular surveys and, following consultation, it was decided to base the HALE estimates for these countries on the methods used to estimate posterior prevalences for non-survey countries (see Section 4.4).

Statistical methods and new survey techniques have been used to improve the comparability of self-report health status data collected in 55 Member States for the calculation of HALE.

4.4 Posterior health state prevalences for Member States

The prevalence estimates for Member States based on the GBD 2000 and the prevalence estimates for the Member States with health surveys have been combined using Bayesian methods to obtain posterior health state prevalences for all Member States. Bayesian statistical analysis techniques use evidence E (the health surveys) together with prior probability distributions $P(H)$ (the GBD-based prevalence estimates) to calculate new posterior probability distributions as follows:

$$P(H|E) = P(H)P(E|H)/P(E)$$

where $P(H|E)$ is called the posterior probability of H given evidence E. The term $P(E|H)$ is called the likelihood, and it gives the probability of E given the prior probability distribution of H.

When the evidence (survey mean severity-weighted prevalences by age and sex) and the prior means are both normally distributed, then the posterior mean severity-weighted prevalence is given by the weighted sum of the survey mean and the prior mean as follows:

$$Prev_{Post} = w_1 * Prev_{Survey} + w_2 * Prev_{Prior}$$

where the weights are defined in terms of the standard deviation SD_1 for the average survey prevalence (for a given age and sex) and the standard deviation SD_2 for the prior prevalence (for the given age and sex) as:

$$w_1 = SD_2^2 / \left(SD_1^2 + SD_2^2\right)$$

$$w_2 = SD_1^2 / \left(SD_1^2 + SD_2^2\right)$$

The standard deviations for the prior means where estimated by carrying out an uncertainty analysis of the GBD prevalence YLD estimates at country level[49]. This took into account uncertainty in the regional disease-specific YLD estimates arising from uncertainty in epidemiological estimates of prevalence and severity of sequelae, as well as uncertainty in the estimates of YLD arising from residual cause categories, uncertainty in the estimation of country-level prevalence YLD from regional averages and country cause of death data, and uncertainty in the adjustment for comorbidity between causes. While uncertainty in YLD estimates for individual diseases may best be modelled by uniform or triangular distributions, the central limit theorem ensures that the overall uncertainty distribution for prevalence YLD from all causes is approximately normal. The variance of this distribution is the most appropriate statistical measure for the range of the uncertainty.

The standard deviations for the survey means were derived from the sampling variation (due to finite sample size) together with uncertainty arising from the HOPIT calibration process (the uncertainty in estimates of HOPIT parameters). Additionally, uncertainty arising from non-random causes such as sampling bias was estimated for postal surveys and for other surveys separately using least squares regression to estimate root mean standard error of survey estimates around the prior estimates[49].

The resulting survey weight w_1 varied across survey countries by age and sex, due to variation both in survey standard deviations and in prior standard deviations. The average survey weight across all countries ranged from around 0.2 at younger and older ages to 0.4 for middle age groups for males, and from around 0.15 at younger and older ages to 0.2 for middle age groups for females (Figure 10). In estimating the posterior prevalences for the survey countries, survey prevalences for 18-29 year olds were assumed to apply to the age group 15-

29 years. Posterior prevalences for 0-4 and 5-14 year age groups were assumed to be the same as the prior prevalences for those age groups.

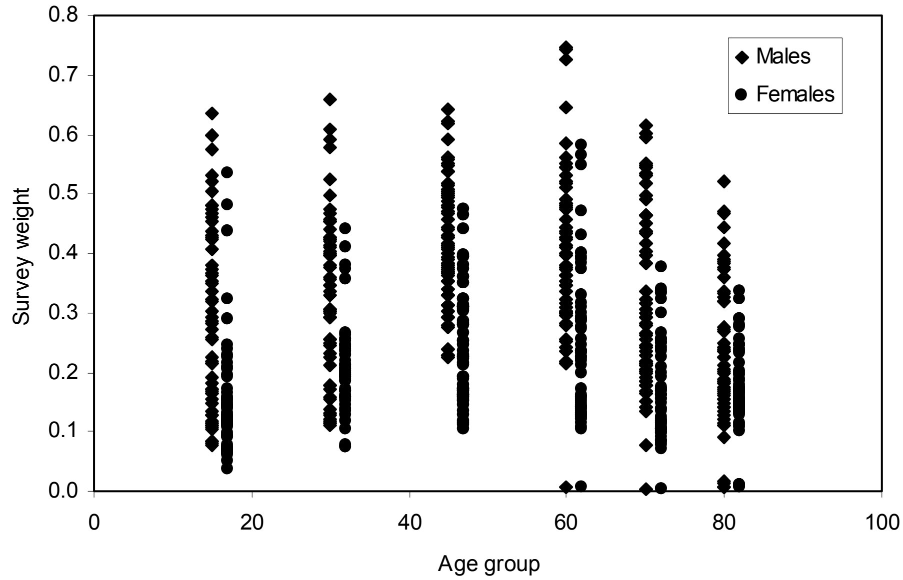


Figure 10. Survey weights by age and sex, 63 surveys in 55 countries, 2000-2001

Because the survey mean prevalences are on average higher than the GBD priors, the posterior estimates are on average higher than the priors. If GBD priors for non-survey countries are not updated, then the use of posteriors for survey countries only would result in a systematic difference in prevalences between survey and non-survey countries.

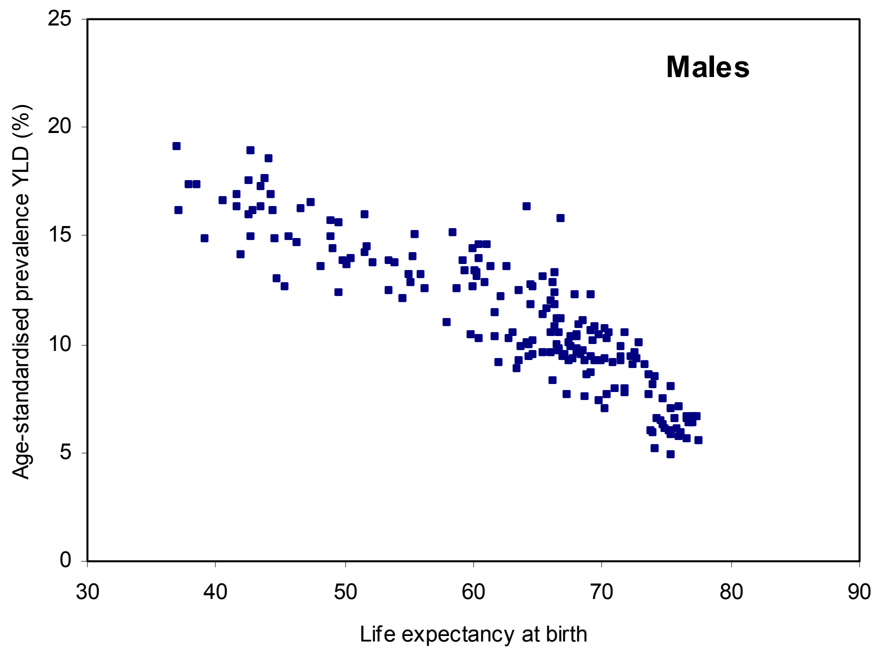
To avoid this problem, the evidence from the surveys was also used to update the non-survey priors. Least squares ordinary regression was used to fit the following model for the survey countries:

$$Prev_{Post} = \alpha + \beta * Prev_{Prior} + \delta_1 * POSTAL + \delta_2 * EUROBC$$

where POSTAL is 1 for postal surveys, 0 otherwise, and EUROBC is 1 for countries in the EURO region in mortality strata B and C (high adult mortality countries), 0 for countries in other regions.

A range of models including factors such as dummies for other survey types and regions, country life expectancy, country-specific risk of death at given ages, and GDP per capita were also examined. None of these models provided significantly better fit to the data. Only the above terms were significant in the model and retained. Goodness of fit was taken into account through the uncertainty analysis as outlined below.

The fitted model was used to estimate posterior severity-weighted prevalences for all non-survey countries. The Bayesian posterior for survey countries was adjusted for countries with postal surveys using the regression coefficient for the postal dummy. This adjusts for the systematic and significant differences in prevalences between postal and household surveys, so that the reference standard for all posterior estimates is household survey type. Where a country had a household and postal or telephone survey, the posterior based on the household survey was used. Where a country had a brief-face-to-face and postal or telephone survey, the arithmetic average of the two posteriors was used.



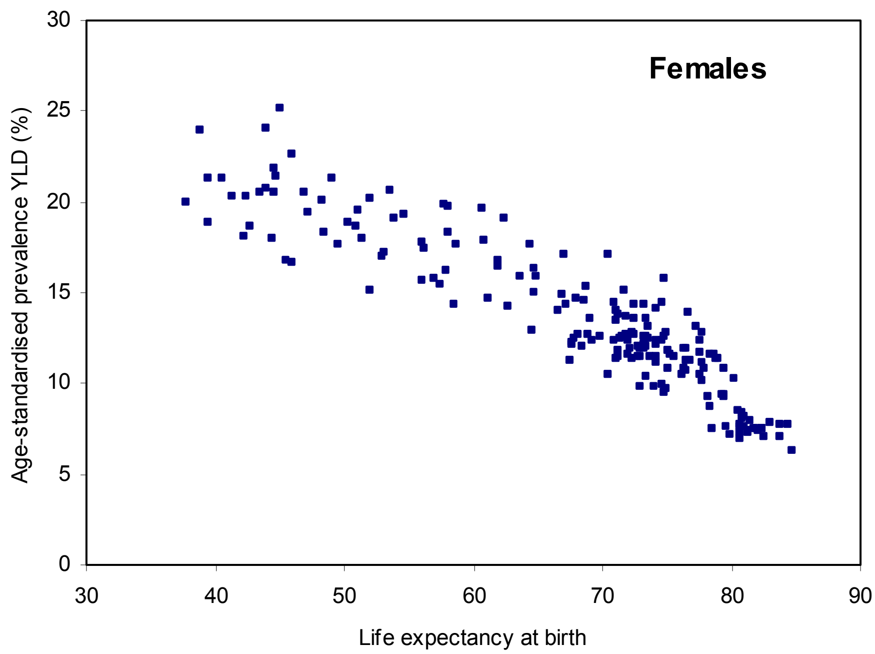
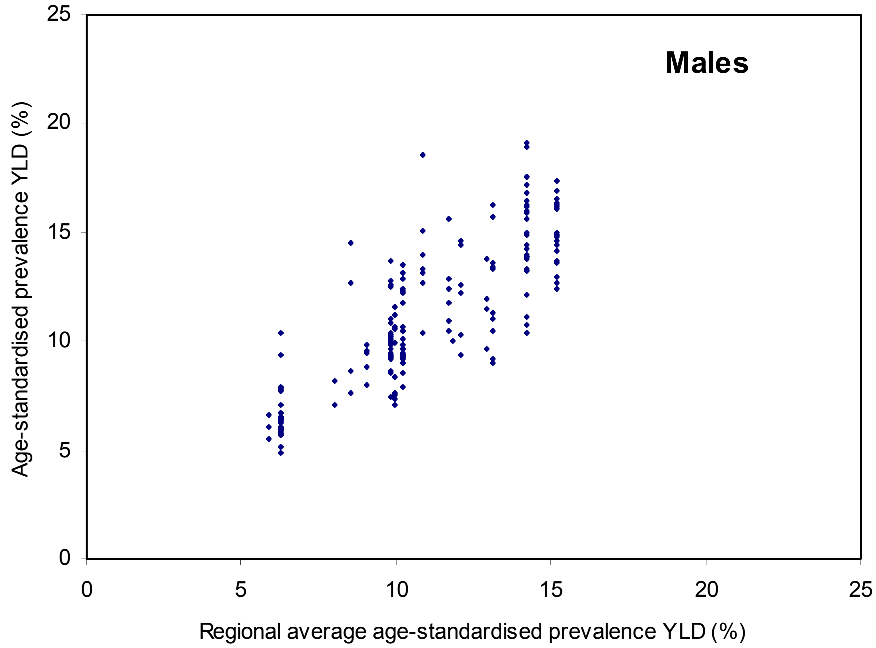


Figure 11. Estimated age-standardised posterior prevalence YLD rate versus life expectancy at birth, by sex, WHO Member States, 2000.



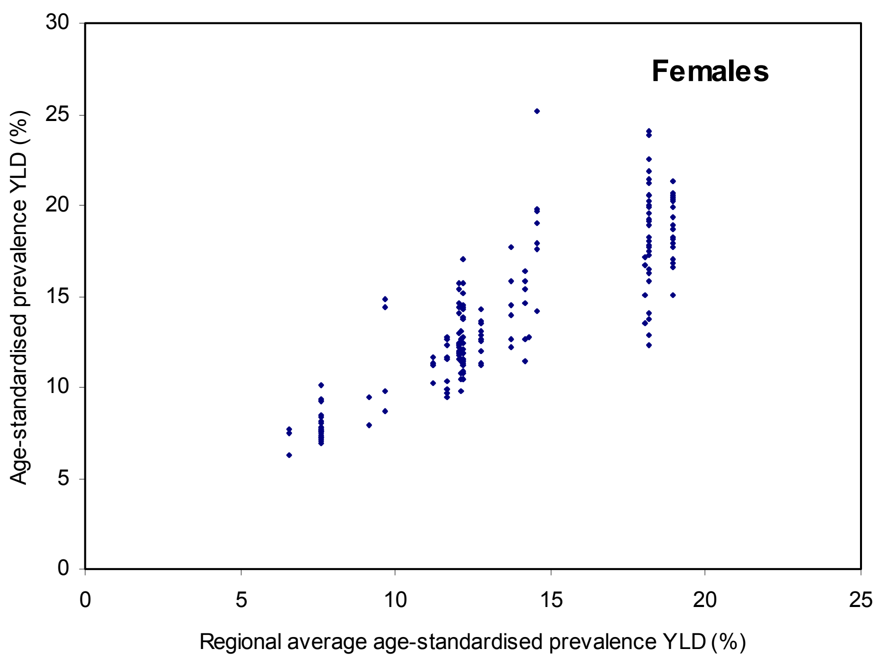


Figure 12. Estimated age-standardised posterior prevalence YLD: country versus regional rate, by sex, WHO Member States, 2000.

A Bayesian technique is used to estimate posterior prevalences for 191 Member States by utilising prior prevalence estimates based on the GBD 2000 and country-level data, together with independent evidence from the WHO Multi-country Household Survey program for 55 Member States.

4.5 Calculation of HALE

Sullivan's method was used to compute HALE for each Member State from the country life table and the severity-weighted prevalence estimates. Sullivan's method involves using the severity-weighted prevalence of health states (adjusted for comorbidity) at each age in the current population (at a given point of time) to divide the hypothetical years of life lived by a period life table cohort at different ages into years with and without disability. The method is illustrated in detail in Mathers et al.[42].

Using standard notation for the country life table parameters, we calculated HALE at age x as follows:

D_x Severity-weighted prevalence of disability between ages x and x+5

$YD_x = L_x * D_x$ Equivalent years of healthy life lost due to disability between ages
x and x+5

$YWD_x = L_x * (1- D_x)$ Equivalent years of healthy life lived between ages x and x+5
L_x is the total years lived by the life table population between ages x and x+5

HALE at age x is the sum of YWD_i from i = x to w (the last open-ended age interval in the life table) divided by l_x (survivors at age x):

$$HALE_x = \left(\sum_{i=x}^{w} YWD_i \right) / l_x \qquad (11)$$

$$LHE_x = \left(\sum_{i=x}^{w} YD_i \right) / l_x = LE_x - HALE_x \qquad (12)$$

LHE_x,the equivalent healthy years of life lost, is the sum of YD_i from i = x to w divided by l_x (survivors at age x).

Sullivan's method was applied in abridged life tables using five year age intervals, up to an open-ended interval of 100+ years. The first interval was subdivided into 0 years and 1-4 years. Posterior prevalences were calculated for the GBD age groups (0-4, 5-14, 15-29, 30-44, 45-59, 60-69, 70-79, 80+) and were assumed to be constant for the five year age groups within each GBD age group. More detailed calculations showed that error in the final estimate of HALE introduced by this approximation is less than 0.1 years.

4.6 Uncertainty analysis

Uncertainty intervals have been estimated for life expectancies and other life table parameters for WHO member countries as described by Salomon et al.[49]. To capture the uncertainty due to sampling, indirect estimation techniques and projections, a total of between 600 and 1000 life tables were developed for each Member State in order to quantify the uncertainty distribution of key life table parameters. In countries with a substantial HIV epidemic, recent estimates of the level and uncertainty range of the magnitude of HIV/AIDS deaths by age and sex have been incorporated into the life table uncertainty analysis.

The degree of uncertainty in country-level weighted disability prevalences has also been estimated for each country. This is mainly determined by levels of uncertainty in

(a) GBD prior prevalence estimates (including uncertainty in epidemiological estimates for prevalence, incidence and/or severity of disability associated with specific conditions, and in health state preferences),

(b) uncertainty in the survey-based prevalence estimates, and

(c) uncertainty arising from the estimation of posterior prevalence.

A more detailed description of the uncertainty analysis for the survey prevalence estimates will be forthcoming in a WHO/GPE discussion paper to be released in October[49]. The overall approach was as follows:

1. The degree of uncertainty in the country-level GBD priors was estimated from an analysis of uncertainty in (a) epidemiological estimates for prevalence and/or incidence of disability associated with specific causes or cause groups, (b) disability weights arising from uncertainty in health state valuations and, in some cases, also in the disability severity distribution associated with a condition, (c) estimation of prevalence YLD at country level from the regional prevalence YLD rates, and in some cases from incidence YLD, and (d) and the approximate nature of adjustments for comorbidity.

2. The standard deviations for the survey means were derived from the sampling variation (due to finite sample size) together with uncertainty arising from the HOPIT calibration process (the uncertainty in estimates of HOPIT parameters). Additionally, uncertainty arising from non-random causes such as sampling bias was estimated for postal surveys and for other surveys separately using least squares regression to estimate root mean standard error of survey estimates around the prior estimates.

3. The variance of the posterior estimate for countries with surveys is given by:

$$SD_{POST}{}^2 = SD_1{}^2 \, SD_2{}^2 \Big/ \left(SD_1{}^2 + SD_2{}^2\right)$$

   where SD_1 is the standard deviation for the average survey prevalence (for a given age and sex) and SD_2 is the standard deviation for the prior prevalence (for the given age and sex).

4. Uncertainty in the posterior estimates derived from the regression model was estimated using a Monte Carlo simulation procedure to capture uncertainty arising from the priors, the posterior estimates for survey countries arising from the combined uncertainties of the priors and the surveys), and uncertainty in the regression model parameter estimates.

Uncertainty in the HALE estimates was calculated by drawing prevalences from the posterior prevalence distribution and combining these with the life table draws to generate an uncertainty distribution for HALE. In making the prevalence draws, allowance was made for correlation in prevalences across age groups, and for correlation between prevalences and mortality rates (arising from the country-level estimation process for GBD priors).

Annex Table A gives 95% uncertainty intervals for HALE for all Member States. Note that the uncertainty intervals published last year in the WHR 2000 were 80% uncertainty intervals, not 95% intervals. These uncertainty intervals will enable readers to compare HALE estimates for Member States, keeping in mind the uncertainty in these comparisons. This will help readers to avoid giving undue emphasis to small differences in mean ranks for countries.

> The uncertainty estimates for HALE in 2000 are based on a more comprehensive analysis of all sources of uncertainty in the life tables, GBD prior estimates, survey estimates and Bayesian posterior estimation.

5 Results

5.1 Posterior prevalences for WHO regions and subregions

Using the methods outlined above, we have estimated severity-weighted posterior health state prevalences by age for males and females in the 191 Member States of WHO for 2000, as well as for 17 epidemiological sub-regions of the world, the 6 WHO regions and for the total global population. These estimates are based on country-specific estimates of mortality, cause of death patterns, epidemiological analyses and health survey data. We summarise the results in this Section at regional level (Tables 7 and 8).

5.2 HALE for WHO regions and subregions

Using the severity-weighted posterior health state prevalences by age for males and females in the 191 Member States of WHO for 2000, in conjunction with new life tables for the year 2000, we have estimated healthy life expectancy (HALE) for all Member States. These estimates are based on country-specific estimates of mortality, cause of death patterns, epidemiological analyses and health survey data. We summarise the results in this Section at regional level. Estimates and uncertainty intervals for HALE at age 0 and 60 are given in full in Annex Table A for each Member State.

Table 7. Overall prevalence YLD rates (%) for WHO epidemiological subregions for the year 2000.

Sex	Subregion	0-4	5-14	15-29	30-44	45-59	60-69	70-79	80-89	Age-std (a)
Males										
	AFRO	9.0	6.8	10.7	14.9	21.7	34.3	47.2	54.5	14.7
	AMRO	5.0	4.5	7.7	9.8	12.7	20.0	27.2	38.6	9.3
	EMRO	7.7	5.2	7.8	11.2	18.8	31.5	41.6	48.7	12.0
	EURO	3.8	3.3	7.4	9.6	14.3	21.0	28.0	35.3	9.1
	SEARO	6.4	5.0	7.2	10.0	15.6	25.6	36.3	48.6	10.5
	WPRO	4.8	3.9	6.3	7.7	11.7	19.9	31.2	40.7	8.4
	World	6.3	4.7	7.5	9.6	14.2	22.7	31.9	40.9	9.9
Females										
	AFRO	8.1	6.4	14.4	19.7	27.2	42.1	52.0	58.0	18.6
	AMRO	4.7	4.5	9.5	11.3	14.7	21.3	27.2	40.7	10.9
	EMRO	7.7	5.4	11.2	16.3	26.5	40.8	46.6	54.3	16.6
	EURO	3.7	3.5	8.5	10.4	14.1	20.8	28.0	36.9	10.0
	SEARO	6.1	5.1	10.6	13.7	20.3	30.9	38.7	50.5	13.9
	WPRO	4.8	4.0	7.3	8.6	12.6	19.2	28.0	40.9	9.5
	World	6.0	4.8	9.8	11.9	16.6	24.7	31.4	41.3	12.0

Table 8. Overall prevalence YLD rates (%) for WHO epidemiological subregions for the year 2000.

Sex	Subregion	0-4	5-14	15-29	30-44	45-59	60-69	70-79	80-89	Age-std (a)
Males										
	AFRO D	9.0	6.6	9.9	13.7	21.7	34.7	46.7	53.1	14.2
	AFRO E	9.0	6.9	11.5	16.0	21.7	34.0	47.7	55.9	15.2
	AMRO A	2.3	2.8	8.1	9.2	10.0	16.0	23.6	36.6	8.0
	AMRO B	6.1	5.3	7.3	10.0	15.0	24.0	32.0	42.5	10.2
	AMRO D	6.0	5.4	8.5	12.0	18.2	27.0	36.0	45.0	11.7
	EMRO B	5.4	3.8	6.1	9.3	15.4	28.0	37.6	42.7	9.8
	EMRO D	8.4	5.7	8.6	12.1	20.4	32.9	43.2	51.3	12.9
	EURO A	2.0	2.3	5.6	6.9	8.7	13.2	21.7	31.7	6.3
	EURO B1	4.5	3.5	7.3	10.2	16.9	24.7	30.5	40.2	10.0
	EURO B2	7.8	5.3	8.1	11.3	20.5	28.7	38.2	46.6	12.1
	EURO C	4.7	3.8	9.9	13.6	23.1	33.5	42.2	46.9	13.1
	SEARO B	6.0	4.5	6.9	8.7	12.5	19.0	31.3	44.1	9.1
	SEARO D	6.5	5.0	7.2	10.4	16.4	27.3	37.5	49.5	10.8
	WPRO A	2.8	2.9	5.0	6.4	7.9	11.1	16.9	29.2	5.9
	WPRO B1	4.7	3.9	6.3	7.6	12.0	21.3	34.5	44.6	8.6
	WPRO B2	5.5	4.4	7.0	9.2	14.9	23.5	34.9	48.2	9.8
	WPRO B3	6.0	4.6	7.7	11.5	20.6	31.4	38.3	41.2	11.8
	World	6.3	4.7	7.5	9.6	14.2	22.7	31.9	40.9	9.9
Females										
	AFRO D	8.2	6.2	13.9	16.6	22.3	35.1	48.0	61.4	18.1
	AFRO E	8.0	6.5	16.2	19.2	22.3	34.0	47.2	61.3	19.0
	AMRO A	2.2	2.8	8.4	8.6	10.7	16.2	24.5	43.7	9.1
	AMRO B	5.7	5.1	9.8	11.9	15.7	23.9	32.1	46.0	12.2
	AMRO D	5.7	5.3	10.6	13.1	17.5	25.8	34.7	48.3	13.7
	EMRO B	5.5	3.9	8.5	11.5	16.8	27.6	35.3	48.0	12.7
	EMRO D	8.4	6.0	12.6	15.9	22.6	34.0	44.8	61.6	18.1
	EURO A	1.9	2.4	6.9	7.7	9.2	14.2	22.4	36.1	7.6
	EURO B1	4.3	3.8	9.4	10.8	13.4	18.2	23.6	36.5	11.6
	EURO B2	7.7	5.4	11.2	13.2	19.0	25.5	32.3	44.0	14.2
	EURO C	4.4	3.9	8.8	10.9	13.8	18.7	24.4	36.9	12.1
	SEARO B	5.6	4.5	9.9	11.1	15.4	23.5	32.6	45.4	11.2
	SEARO D	6.3	5.2	12.2	14.5	19.4	28.3	38.2	50.0	14.6
	WPRO A	2.5	2.9	6.1	6.8	7.9	11.6	17.4	32.7	6.6
	WPRO B1	4.8	4.0	7.2	8.4	12.3	18.2	29.3	45.1	9.7
	WPRO B2	5.4	4.4	9.6	10.9	14.7	22.9	33.1	48.4	12.0
	WPRO B3	5.8	4.8	10.7	13.5	19.4	28.8	35.1	41.9	14.3
	World	6.0	4.8	9.8	11.9	16.6	24.7	31.4	41.3	12.0

(a) Total rate age-standardised to World Standard Population.

Table 9. Life expectancy (LE), healthy life expectancy (HALE), and lost healthy years as per cent of total LE (LHE%), at birth and at age 60, by sex and total, WHO regions and world, 2000

	Persons			Males			Females		
WHO Region	HALE (years)	LE (years)	LHE% (%)	HALE (years)	LE (years)	LHE% (%)	HALE (years)	LE (years)	LHE% (%)
At birth									
AFRO	38.8	47.3	18.0	39.1	46.4	15.8	38.5	48.2	20.2
AMRO	63.2	73.0	13.4	61.3	69.8	12.2	65.1	76.2	14.5
EMRO	51.2	62.4	17.9	52.0	61.3	15.2	50.4	63.5	20.6
EURO	62.9	71.9	12.6	59.9	67.9	11.7	65.8	76.0	13.4
SEARO	52.7	61.9	15.0	52.6	60.4	12.8	52.7	63.5	17.0
WPRO	63.0	71.6	12.0	61.4	69.2	11.2	64.6	74.0	12.7
World	56.0	65.0	13.8	54.9	62.7	12.5	57.0	67.2	15.1
At age 60									
AFRO	8.3	14.8	43.9	8.3	13.8	40.2	8.3	15.8	47.3
AMRO	15.0	20.5	27.0	13.9	18.7	25.8	16.0	22.3	28.0
EMRO	9.8	16.5	40.9	9.9	15.6	36.7	9.7	17.5	44.7
EURO	14.2	19.2	26.2	12.7	17.1	25.5	15.6	21.3	26.7
SEARO	10.7	16.3	34.3	10.2	14.9	31.6	11.2	17.7	36.6
WPRO	14.1	19.3	26.8	12.7	17.3	26.7	15.6	21.3	26.9
World	13.0	18.4	29.4	11.9	16.7	28.3	14.1	20.2	30.3

Country-level estimates for mortality and disability were aggregated to estimate life expectancy (LE) and healthy life expectancy (HALE) for each of the six WHO Regions and for the world (Table 9). Regional healthy life expectancies at birth in 2000 ranged from a low of 39 years for African males and females to a high of almost 66 years for females in the low mortality countries of Western Europe. Regional healthy life expectancies at age 60 in 2000 ranged from a low of 8.3 years for Africans to a high of around 16 years for females in Europe, North America and the Western Pacific region.

Overall, global healthy life expectancy at birth for males and females combined in 2000 is 56.0 years, 9.0 years lower than total life expectancy at birth. Global HALE at birth for females is just over 2 years greater than that for men (Table 9). In comparison, total life expectancy at birth is almost 4 years higher than that for men. HALE at birth ranges from a low of 39 years for African women to a high of 72 years in the low mortality countries of mainly Western Europe and North America. This is a 2-fold difference in healthy life expectancy between major regional populations of the world. The difference between HALE and total life expectancy is HLE (healthy life expectancy "lost" due to disability). The equivalent "lost" healthy years range from 20% (of total life expectancy at birth) in Africa to 11-12% in the European region and the Western Pacific region. The equivalent "lost" healthy years at age 60 are a higher percentage of remaining life expectancy, due to the higher prevalence of disability at older ages. These range from around 40-50% in sub-Saharan Africa to around 25% in developed countries.

Table 10. Life expectancy (LE), healthy life expectancy (HALE), and lost healthy years (LHE) as per cent of total LE (HLE%), at birth and at age 60, by sex and total, by mortality subregion, 1999

	Persons			Males			Females		
WHO Region	HALE (years)	LE (years)	LHE% (%)	HALE (years)	LE (years)	LHE% (%)	HALE (years)	LE (years)	LHE% (%)
At birth									
AFRO D	42.1	51.6	18.5	42.4	50.5	16.2	41.8	52.7	20.6
AFRO E	36.5	44.4	17.8	36.7	43.5	15.6	36.2	45.2	19.9
AMRO A	68.0	77.2	11.8	66.3	74.4	10.9	69.7	79.9	12.8
AMRO B	60.7	71.1	14.7	58.6	67.6	13.2	62.7	74.6	15.9
AMRO D	55.4	65.9	16.0	54.2	63.5	14.6	56.6	68.4	17.3
EMRO B	59.5	69.9	15.0	59.3	68.4	13.3	59.6	71.4	16.5
EMRO D	52.8	65.7	19.5	53.5	63.8	16.3	52.2	67.5	22.6
EURO A	70.2	78.0	10.0	68.2	74.8	8.9	72.2	81.2	11.1
EURO B1	60.5	70.3	14.0	58.4	66.9	12.8	62.6	73.7	15.1
EURO B2	54.3	64.7	16.1	52.5	61.6	14.8	56.0	67.8	17.3
EURO C	56.0	66.2	15.4	51.1	60.3	15.2	61.0	72.1	15.5
SEARO B	58.7	67.1	12.6	57.2	64.6	11.3	60.1	69.7	13.8
SEARO D	51.1	60.5	15.6	51.5	59.3	13.2	50.7	61.7	17.8
WPRO A	73.5	80.8	9.1	70.9	77.4	8.3	76.1	84.3	9.7
WPRO B1	62.2	70.9	12.2	60.9	68.8	11.5	63.6	73.0	13.0
WPRO B2	53.7	62.1	13.4	52.4	59.6	12.1	55.0	64.5	14.6
WPRO B3	50.1	59.5	15.8	49.6	58.0	14.4	50.5	60.9	17.1
World	56.0	65.0	13.8	54.9	62.7	12.5	57.0	67.2	15.1
At age 60									
AFRO D	8.4	15.1	44.3	8.5	14.2	40.2	8.3	16.0	47.9
AFRO E	8.2	14.5	43.6	8.1	13.5	40.1	8.3	15.6	46.7
AMRO A	16.4	21.6	23.8	15.3	19.8	22.6	17.6	23.4	24.9
AMRO B	13.4	19.3	30.8	12.4	17.6	29.6	14.3	21.0	31.8
AMRO D	11.9	18.0	33.9	11.3	16.8	32.4	12.5	19.3	35.2
EMRO B	11.5	17.6	34.8	11.1	16.7	33.1	11.8	18.5	36.3
EMRO D	9.3	16.4	43.4	9.5	15.4	38.2	9.1	17.5	47.9
EURO A	17.0	21.6	21.2	15.6	19.4	19.4	18.4	23.8	22.6
EURO B1	12.8	18.1	29.1	11.6	16.3	28.6	14.0	19.9	29.5
EURO B2	11.1	16.7	33.5	10.1	15.3	33.9	12.1	18.1	33.1
EURO C	10.6	16.1	34.5	8.5	13.7	37.5	12.6	18.6	32.2
SEARO B	12.6	17.4	27.6	12.0	16.3	26.2	13.2	18.6	28.7
SEARO D	10.3	16.1	36.0	9.9	14.7	32.9	10.7	17.5	38.7
WPRO A	19.6	23.9	17.9	17.6	21.2	17.0	21.6	26.5	18.6
WPRO B1	13.2	18.5	28.7	11.9	16.6	28.7	14.5	20.4	28.7
WPRO B2	11.4	16.5	31.1	10.8	15.4	30.0	12.0	17.6	32.0
WPRO B3	10.6	16.5	35.5	9.9	15.2	34.8	11.3	17.7	36.2
World	13.0	18.4	29.4	11.9	16.7	28.3	14.1	20.2	30.3

When HALE is calculated for the 17 epidemiological subregions of the world, the range is even greater (Table 10). Subregional healthy life expectancies at birth in 2000 ranged from a low of 36 years for the very high mortality subregion of Africa to a high of 76 years for females in the low mortality countries of the Western Pacific region (these include Japan, Australia, New Zealand and Singapore). The very low health expectancies of the African countries in both subregions D and E reflects the high burden of HIV/AIDS, malaria, other communicable, maternal, perinatal and nutritional conditions, and injuries.

Despite the fact that people live longer in the richer, more developed countries, and have greater opportunity to acquire non-fatal disabilities in older age, disability has a greater absolute (and relative) impact on healthy life expectancy in poorer countries. Separating life expectancy into equivalent years of good health and years of lost good health thus widens rather than narrows the difference in health status between the rich and the poor countries.

The relative contributions of diseases and injuries to variations in HALE are best summarised in terms of the loss of healthy life measured in DALYs. The World Health Report 2001 provides detailed estimates of DALYs for over 100 disease and injury categories for the 14 mortality subregions and also gives tables of the leading causes of DALYs worldwide and by region. While the rankings are broadly similar for the two sexes, there are important differences. Thus while lower respiratory infections, perinatal conditions, HIV/AIDS and are the three leading causes of DALYs their relative importance differs slightly for males and females. More importantly, depression is the fourth leading cause of disease burden for females but ranks seventh for males. Maternal conditions are the seventh leading cause for females, causing almost 4% of their global disease burden in 2000. Road traffic accidents are a leading cause of overall disease and injury burden for males (3.1%) but not for females (1.3%).

5.3 HALE estimates for WHO Member States, 2000

Annex Table A gives estimates of healthy life expectancy at age 0 and age 60 together with 95% uncertainty intervals for 191 WHO Member States. Japanese women lead the world with an estimated average healthy life expectancy of 76.3 years at birth in the year 2000, 8.4 years lower than total life expectancy at birth. HALE at birth for Japanese males is 5.1 years lower at 71.2 years. This is a narrower gap than for total life expectancy at birth of 7.2 years. After Japan, in second to sixth places, are Switzerland, San Marino, Andorra, Monaco, and Australia with healthy life expectancies at birth (males and females combined) in the range 71.5 to 72.1 years, followed by a number of other industrialized countries of Western Europe. Note however, that there is a considerable range of uncertainty in the ranks for countries other than Japan, with typical 95% uncertainty ranges of around 3 years for developed countries. Canada is in 17th place (70.0 years) and the USA in 28th place (67.2 year).

Other countries with reasonably high healthy life expectancies in the Americas include Chile (65.5 years), Costa Rica (65.3 years), Dominica (64.6 years), Mexico (64.2 years) and Uruguay at 64.1 years. Brazil is split, with a high healthy life expectancy in its southern half, and a lower one in the north. The total average is a relatively low 57.1 years, at 54.9 for males and 59.2 for females.

China has a healthy life expectancy above the global average, at 62.1 years, 63.3 years for women and 60.9 for men. Other countries in the Asian region generally have lower HALE. Improving health in Viet Nam has resulted in a healthy life expectancy of 58.9 years, while Thailand has not improved significantly over the past decade, though it is still ahead of Viet

Nam at 59.7 years. Healthy life expectancy in Myanmar is just 49.1 years, substantially behind its Southeast Asian neighbors.

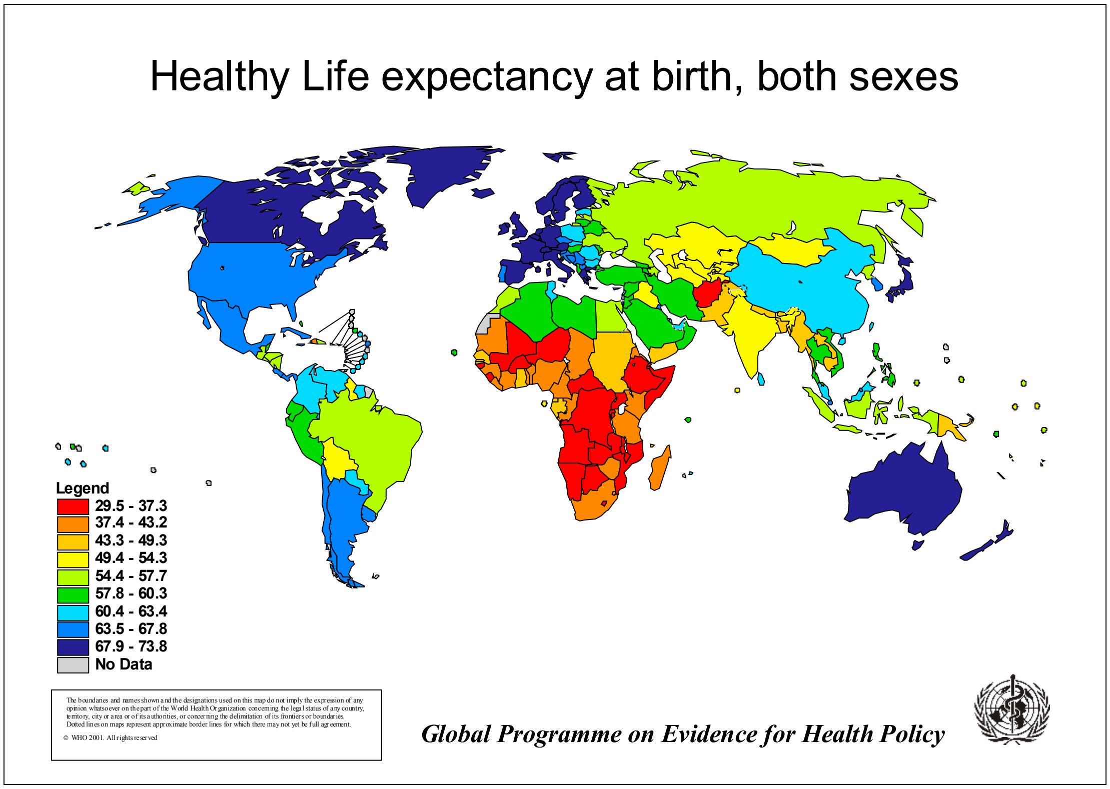


Figure 13. Average HALE at birth (males and females combined), 191 Member States, 2000

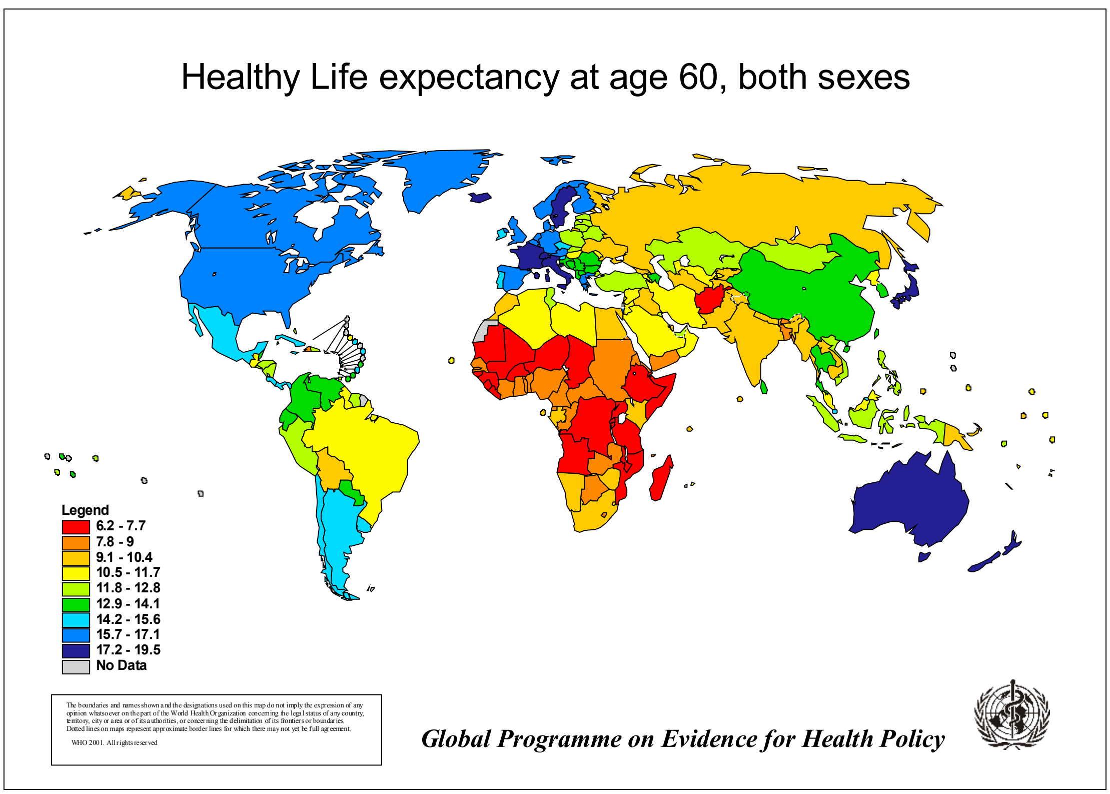


Figure 14. Average HALE at birth (males and females combined), 191 Member States, 2000

In Russia, healthy life expectancy is 60.6 for females, 5 years below the European average, but just 50.3 years for males, 9.6 years below the European average. This is one of the widest sex gaps in the world and reflects the sharp increase in adult male mortality in the early 1990s. The most common explanation is the high incidence of male alcohol abuse, which led to high rates of accidents, violence and cardiovascular disease. From 1987 to 1994, the risk of premature death increased by 70% for Russian males. Between 1994 and 1998, life expectancy improved for males, but has declined significantly again in the last three years. Similar rates exist for other countries of the former Soviet Union.

The bottom 10 countries for HALE are all in sub-Saharan Africa, where the HIV-AIDS epidemic is rampant. The lowest health expectancy in 2000 was estimated at 29.5 years in Sierra Leone. Life expectancy in several countries in southern Africa has been reduced 15-20 years in comparison to life expectancy without HIV. Other African countries have lost 5-10 years of life expectancy because of HIV (Salomon and Murray 2001). AIDS is now the leading cause of death in Sub-Saharan Africa, far surpassing the traditional deadly diseases of malaria, tuberculosis, pneumonia and diarrhoeal disease. AIDS killed 2.2 million Africans in 2000, versus 300,000 AIDS deaths 10 years previously.

The worldwide pattern of health expectancies at birth in 2000 is shown in Figure 13, highlighting the enormous variation between developing countries and developed countries, as well as between the lower and higher mortality regions of Europe. Figure 14 shows the distribution of healthy life expectancy at age 60 in 2000. Both these figures show average HALE for males and females combined.

Figure 15 shows average HALE at birth versus total life expectancy at birth for 191 countries. While lower life expectancies are generally associated with lower healthy life expectancy – the two indicators are correlated - there are large variations in healthy life expectancy for any given level of life expectancy. For example, for countries with a life expectancy of 70, healthy life expectancy varies from 57 to 61.5, a non-trivial variation. If male and female HALE are considered separately, the range of variation increases to 57—65 at total life expectancy of 70. Full details of male and female HALE and total life expectancy at birth and at age 60, together with 95% uncertainty ranges, are also available by country in the World Health Report 2001 (WHO 2001).

Figure 16 shows the relationship between healthy life expectancy at birth for males and females for the Member States. In the countries with HALE at birth of 45 years or lower, male and female HALE are almost the same. These countries are almost entirely African countries, but include the Lao People's Republic, Haiti and Nepal. There are a number of countries with HALE around 50 years, where female HALE at birth is actually lower than male HALE. These countries are mostly in Africa and the Eastern Mediterranean region, but also include Afghanistan, Pakistan and Bangladesh. For other countries with HALE at birth of greater than 50 years, female HALE is generally higher than male HALE, though the gap is lower than for total life expectancy. In many countries of Eastern Europe, female HALE at birth is substantially higher than male, reflecting very high levels of adult mortality in men in the 1990s. Similar patterns are apparent for the male-female gap in healthy life expectancy at age 60, although the male-female reversal in Eastern Mediterranean countries no longer occurs. Figure 17 shows the worldwide patterns of female-male differences in healthy life expectancy at birth.

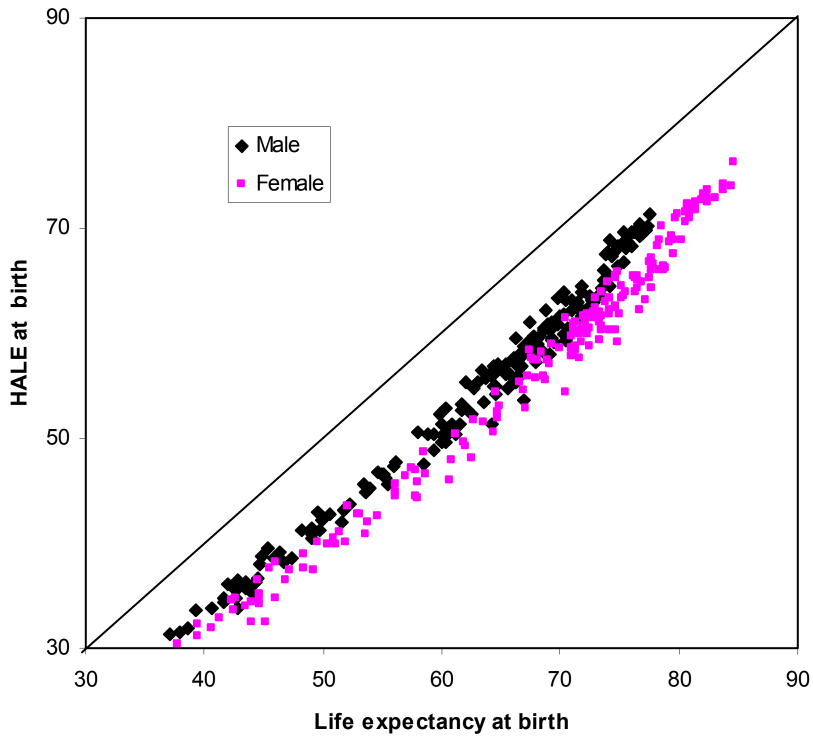


Figure 15. Healthy life expectancy at birth versus total life expectancy at birth, by sex, WHO Member States, 2000.

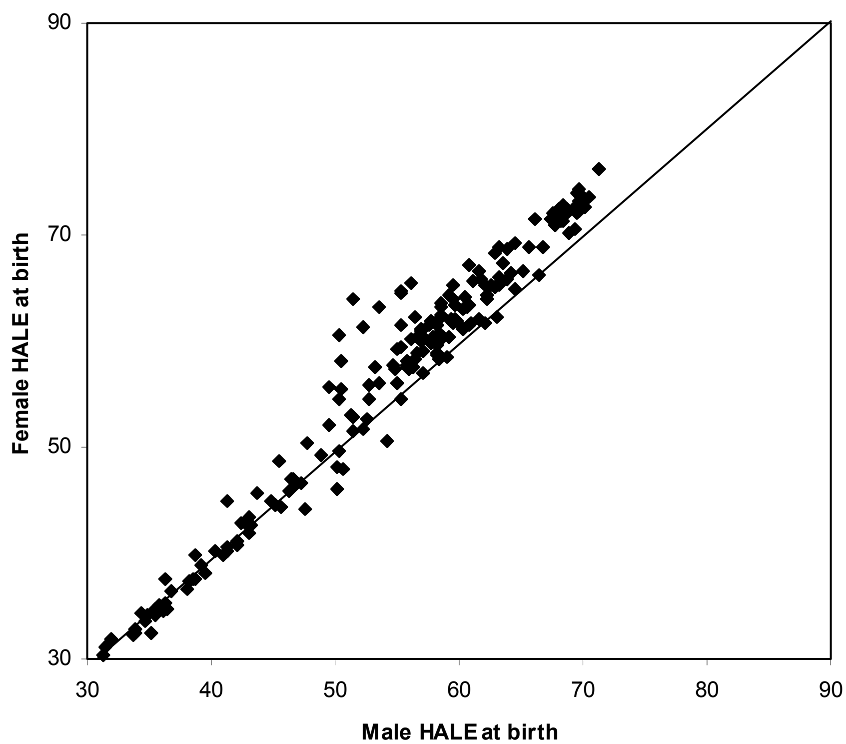


Figure 16. Healthy life expectancy at birth: males versus females, WHO Member States, 2000.

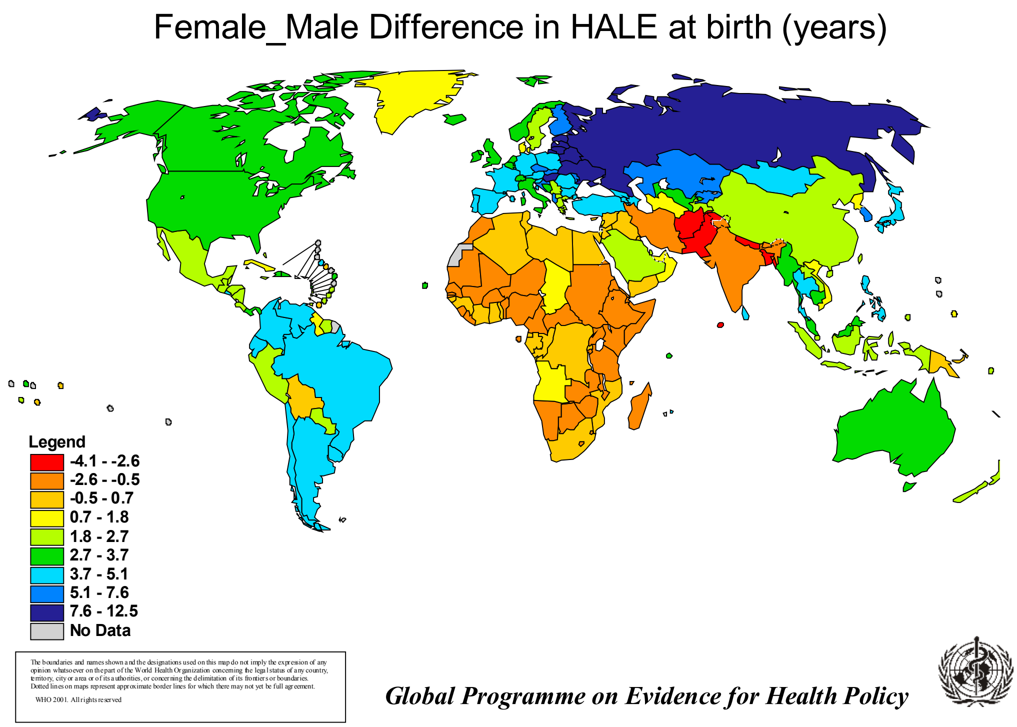


Figure 17. Female-male difference in HALE at birth, 191 Member States, 2000

6. Discussion and conclusions

This paper has described the methods used to produce estimates of healthy life expectancy (HALE) for 191 countries in 2000. These estimates are based on a very substantial information and analytic base for mortality rates and life expectancies, cause of death distributions, internally consistent estimates of the incidence, prevalence and disability distributions for 135 disease and injury causes by age group, sex and region of the world, and an analysis of 63 cross-population comparable health surveys around the world.

People living in poor countries not only face lower life expectancies than those in richer countries but also live a higher proportion of their lives in poor health. Figure 18 shows average healthy life expectancy at birth (with 95% uncertainty intervals), plotted against income per capita (Gross Domestic Product measured in international dollars using purchasing power parity conversion rates). Richer countries should be much more active in seeking ways to improve the health of the world's poor. WHO has been a strong advocate for efforts to increase the resources available for this purpose. Its Commission on Macroeconomics and Health is currently reviewing evidence on the link between health improvements and human and economic development, and ways in which additional resources for health can be used most effectively.

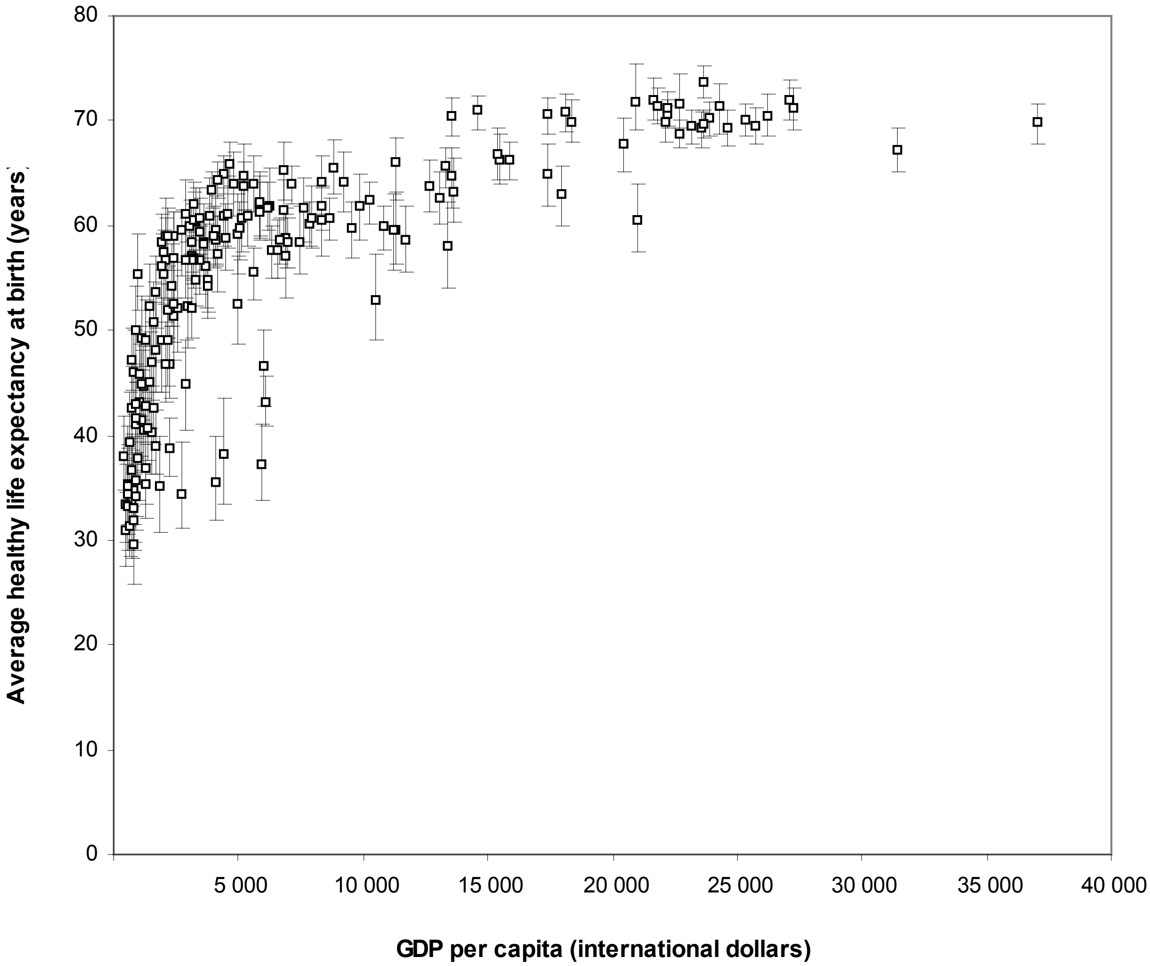


Figure 18. Healthy life expectancy at birth versus Gross Domestic Product (GDP) per capita in international dollars (purchasing power parity conversion), 191 countries, 2000

Healthy life expectancy estimates for Member States for the year 2000 are not directly comparable with those published in last year's World Health Report for 1999 as they incorporate new epidemiological information, new data from health surveys, and new information on mortality rates, as well as improvements in methods. Changes and improvements in data and methods have been highlighted in text boxes throughout Sections 2 to 4 of this discussion paper. The new evidence from the WHO Multi-country Household Survey Study has resulted in an overall increase in severity-weighted prevalences, an increase for females relative to males, and hence to a reduction in HALE estimates. This has affected all Member States and at the global level, reduced HALE at birth from the previous estimate of 56.8 years in 1999 to the current estimate of 56.0 years for the year 2000. For some Member States, there have also been changes in HALE estimates due to new information provided on age-specific mortality rates.

As with any innovative approach, methods and data sources can and will be refined and improved. Careful scrutiny and use of the HALE results reported here will lead to progressively better estimates. A wide range of people from WHO programs, from countries and other agencies have already been involved and consulted in the development of these initial estimates of HALE for WHO member countries. Useful feedback from Member States during consultations on the HALE estimates prior to publication of the World Health Report led to provision of new data and HALE estimates in a number of cases. It is anticipated that continuing consultations and peer review will lead to progressive refinement and improvement of the estimates presented here and of the data sources and statistical methods used. Improvements in the estimation of HALE for Member States will also require further collaborative efforts between WHO and Member States to improve population health survey data, to improve the completeness of death registration systems, and to improve the estimation of burden of diseases and injuries at country level.

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ANNEX TABLES

Annex Table A. Healthy life expectancy (HALE) and life expectancy (LE) at birth and age 60, by sex, WHO Member States, 2000

			Healthy life expectancy (HALE) in years								Life expectancy at birth (years)		Expected lost healthy years at birth (HLE) (b)		Per cent of total life expectancy lost	
		Total	Males				Females									
	Member State	population at birth	At birth	Uncertainty range (a)	At age 60	Uncertainty range (a)	At birth	Uncertainty range (a)	At age 60	Uncertainty range (a)	Males	Females	Males	Females	Males	Females
1	Afghanistan	33.8	35.1	30.3 - 40.4	7.1	5.5 - 8.8	32.5	26.2 - 39.5	5.8	2.6 - 9.0	44.2	45.1	9.1	12.5	20.5	27.8
2	Albania	59.4	56.5	54.4 - 59.3	11.4	10.3 - 12.6	62.3	59.9 - 64.8	14.4	13.0 - 16.0	64.3	72.9	7.9	10.6	12.2	14.5
3	Algeria	58.4	58.4	55.8 - 61.9	11.1	9.4 - 13.1	58.3	54.5 - 62.2	11.0	8.9 - 12.9	68.1	71.2	9.7	12.9	14.3	18.1
4	Andorra	71.8	69.8	67.4 - 73.0	17.0	15.4 - 18.7	73.7	70.7 - 77.9	19.4	17.3 - 22.5	77.2	83.8	7.3	10.1	9.5	12.1
5	Angola	36.9	36.2	33.7 - 42.0	7.4	5.3 - 10.1	37.6	33.3 - 42.8	7.3	4.6 - 10.3	44.3	48.3	8.1	10.8	18.2	22.3
6	Antigua and Barbuda	61.9	61.7	58.4 - 64.8	14.8	13.5 - 16.3	62.1	59.0 - 65.2	15.4	14.1 - 16.9	71.8	76.6	10.1	14.5	14.1	18.9
7	Argentina	63.9	61.8	59.6 - 64.0	13.2	12.0 - 14.6	65.9	63.0 - 68.6	16.0	14.8 - 17.5	70.2	77.8	8.4	11.9	12.0	15.2
8	Armenia	59.0	56.9	55.0 - 58.6	9.7	8.8 - 10.6	61.1	58.1 - 64.1	12.0	10.9 - 13.1	64.4	71.2	7.5	10.1	11.7	14.2
9	Australia	71.5	69.6	67.8 - 71.5	17.0	16.1 - 18.1	73.3	69.8 - 75.4	19.5	18.7 - 20.6	76.6	82.1	6.9	8.8	9.1	10.7
10	Austria	70.3	68.1	66.9 - 69.4	15.2	14.5 - 16.0	72.5	70.3 - 74.3	18.4	17.8 - 19.2	74.9	81.4	6.8	8.9	9.0	10.9
11	Azerbaijan	55.4	53.3	50.6 - 56.3	12.2	10.8 - 14.0	57.5	54.3 - 60.8	14.6	12.9 - 16.5	61.7	68.9	8.4	11.4	13.6	16.5
12	Bahamas	58.1	57.2	54.0 - 60.5	12.4	10.2 - 14.7	59.1	54.2 - 64.0	12.6	10.1 - 15.2	68.0	74.8	10.8	15.7	15.9	21.0
13	Bahrain	62.7	63.0	61.0 - 65.2	11.3	9.8 - 12.8	62.3	59.1 - 65.1	11.4	10.2 - 12.6	72.7	74.7	9.7	12.4	13.3	16.6
14	Bangladesh	49.3	50.6	47.4 - 54.1	8.8	7.5 - 10.4	47.9	43.6 - 52.6	8.0	6.4 - 9.9	60.4	60.8	9.8	12.9	16.2	21.2
15	Barbados	63.3	62.3	59.7 - 65.0	13.4	12.1 - 14.9	64.3	60.9 - 67.7	16.1	14.1 - 18.4	71.6	77.7	9.3	13.4	13.0	17.2
16	Belarus	60.1	55.4	53.4 - 57.5	9.9	9.2 - 10.8	64.8	62.7 - 66.9	14.4	13.2 - 15.9	62.0	74.0	6.6	9.2	10.7	12.4
17	Belgium	69.4	67.7	66.2 - 69.2	15.3	14.5 - 16.2	71.0	69.0 - 73.0	18.0	17.2 - 18.7	74.6	80.9	6.9	9.9	9.2	12.2
18	Belize	59.2	58.0	55.2 - 61.0	12.7	11.2 - 14.1	60.4	55.6 - 64.9	13.6	11.0 - 16.4	69.1	74.7	11.1	14.3	16.1	19.2
19	Benin	42.5	43.1	39.8 - 46.5	8.4	6.7 - 10.1	41.9	37.5 - 46.5	7.4	3.9 - 10.5	51.7	53.8	8.5	11.9	16.5	22.0
20	Bhutan	49.2	50.1	44.8 - 55.1	9.3	7.5 - 11.1	48.2	43.5 - 53.7	8.8	6.1 - 11.7	60.4	62.5	10.3	14.3	17.0	22.9
21	Bolivia	51.4	51.4	47.4 - 55.5	9.8	8.3 - 11.5	51.4	47.1 - 55.9	10.0	8.0 - 11.8	60.9	63.6	9.5	12.1	15.6	19.1
22	Bosnia and Herzegovina	63.7	62.1	60.3 - 64.3	12.4	11.3 - 13.5	65.3	62.8 - 67.9	14.3	13.0 - 15.7	68.7	74.7	6.6	9.4	9.5	12.5
23	Botswana	37.3	38.1	34.3 - 42.0	8.3	6.4 - 10.1	36.5	33.2 - 40.0	8.9	6.3 - 11.5	44.6	44.4	6.5	7.9	14.6	17.7
24	Brazil	57.1	54.9	51.4 - 58.1	10.7	9.2 - 12.0	59.2	54.8 - 64.1	12.6	9.8 - 15.2	64.5	71.9	9.5	12.7	14.8	17.6
25	Brunei Darussalam	64.9	63.8	61.5 - 66.0	13.3	12.0 - 14.6	65.9	62.4 - 69.6	15.1	13.8 - 16.5	73.4	78.7	9.6	12.7	13.1	16.2
26	Bulgaria	63.4	61.0	59.4 - 62.6	12.4	11.8 - 13.1	65.8	63.8 - 67.7	15.2	14.0 - 16.4	67.4	74.9	6.3	9.2	9.4	12.2
27	Burkina Faso	34.8	35.4	32.5 - 38.3	8.0	6.2 - 9.7	34.1	30.5 - 37.9	7.4	4.9 - 10.0	42.6	43.6	7.2	9.5	16.8	21.7
28	Burundi	33.4	33.9	30.4 - 37.5	7.6	6.0 - 9.1	32.9	29.3 - 36.9	7.7	5.4 - 10.3	40.6	41.3	6.7	8.5	16.5	20.5
29	Cambodia	47.1	45.6	43.1 - 48.0	9.0	7.8 - 10.3	48.7	45.4 - 52.4	10.1	8.0 - 12.2	53.4	58.5	7.8	9.8	14.7	16.8
30	Cameroon	40.4	40.9	37.6 - 44.0	8.4	6.2 - 10.6	39.9	36.7 - 43.2	8.0	5.7 - 10.5	49.0	50.4	8.1	10.5	16.5	20.8
31	Canada	70.0	68.3	66.9 - 69.7	15.4	14.6 - 16.3	71.7	70.0 - 73.5	17.8	17.0 - 18.6	76.0	81.5	7.7	9.8	10.2	12.0
32	Cape Verde	58.4	56.9	53.7 - 60.2	11.3	9.8 - 12.8	60.0	56.3 - 63.8	12.0	10.0 - 14.1	66.5	72.3	9.6	12.3	14.4	17.0
33	Central African Republic	34.1	34.7	31.6 - 38.2	8.2	6.6 - 9.8	33.6	30.3 - 37.3	7.9	5.9 - 9.8	41.6	42.5	6.9	8.9	16.7	20.9
34	Chad	39.3	38.6	35.3 - 43.7	7.4	5.5 - 9.4	39.9	36.1 - 44.5	7.5	4.6 - 10.5	47.4	51.1	8.7	11.2	18.4	22.0
35	Chile	65.5	63.5	61.5 - 66.0	13.1	11.8 - 14.5	67.4	64.5 - 70.3	15.7	14.4 - 17.1	72.5	79.5	9.0	12.1	12.4	15.2
36	China	62.1	60.9	59.5 - 62.5	11.8	11.0 - 12.8	63.3	59.1 - 65.8	14.3	13.6 - 15.1	68.9	73.0	8.0	9.7	11.6	13.2
37	Colombia	60.9	58.6	56.2 - 61.0	12.9	11.6 - 14.2	63.3	59.8 - 66.2	14.0	12.8 - 15.1	67.2	75.1	8.6	11.8	12.8	15.7
38	Comoros	46.0	46.2	42.8 - 49.6	8.0	6.6 - 9.5	45.8	41.4 - 50.3	7.7	5.4 - 9.9	55.3	58.1	9.1	12.3	16.4	21.1
39	Congo	42.6	42.5	39.3 - 47.0	8.7	7.0 - 11.0	42.8	39.1 - 47.2	8.9	6.1 - 11.7	50.1	52.9	7.7	10.1	15.3	19.1
40	Cook Islands	60.7	60.4	58.1 - 62.8	11.4	10.4 - 12.3	61.1	57.7 - 64.9	13.0	11.6 - 14.6	68.7	72.1	8.3	11.0	12.0	15.3

Annex Table A (continued). Healthy life expectancy (HALE) and life expectancy (LE) at birth and age 60, by sex, WHO Member States, 2000

			Healthy life expectancy (HALE) in years								Life expectancy at birth (years)		Expected lost healthy years at birth (HLE)		Per cent of total life expectancy lost	
		Total	Males				Females									
	Member State	population at birth	At birth	Uncertainty range	At age 60	Uncertainty range	At birth	Uncertainty range	At age 60	Uncertainty range	Males	Females	Males	Females	Males	Females
41	Costa Rica	65.3	64.2	61.9 - 66.9	14.0	12.4 - 15.6	66.4	63.1 - 69.2	15.6	14.2 - 17.1	73.4	78.8	9.2	12.4	12.6	15.7
42	Cote d'Ivoire	39.0	39.1	36.7 - 42.6	8.6	7.3 - 10.1	38.9	35.9 - 42.1	8.5	5.9 - 11.2	46.4	48.4	7.2	9.5	15.6	19.7
43	Croatia	64.0	60.8	59.5 - 62.0	11.4	10.8 - 12.1	67.1	64.7 - 69.2	15.2	14.6 - 15.8	69.8	77.7	9.0	10.6	12.9	13.6
44	Cuba	65.9	65.1	63.0 - 67.2	14.5	13.4 - 15.6	66.7	64.4 - 68.8	15.5	14.1 - 16.9	73.7	77.5	8.6	10.9	11.6	14.0
45	Cyprus	66.3	66.4	64.6 - 68.7	14.5	12.9 - 16.3	66.2	63.4 - 68.8	14.1	12.8 - 15.7	74.8	79.0	8.4	12.7	11.2	16.1
46	Czech Republic	65.6	62.9	61.3 - 64.4	13.0	12.2 - 13.8	68.3	65.7 - 70.5	15.8	15.2 - 16.4	71.5	78.2	8.6	9.9	12.0	12.6
47	Dem. People's Rep. of Korea	55.4	54.9	51.5 - 58.4	11.1	10.0 - 12.4	56.0	52.2 - 59.8	12.1	10.6 - 13.8	64.5	67.2	9.6	11.2	14.8	16.7
48	Dem. Republic of the Congo	34.4	34.4	31.6 - 39.4	7.2	5.9 - 8.8	34.4	30.5 - 39.3	7.4	5.1 - 9.6	41.6	44.0	7.2	9.6	17.4	21.9
49	Denmark	69.5	68.9	67.5 - 70.3	15.7	14.9 - 16.6	70.1	68.2 - 72.0	16.5	15.8 - 17.3	74.2	78.5	5.3	8.4	7.2	10.7
50	Djibouti	35.1	35.6	31.3 - 40.4	7.4	5.5 - 9.5	34.6	30.1 - 39.6	7.0	4.6 - 9.6	43.5	44.7	7.8	10.1	18.0	22.5
51	Dominica	64.6	63.2	59.7 - 66.1	14.4	13.1 - 15.9	66.1	63.3 - 69.3	16.4	14.8 - 18.1	72.6	78.3	9.4	12.2	13.0	15.6
52	Dominican Republic	56.2	54.7	50.9 - 58.2	12.3	11.0 - 13.5	57.7	53.4 - 61.9	13.0	11.0 - 15.0	65.5	71.6	10.8	14.0	16.4	19.5
53	Ecuador	60.3	58.4	55.4 - 61.3	12.7	11.3 - 14.0	62.2	58.6 - 66.0	14.4	12.4 - 16.5	68.2	74.2	9.9	12.0	14.5	16.2
54	Egypt	57.1	57.1	55.4 - 58.8	9.9	8.6 - 11.2	57.0	54.1 - 59.3	10.0	8.9 - 11.2	65.4	69.1	8.3	12.0	12.6	17.4
55	El Salvador	57.3	55.3	52.0 - 58.7	11.9	10.5 - 13.5	59.4	55.3 - 63.3	13.3	10.7 - 15.9	66.3	73.3	11.0	13.9	16.6	19.0
56	Equatorial Guinea	44.8	44.9	40.6 - 48.7	8.7	7.1 - 10.3	44.8	40.2 - 49.4	8.3	5.8 - 10.9	53.5	56.2	8.7	11.4	16.2	20.2
57	Eritrea	41.0	41.4	38.1 - 45.0	8.3	6.5 - 10.0	40.5	36.5 - 45.0	8.1	5.6 - 10.7	49.1	51.0	7.7	10.4	15.7	20.4
58	Estonia	60.8	56.2	54.7 - 57.6	10.0	9.1 - 10.9	65.4	62.5 - 67.7	14.8	14.0 - 15.8	65.4	76.5	9.3	11.0	14.2	14.4
59	Ethiopia	35.4	35.7	32.2 - 40.9	7.7	5.8 - 9.7	35.1	30.4 - 40.9	7.5	4.9 - 10.3	42.8	44.7	7.1	9.6	16.6	21.4
60	Fiji	59.6	58.7	55.9 - 61.3	11.2	9.6 - 12.7	60.5	56.9 - 64.3	12.7	10.8 - 14.4	66.9	71.2	8.3	10.7	12.3	15.1
61	Finland	68.8	66.1	64.9 - 67.2	14.8	14.0 - 15.4	71.5	69.9 - 73.0	17.9	17.4 - 18.5	73.7	80.9	7.6	9.5	10.3	11.7
62	France	70.7	68.5	67.4 - 69.5	16.6	15.9 - 17.2	72.9	71.4 - 74.5	19.4	18.9 - 20.0	75.2	83.1	6.7	10.2	8.9	12.2
63	Gabon	46.6	46.8	42.9 - 50.0	9.2	7.7 - 10.8	46.5	42.6 - 49.9	9.3	7.6 - 11.2	54.6	56.9	7.8	10.4	14.2	18.4
64	Gambia	46.9	47.3	44.1 - 50.6	8.5	6.8 - 10.3	46.6	42.4 - 50.8	8.1	6.0 - 10.5	55.9	58.7	8.6	12.1	15.4	20.6
65	Georgia	58.2	56.1	54.1 - 58.3	9.5	8.5 - 10.5	60.2	57.3 - 62.8	11.1	10.3 - 11.9	65.7	71.8	9.6	11.6	14.6	16.1
66	Germany	69.4	67.4	66.0 - 68.7	14.8	14.0 - 15.6	71.5	69.4 - 73.3	17.6	16.9 - 18.2	74.3	80.6	6.9	9.2	9.3	11.4
67	Ghana	46.7	46.5	43.4 - 49.7	8.9	6.9 - 10.8	46.9	43.5 - 51.1	9.0	6.5 - 11.3	55.0	57.9	8.5	11.0	15.5	18.9
68	Greece	71.0	69.7	68.5 - 70.8	16.0	15.2 - 16.6	72.3	69.9 - 74.0	17.6	17.1 - 18.3	75.4	80.8	5.7	8.5	7.6	10.5
69	Grenada	61.9	62.1	59.5 - 65.1	14.0	12.6 - 15.4	61.8	57.8 - 65.7	14.1	12.0 - 16.4	70.9	73.2	8.8	11.5	12.4	15.7
70	Guatemala	54.7	53.5	49.9 - 57.2	11.3	9.1 - 13.6	56.0	52.3 - 59.7	11.7	10.0 - 13.5	63.5	68.6	10.1	12.6	15.8	18.3
71	Guinea	40.3	40.4	36.7 - 44.0	7.3	5.6 - 9.1	40.1	35.9 - 45.5	7.0	3.9 - 10.3	49.0	52.0	8.6	11.9	17.5	22.8
72	Guinea-Bissau	36.6	36.7	33.6 - 39.8	7.2	5.1 - 9.1	36.4	33.0 - 40.3	7.1	4.1 - 10.1	44.5	46.9	7.7	10.5	17.4	22.3
73	Guyana	52.1	51.4	48.3 - 54.6	10.3	9.1 - 11.6	52.8	47.7 - 58.4	11.1	8.9 - 13.6	61.5	67.0	10.1	14.2	16.4	21.2
74	Haiti	43.1	41.3	37.0 - 46.2	7.8	6.1 - 9.5	44.9	38.8 - 51.1	8.5	5.7 - 11.4	49.7	56.1	8.4	11.2	16.9	20.0
75	Honduras	56.8	55.8	52.5 - 59.6	11.7	10.0 - 13.3	57.8	53.6 - 62.0	12.7	10.9 - 14.7	66.3	71.0	10.6	13.2	16.0	18.6
76	Hungary	59.9	55.3	53.7 - 56.9	9.4	8.3 - 10.3	64.5	61.8 - 66.7	13.8	13.0 - 14.6	66.3	75.2	11.0	10.7	16.5	14.2
77	Iceland	71.2	69.8	68.1 - 71.5	16.2	15.1 - 17.4	72.6	70.3 - 74.9	18.6	17.6 - 19.6	77.1	81.8	7.3	9.3	9.5	11.3
78	India	52.0	52.2	50.2 - 54.2	9.9	8.7 - 11.0	51.7	48.5 - 54.8	10.9	9.6 - 12.1	59.8	62.7	7.6	11.0	12.7	17.5
79	Indonesia	57.4	56.5	55.7 - 58.2	11.6	10.8 - 12.5	58.4	55.8 - 61.0	12.5	11.8 - 13.3	63.4	67.4	6.9	9.1	10.9	13.5
80	Iran (Islamic Republic of)	58.8	59.0	56.4 - 61.6	11.3	9.7 - 12.9	58.6	55.3 - 61.9	11.4	10.0 - 12.7	68.1	69.9	9.1	11.4	13.3	16.2

Annex Table A (continued). Healthy life expectancy (HALE) and life expectancy (LE) at birth and age 60, by sex, WHO Member States, 2000

		Healthy life expectancy (HALE) in years									Life expectancy at birth (years)		Expected lost healthy years at birth (HLE)		Per cent of total life expectancy lost	
			Males				Females									
	Member State	Total population at birth	At birth	Uncertainty range	At age 60	Uncertainty range	At birth	Uncertainty range	At age 60	Uncertainty range	Males	Females	Males	Females	Males	Females
81	Iraq	52.6	52.6	48.6 - 57.0	9.3	6.7 - 12.0	52.5	48.6 - 57.3	9.5	7.5 - 11.9	61.7	64.7	9.2	12.1	14.8	18.7
82	Ireland	69.3	67.8	66.3 - 69.1	14.3	13.5 - 15.1	70.9	68.6 - 72.7	16.9	16.2 - 17.6	74.1	79.7	6.3	8.8	8.5	11.0
83	Israel	69.9	69.3	67.7 - 71.0	16.2	15.2 - 17.3	70.6	68.3 - 72.9	17.1	15.8 - 18.4	76.6	80.6	7.3	10.0	9.6	12.4
84	Italy	71.2	69.5	68.4 - 70.8	16.3	15.6 - 17.2	72.8	70.5 - 74.5	18.8	18.1 - 19.4	76.0	82.4	6.4	9.6	8.5	11.6
85	Jamaica	64.0	62.9	59.8 - 65.8	14.6	13.5 - 15.9	65.0	62.1 - 68.1	15.7	13.7 - 17.7	72.8	76.6	10.0	11.5	13.7	15.1
86	Japan	73.8	71.2	69.9 - 72.5	17.6	16.8 - 18.4	76.3	74.6 - 77.8	21.4	20.3 - 22.5	77.5	84.7	6.3	8.4	8.1	9.9
87	Jordan	58.5	58.2	56.4 - 60.3	10.3	9.0 - 11.7	58.8	56.0 - 61.4	11.3	10.1 - 12.6	68.5	72.5	10.3	13.6	15.0	18.8
88	Kazakhstan	54.3	50.5	48.0 - 53.1	10.9	9.9 - 11.9	58.1	55.6 - 60.6	14.6	13.1 - 16.0	58.0	68.4	7.5	10.3	13.0	15.0
89	Kenya	40.7	41.2	38.7 - 44.4	9.3	8.0 - 10.7	40.1	36.7 - 43.8	9.1	7.0 - 11.0	48.2	49.6	7.0	9.4	14.5	19.1
90	Kiribati	53.6	52.8	49.6 - 56.1	10.7	9.2 - 12.2	54.4	50.7 - 57.9	11.4	9.3 - 13.3	60.4	64.5	7.6	10.1	12.6	15.7
91	Kuwait	64.7	64.6	62.1 - 66.8	12.4	10.8 - 13.8	64.8	61.4 - 68.0	13.0	10.7 - 15.0	74.2	76.8	9.6	12.0	13.0	15.6
92	Kyrgyzstan	52.6	49.6	46.5 - 53.1	8.5	6.2 - 10.9	55.6	51.2 - 60.1	11.8	9.7 - 13.9	60.0	68.8	10.4	13.2	17.4	19.2
93	Lao People's Dem. Republic	44.7	43.7	39.1 - 47.5	9.6	8.1 - 11.2	45.7	40.6 - 49.6	10.6	8.4 - 12.7	52.2	56.1	8.6	10.4	16.4	18.5
94	Latvia	57.7	51.4	49.0 - 53.5	9.1	7.9 - 10.0	63.9	60.9 - 66.5	14.4	13.5 - 15.4	64.2	75.5	12.8	11.6	19.9	15.3
95	Lebanon	60.7	60.3	57.6 - 63.1	11.3	9.6 - 12.8	61.1	57.4 - 65.1	12.2	10.3 - 14.3	69.1	73.3	8.9	12.2	12.8	16.7
96	Lesotho	35.3	36.1	33.1 - 39.7	8.7	6.8 - 10.6	34.5	31.2 - 38.7	8.8	6.4 - 11.3	42.0	42.2	5.9	7.7	14.1	18.2
97	Liberia	37.8	38.2	34.0 - 42.4	7.3	6.1 - 8.5	37.4	33.5 - 41.5	6.9	4.3 - 9.5	46.6	49.1	8.4	11.7	18.1	23.9
98	Libyan Arab Jamahiriya	58.5	58.4	55.7 - 61.4	10.6	9.0 - 12.4	58.6	55.2 - 62.5	11.3	9.2 - 13.4	67.5	71.0	9.2	12.4	13.6	17.4
99	Lithuania	58.4	53.6	51.6 - 55.5	10.1	9.0 - 11.0	63.2	60.2 - 65.9	14.2	13.2 - 15.2	66.9	77.2	13.3	14.0	19.8	18.2
100	Luxembourg	69.8	67.6	66.2 - 69.2	14.9	14.1 - 15.8	72.0	69.5 - 74.0	18.4	17.6 - 19.1	73.9	80.8	6.3	8.7	8.5	10.8
101	Madagascar	42.9	43.2	40.6 - 46.1	8.0	6.4 - 9.5	42.6	38.0 - 47.3	7.5	4.6 - 10.9	51.7	54.6	8.5	12.0	16.5	22.1
102	Malawi	30.9	31.4	28.2 - 34.6	7.6	5.8 - 9.4	30.5	26.8 - 34.4	7.8	5.1 - 11.0	37.1	37.8	5.8	7.4	15.5	19.5
103	Malaysia	61.6	59.7	57.3 - 62.1	10.6	8.9 - 12.3	63.4	60.3 - 66.6	12.7	11.3 - 14.1	68.3	74.1	8.6	10.7	12.6	14.5
104	Maldives	52.4	54.2	50.3 - 58.2	10.1	8.4 - 11.9	50.6	46.4 - 55.9	8.6	6.1 - 10.8	64.6	64.4	10.4	13.8	16.1	21.5
105	Mali	34.5	34.8	31.5 - 39.3	7.1	5.9 - 8.9	34.1	29.5 - 38.9	7.2	4.3 - 10.1	42.7	44.6	7.9	10.5	18.5	23.5
106	Malta	70.4	68.7	67.3 - 70.2	15.6	14.7 - 16.5	72.1	69.7 - 74.1	17.7	16.9 - 18.5	75.4	80.7	6.7	8.6	8.9	10.7
107	Marshall Islands	56.1	54.8	51.9 - 57.9	10.4	8.8 - 12.2	57.4	54.3 - 60.3	12.3	10.6 - 14.2	62.8	67.8	7.9	10.4	12.7	15.3
108	Mauritania	41.5	42.1	37.7 - 46.3	7.8	5.7 - 10.0	40.8	35.5 - 46.0	7.1	3.7 - 10.3	51.7	53.5	9.6	12.7	18.5	23.8
109	Mauritius	60.5	58.6	55.6 - 61.3	10.1	8.6 - 11.5	62.5	58.4 - 66.3	12.3	10.1 - 14.6	67.6	74.6	9.1	12.2	13.4	16.3
110	Mexico	64.2	63.1	60.8 - 65.2	14.5	13.1 - 16.0	65.3	61.5 - 68.1	15.0	13.8 - 16.4	71.0	76.2	7.9	10.9	11.2	14.3
111	Micronesia (Fed. States of)	56.6	55.8	52.8 - 58.8	11.0	9.5 - 12.5	57.5	54.0 - 61.0	12.0	10.6 - 13.4	63.7	67.7	8.0	10.3	12.5	15.2
112	Monaco	71.7	69.4	67.5 - 72.1	17.2	16.0 - 18.8	73.9	71.1 - 76.7	20.2	18.4 - 22.4	76.8	84.4	7.4	10.5	9.6	12.4
113	Mongolia	52.4	50.3	46.3 - 54.3	10.8	9.0 - 12.6	54.5	50.8 - 58.2	12.7	10.4 - 15.1	61.2	66.9	10.9	12.4	17.8	18.5
114	Morocco	54.9	55.3	53.4 - 57.3	9.9	8.4 - 11.4	54.5	51.3 - 57.2	10.0	8.7 - 11.2	66.1	70.4	10.8	16.0	16.3	22.7
115	Mozambique	31.3	31.5	28.9 - 34.9	7.3	5.4 - 9.6	31.1	28.1 - 34.7	7.3	5.4 - 9.7	37.9	39.5	6.4	8.4	17.0	21.3
116	Myanmar	49.1	47.7	43.8 - 51.6	9.2	7.6 - 10.9	50.5	45.7 - 54.3	10.1	7.8 - 12.1	56.2	61.1	8.5	10.7	15.1	17.4
117	Namibia	35.6	36.5	32.5 - 41.2	9.2	7.4 - 11.0	34.7	31.4 - 38.8	9.1	6.6 - 11.7	42.8	42.6	6.3	7.9	14.8	18.6
118	Nauru	52.9	50.4	47.0 - 54.4	7.9	6.6 - 9.5	55.4	51.0 - 60.2	10.5	8.2 - 13.2	58.8	66.6	8.3	11.1	14.1	16.7
119	Nepal	45.8	47.5	44.4 - 51.1	10.2	8.3 - 12.0	44.2	39.1 - 49.8	9.6	6.3 - 12.7	58.5	58.0	11.0	13.8	18.8	23.9
120	Netherlands	69.7	68.2	67.1 - 69.3	15.2	14.6 - 15.9	71.2	69.7 - 72.7	17.8	17.2 - 18.4	75.4	81.0	7.3	9.7	9.6	12.0

Annex Table A (continued). Healthy life expectancy (HALE) and life expectancy (LE) at birth and age 60, by sex, WHO Member States, 2000

	Member State	Total population at birth	Healthy life expectancy (HALE) in years: Males — At birth	Uncertainty range	At age 60	Uncertainty range	Females — At birth	Uncertainty range	At age 60	Uncertainty range	Life expectancy at birth (years): Males	Females	Expected lost healthy years at birth (HLE): Males	Females	Per cent of total life expectancy lost: Males	Females
121	New Zealand	70.8	69.5	68.0 - 71.0	16.7	15.8 - 17.7	72.1	69.8 - 74.0	18.8	17.9 - 19.6	75.9	80.9	6.4	8.9	8.5	11.0
122	Nicaragua	56.9	55.8	51.8 - 60.3	11.3	9.6 - 13.4	58.0	54.3 - 62.4	12.5	10.6 - 14.7	66.4	71.1	10.6	13.0	16.0	18.3
123	Niger	33.1	33.9	30.9 - 37.7	6.6	3.8 - 9.3	32.4	27.1 - 37.6	5.8	3.2 - 8.4	42.7	43.9	8.8	11.5	20.7	26.2
124	Nigeria	41.6	42.1	39.2 - 45.0	8.4	6.8 - 10.0	41.1	37.7 - 45.0	8.2	6.4 - 10.1	49.8	51.4	7.7	10.3	15.5	20.1
125	Niue	61.1	60.8	57.1 - 64.2	13.0	11.4 - 14.7	61.4	58.6 - 65.2	13.8	11.9 - 16.2	69.5	72.8	8.7	11.4	12.6	15.6
126	Norway	70.5	68.8	67.0 - 70.5	15.8	14.8 - 16.8	72.3	70.2 - 74.6	18.2	16.9 - 19.5	75.7	81.4	6.9	9.1	9.2	11.2
127	Oman	59.7	59.2	57.2 - 61.4	10.3	8.8 - 11.9	60.3	56.6 - 63.1	12.0	10.5 - 13.5	69.5	73.5	10.3	13.2	14.8	17.9
128	Pakistan	48.1	50.2	46.6 - 54.2	9.8	8.7 - 11.2	46.1	41.5 - 51.1	8.7	5.6 - 11.8	60.1	60.7	10.0	14.7	16.6	24.1
129	Palau	57.7	56.5	54.3 - 58.6	9.5	8.4 - 10.3	58.9	55.7 - 62.4	10.7	9.2 - 12.2	64.7	69.3	8.2	10.4	12.6	15.0
130	Panama	63.9	62.6	60.1 - 65.1	13.7	12.4 - 14.9	65.3	62.6 - 68.0	15.3	13.8 - 16.8	71.5	76.3	8.9	11.0	12.5	14.4
131	Papua New Guinea	46.8	46.6	42.8 - 50.5	9.2	7.7 - 10.6	47.1	43.6 - 50.9	10.5	8.7 - 12.1	55.1	57.5	8.5	10.4	15.4	18.1
132	Paraguay	60.9	59.9	56.7 - 63.4	12.3	10.4 - 14.3	61.9	58.8 - 65.5	14.0	12.4 - 15.6	70.2	74.2	10.3	12.3	14.7	16.6
133	Peru	58.8	57.8	55.2 - 60.6	12.0	10.5 - 13.6	59.8	56.2 - 63.6	13.6	11.6 - 15.8	66.7	71.6	8.9	11.8	13.4	16.4
134	Philippines	59.0	57.0	54.3 - 59.4	11.5	10.3 - 12.6	60.9	57.7 - 64.3	13.6	11.9 - 15.5	64.6	71.1	7.7	10.2	11.9	14.3
135	Poland	61.8	59.3	57.9 - 60.5	10.9	10.1 - 11.7	64.3	61.2 - 66.7	13.8	12.9 - 14.6	69.2	77.7	10.0	13.4	14.4	17.2
136	Portugal	66.3	63.9	62.5 - 65.4	13.6	12.7 - 14.4	68.6	66.2 - 70.5	16.0	15.3 - 16.7	71.7	79.3	7.8	10.7	10.9	13.5
137	Qatar	60.6	59.3	56.5 - 62.6	9.2	7.0 - 11.4	61.8	58.4 - 65.4	11.6	9.8 - 13.6	70.4	75.0	11.1	13.2	15.7	17.6
138	Republic of Korea	66.0	63.2	60.8 - 65.3	12.3	11.1 - 13.4	68.8	64.0 - 71.4	16.0	15.1 - 17.0	70.5	78.3	7.3	9.5	10.3	12.1
139	Republic of Moldova	58.4	55.4	52.4 - 57.9	10.2	8.8 - 11.4	61.5	59.1 - 64.3	12.5	11.1 - 13.9	63.1	70.5	7.7	8.9	12.3	12.7
140	Romania	61.7	59.5	57.4 - 61.4	12.1	11.0 - 12.9	64.0	61.6 - 66.8	14.4	13.1 - 15.7	66.2	73.5	6.8	9.5	10.2	12.9
141	Russian Federation	55.5	50.3	48.6 - 52.4	8.2	7.3 - 8.9	60.6	57.0 - 63.3	12.2	11.5 - 13.0	59.4	72.0	9.1	11.4	15.3	15.8
142	Rwanda	31.9	32.0	29.6 - 36.5	7.0	4.8 - 9.4	31.8	28.3 - 36.2	7.2	5.3 - 9.2	38.5	40.5	6.5	8.7	17.0	21.5
143	Saint Kitts and Nevis	59.6	57.6	54.7 - 60.7	10.3	9.4 - 11.3	61.5	57.8 - 65.6	12.6	10.8 - 14.5	66.1	72.0	8.4	10.5	12.8	14.5
144	Saint Lucia	62.0	60.7	58.1 - 63.0	12.5	11.3 - 13.8	63.3	60.0 - 66.5	13.9	12.1 - 15.6	69.2	74.2	8.5	10.9	12.2	14.7
145	Saint Vincent and Grenadines	60.9	59.7	57.1 - 62.2	12.1	11.0 - 13.3	62.1	59.1 - 65.0	14.1	12.5 - 15.7	67.7	73.3	8.0	11.3	11.9	15.4
146	Samoa	59.9	58.2	55.6 - 60.6	12.3	10.9 - 13.7	61.6	59.0 - 64.4	14.3	12.7 - 16.0	66.7	72.9	8.5	11.3	12.7	15.6
147	San Marino	72.0	69.7	68.0 - 71.8	15.9	14.8 - 17.0	74.3	72.2 - 76.4	19.9	18.4 - 21.5	76.1	83.8	6.5	9.5	8.5	11.4
148	Sao Tome and Principe	50.0	50.3	46.8 - 53.6	9.6	8.0 - 11.0	49.7	44.8 - 54.7	9.2	7.5 - 10.6	60.3	61.9	10.0	12.2	16.6	19.8
149	Saudi Arabia	59.5	58.3	55.0 - 61.1	10.5	8.4 - 12.3	60.7	56.5 - 64.9	12.1	9.8 - 14.2	68.1	73.5	9.7	12.8	14.3	17.4
150	Senegal	44.9	45.2	42.1 - 48.0	8.4	6.8 - 9.8	44.5	40.9 - 48.4	8.0	5.0 - 11.1	54.0	56.1	8.8	11.6	16.3	20.7
151	Seychelles	58.7	57.0	54.1 - 59.7	9.4	7.2 - 11.5	60.4	57.1 - 64.0	10.7	8.8 - 13.1	66.5	74.2	9.5	13.8	14.3	18.6
152	Sierra Leone	29.5	29.7	26.4 - 36.0	6.5	4.7 - 8.8	29.3	25.2 - 35.1	6.0	2.9 - 9.5	37.0	38.8	7.3	9.6	19.6	24.6
153	Singapore	67.8	66.8	64.3 - 69.0	14.5	13.1 - 15.8	68.9	65.8 - 71.7	16.2	14.6 - 18.0	75.4	80.2	8.6	11.3	11.4	14.1
154	Slovakia	62.4	59.6	58.1 - 60.9	10.7	9.9 - 11.6	65.2	62.3 - 67.5	14.0	13.2 - 14.9	69.2	77.5	9.7	12.3	14.0	15.9
155	Slovenia	66.9	64.5	62.1 - 66.7	13.6	12.8 - 14.3	69.3	66.5 - 71.9	16.7	15.4 - 18.0	71.9	79.4	7.4	10.2	10.3	12.8

Annex Table A (continued). Healthy life expectancy (HALE) and life expectancy (LE) at birth and age 60, by sex, WHO Member States, 2000

	Member State	Total population at birth	Healthy life expectancy (HALE) in years: Males At birth	Males Uncertainty range	Males At age 60	Males Uncertainty range	Females At birth	Females Uncertainty range	Females At age 60	Females Uncertainty range	Life expectancy at birth (years): Males	Life expectancy at birth (years): Females	Expected lost healthy years at birth (HLE): Males	Expected lost healthy years at birth (HLE): Females	Per cent of total life expectancy lost: Males	Per cent of total life expectancy lost: Females
156	Solomon Islands	59.0	58.0	55.1 - 61.5	11.2	9.4 - 13.3	60.1	56.6 - 63.8	12.4	10.7 - 14.1	66.6	71.4	8.6	11.3	12.9	15.9
157	Somalia	35.1	35.5	32.5 - 38.9	7.3	5.2 - 9.5	34.7	30.6 - 38.8	6.4	2.6 - 9.7	43.8	45.9	8.3	11.2	18.9	24.4
158	South Africa	43.2	43.0	41.1 - 45.0	9.1	7.9 - 10.5	43.5	40.5 - 46.4	10.4	8.7 - 12.1	49.6	52.1	6.6	8.6	13.3	16.5
159	Spain	70.6	68.7	67.3 - 70.3	15.8	14.9 - 16.8	72.5	70.3 - 74.2	18.3	17.5 - 19.1	75.4	82.3	6.6	9.8	8.8	11.9
160	Sri Lanka	61.1	58.6	55.7 - 61.5	12.5	10.9 - 14.1	63.6	61.0 - 67.0	14.6	12.8 - 16.6	67.6	75.3	9.0	11.7	13.4	15.6
161	Sudan	45.1	45.7	42.2 - 49.3	8.3	6.5 - 10.1	44.4	39.2 - 50.2	7.8	5.8 - 9.6	55.4	57.8	9.8	13.4	17.6	23.1
162	Suriname	60.6	59.5	57.0 - 61.9	12.2	11.0 - 13.6	61.7	58.5 - 64.6	13.3	11.5 - 15.1	68.0	73.5	8.5	11.9	12.5	16.1
163	Swaziland	38.2	38.8	34.1 - 44.2	9.3	7.0 - 11.5	37.6	32.6 - 42.7	9.6	7.5 - 12.0	44.7	45.6	6.0	8.0	13.3	17.4
164	Sweden	71.4	70.1	68.7 - 71.6	16.8	15.9 - 17.7	72.7	70.6 - 74.6	18.7	18.0 - 19.4	77.3	82.0	7.2	9.2	9.3	11.3
165	Switzerland	72.1	70.4	68.7 - 72.1	17.0	16.1 - 17.9	73.7	71.3 - 75.7	19.7	19.0 - 20.4	76.7	82.5	6.2	8.8	8.1	10.7
166	Syrian Arab Republic	58.5	58.2	55.3 - 60.9	10.7	8.7 - 12.6	58.7	54.9 - 62.2	11.3	9.0 - 13.3	69.3	72.4	9.1	12.5	13.6	17.6
167	Tajikistan	50.8	49.6	46.2 - 53.2	9.0	7.1 - 11.0	52.0	47.8 - 56.1	10.3	7.7 - 12.8	60.4	64.7	10.8	12.7	17.9	19.7
168	TFYR Macedonia (c)	64.9	63.9	62.0 - 65.6	12.5	11.7 - 13.4	65.9	64.1 - 67.6	14.3	13.3 - 15.2	70.2	74.8	6.3	8.9	9.0	12.0
169	Thailand	59.7	57.7	55.7 - 59.7	13.2	12.1 - 14.3	61.8	57.9 - 64.9	14.4	13.4 - 15.5	66.0	72.4	8.4	10.5	12.6	14.6
170	Togo	42.7	42.7	39.3 - 46.5	8.6	6.7 - 10.7	42.7	39.3 - 46.8	8.6	6.5 - 10.9	50.5	53.0	7.9	10.3	15.5	19.4
171	Tonga	60.7	59.3	57.0 - 61.9	11.6	10.3 - 13.0	62.0	58.4 - 65.2	13.6	12.3 - 15.0	67.4	72.9	8.1	10.8	12.0	14.9
172	Trinidad and Tobago	61.7	60.3	57.9 - 63.1	11.6	10.2 - 13.1	63.0	59.0 - 65.8	13.3	12.1 - 14.5	68.5	73.8	8.2	10.7	12.0	14.5
173	Tunisia	61.4	61.0	59.2 - 62.9	11.4	10.6 - 12.2	61.7	58.0 - 65.4	12.6	10.6 - 14.7	69.2	73.4	8.2	11.7	11.8	15.9
174	Turkey	58.7	56.8	55.4 - 58.2	11.2	10.3 - 12.1	60.5	57.4 - 63.2	13.4	12.7 - 14.2	66.8	72.5	10.0	12.0	14.9	16.5
175	Turkmenistan	52.1	51.2	48.3 - 54.3	8.8	7.5 - 10.3	53.0	50.1 - 56.7	9.5	7.9 - 11.1	60.0	64.9	8.8	11.9	14.7	18.3
176	Tuvalu	57.0	56.4	54.0 - 58.9	9.9	8.8 - 11.0	57.6	54.0 - 61.0	11.5	8.8 - 13.7	63.6	67.6	7.2	10.0	11.3	14.8
177	Uganda	35.7	36.2	33.4 - 39.8	7.7	6.2 - 9.3	35.2	31.1 - 39.6	7.4	4.9 - 10.0	43.5	44.6	7.2	9.4	16.7	21.1
178	Ukraine	56.8	52.3	51.0 - 53.7	8.1	7.3 - 8.9	61.3	58.0 - 63.5	11.8	11.3 - 12.5	62.6	73.3	10.3	12.0	16.4	16.4
179	United Arab Emirates	63.1	62.3	60.0 - 64.5	11.5	9.8 - 13.2	63.9	59.9 - 66.9	13.3	11.8 - 14.7	72.3	76.4	10.0	12.5	13.8	16.4
180	United Kingdom	69.9	68.3	66.8 - 69.7	15.3	14.4 - 16.1	71.4	69.2 - 73.1	17.4	16.7 - 18.1	74.8	79.9	6.5	8.5	8.7	10.6
181	United Rep. of Tanzania	38.1	38.6	35.4 - 42.7	7.8	5.9 - 9.8	37.5	34.0 - 41.1	7.7	5.2 - 10.2	45.8	47.2	7.2	9.6	15.7	20.4
182	United States of America	67.2	65.7	63.8 - 67.5	15.0	14.0 - 16.0	68.8	66.5 - 71.0	16.8	15.8 - 17.9	73.9	79.5	8.2	10.7	11.1	13.4
183	Uruguay	64.1	61.7	59.0 - 64.6	12.6	11.6 - 13.6	66.5	63.5 - 69.4	15.8	14.0 - 17.7	70.0	77.9	8.4	11.4	11.9	14.6
184	Uzbekistan	54.3	52.7	49.2 - 56.3	9.9	7.9 - 11.9	55.8	51.5 - 60.2	11.6	9.6 - 13.7	62.1	68.0	9.4	12.2	15.1	17.9
185	Vanuatu	56.7	56.0	52.6 - 59.7	10.9	9.4 - 12.6	57.4	53.6 - 61.8	11.7	9.9 - 13.8	64.2	68.1	8.2	10.8	12.8	15.8
186	Venezuela	62.3	60.4	57.7 - 63.2	13.0	11.1 - 14.7	64.2	59.9 - 67.2	14.7	13.2 - 16.1	70.6	76.5	10.1	12.3	14.4	16.1
187	Viet Nam	58.9	58.2	55.6 - 60.7	11.4	10.3 - 12.6	59.7	56.5 - 62.8	12.3	10.3 - 14.2	66.7	71.0	8.5	11.3	12.7	15.9
188	Yemen	49.1	48.9	45.7 - 51.9	8.5	6.8 - 10.4	49.3	44.4 - 53.9	8.8	6.7 - 10.8	59.3	62.0	10.4	12.7	17.5	20.5
189	Yugoslavia	64.3	63.3	62.1 - 64.7	13.0	12.2 - 13.7	65.4	63.2 - 67.3	14.6	13.4 - 15.7	69.8	74.7	6.5	9.3	9.3	12.5
190	Zambia	33.0	33.7	30.6 - 37.0	8.2	6.8 - 9.6	32.3	28.9 - 36.1	8.5	5.5 - 11.5	39.2	39.5	5.5	7.2	14.1	18.3
191	Zimbabwe	38.8	39.6	37.4 - 41.9	9.3	7.7 - 10.8	38.1	34.7 - 41.3	9.7	8.0 - 11.4	45.4	46.0	5.8	7.9	12.8	17.1

(a) Uncertainty ranges show 2.5^{th} and 97.5^{th} percentiles of the uncertainty distribution of HALE.

(b) LHE (Expectation of lost healthy years) is calculated as total life expectancy minus HALE. Per cent of life expectancy lost is LHE/LE as a per cent.

(c) The Former Yugoslav Republic of Macedonia