

Global burden of dementia in the year 2000: summary of methods and data sources.

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1. Introduction

Dementia was estimated to be the 10th leading cause of non-fatal burden in the world in 1990, accounting for 2.6% of total YLD, around the same percentage as congenital malformations (1) In the Version 2 estimates for the Global Burden of Disease 2000 study, published in the World Health Report 2002 (2), dementia is the 11th leading cause of YLDs at global level, accounting for 2.0% of total global YLDs. Dementia is difficult to define and detect in the population. Even with the difficulties of determining prevalence and incidence, it is clear that dementia causes a substantial burden globally. This draft paper summarises the data and methods used to produce the Version 2 estimates of dementia burden for the year 2000.

2. Case and sequelae definitions

Dementia is a syndrome caused by a range of illnesses. Most are currently incurable, and cause progressive, irreversible brain damage. They include Alzheimer's disease (the most common cause), vascular disease, frontal lobe dementia and Lewy Body disease. Symptoms of dementia can include memory loss, difficulties with language, judgement, and insight, failure to recognise people, disorientation, mood changes, hallucinations, delusions, and the gradual loss of ability to perform all tasks of daily living. All dementias are included in the case definition (Table 2.1), which remains unchanged from the GBD 1990 study (3).

Table 2.1: Case and sequelae definitions for dementia

Cause category	GBD 2000 Code	ICD 9 codes	ICD 10 codes
Dementia	U087	290, 330, 331	F01, F03, G30-G31

Sequela	Definition
Cases	Mild, moderate and severe Alzheimer disease, senile and other dementias.

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3. Incidence and prevalence of dementia

Dementia is an extremely common condition among the elderly. Over 100 epidemiological surveys have now been published from many countries (4). Methodological differences make comparisons difficult, although several meta-studies described below provide baseline material for developed countries. An integrative analysis of 47 surveys across 17 countries has suggested approximate rates under 1% for dementia from any cause in persons aged 60 to 69 years, rising to about 39% in persons 90 to 95 years old (5). The prevalence doubles with every five years of age within that range, with few differences taking into account secular changes, age, gender, place of living.

Risks factors for vascular dementia are well known. Epidemiological surveys have identified several risk factors for Alzheimer type dementia (age, family history, Apolipoprotein E epsilon 4 genotype and Down's syndrome), some possible risk factors (head injury, aluminum, previous depression) and some protective factors (education, anti-inflammatory drugs and estrogen replacement) (5).

The prevalence of dementia in subjects 65 years and older in North America is approximately 6%-10%, with Alzheimer's disease accounting for two-thirds of these cases. If milder cases are included, the prevalence rates double.

Alzheimer's disease (AD) has become nearly twice as prevalent as vascular dementia (VaD) in Korea, Japan, and China since transition in early 1990s (6). In the 1980s, VaD was more prevalent than AD in these countries. In Nigeria, the prevalence of dementia was low. Indian studies were contradictory, with both AD and VaD being more prevalent in different studies. American and European studies consistently reported AD to be more prevalent than VaD.

There have now been four age-specific prevalence meta-analyses. Jorm et al. (7) used data from 22 studies from throughout the world and found a consistent trend for prevalence to double with every 5.1 years of age. The exponential rise was somewhat steeper for Alzheimer's disease (doubling every 4.5 years of age) than for vascular dementia (doubling every 5.3 years of age). Hofman et al. (8) pooled data from 12 European studies carried out between 1980 and 1990. This meta-analysis differed from the one by Jorm et al. in that it excluded non-European and older studies.

Nevertheless, as shown in Table 1, the estimated prevalence rates are strikingly similar to the ones derived from the earlier meta-analysis.

The third meta-analysis, Ritchie et al.(9), used data from the 3 studies which had been carried out since 1980 and which used DSM-III diagnostic criteria for dementia. By restricting the studies to those which used the same diagnostic criteria, the authors found much less variability in the prevalence rates in the upper age ranges than had the other two meta-analyses. However, the number of studies included was only small. The estimated prevalence rates from Ritchie et. al. are also shown in Table 3.1.

Table 3.1: Prevalence rates of dementia from 3 age-specific prevalence meta-analyses

	Jorm et al. (1987)	Hofman et al. (1991)	Ritchie et al. (1992)
Age Groups	%	%	%
60-65	0.7	1	0.9
65-69	1.4	1.4	1.6
70-74	2.8	4.1	2.8
75-79	5.6	5.7	4.9

80-84	11.1	13	8.7
85+	23.6	24.5	16.4

The most recent meta-analysis of European population-based studies carried out in the 1990s, the EURODEM study (10), used data from 11 studies carried out in eight European countries. The overall pooled prevalence rates for males and females are shown in Table 3.2.

Table 3.2: Incidence and prevalence rates of dementia from the EURODEM meta-analyses for European studies (10;11)

Age Groups	Incidence per 1,000		Prevalence per 1,000	
	Males	Females	Males	Females
60-64	1.5	1.5	4	4
65-69	2.4	2.5	16	10
70-74	6.4	4.7	29	31
75-79	13.7	17.5	56	60
80-84	27.6	34.1	110	126
85-89	38.8	53.8	128	202
90+	40.1	81.7	221	308

Liu et al. (12) conducted an epidemiological study of several neurological disorders among Chinese aged 50 years and over on the islet of Kinmen. They found a dementia prevalence rate for this age group of 11.2 per 1,000. Chiu, Lam, et al. (13) examined the prevalence of dementia in elderly Chinese aged 70 years and older in Hong Kong using a Cantonese version of the Mini-Mental State Examination. The overall weighted prevalence of dementia in our subjects was 6.1 +/- 0.7%, which is at the lower end of the range of rates reported in whites. Alzheimer's disease (AD) accounted for 64.6% and vascular dementia, 29.3%. These results, together with previous studies in Chinese populations, suggest that the rates of AD in Chinese are low compared with those in whites.

Very few of the 100 studies of the prevalence of dementia have been carried out in Africa. Much of the early work concerned small hospitalised samples. However, a series of studies from Ibadan, Nigeria, have produced consistently low rates for dementia, especially for Alzheimer's Disease. The most recent studies reveal rather higher rates, but still lower than surveys carried out elsewhere (14;15). The most recent Ibadan study (16) determined the prevalence of dementia in a cohort of 2494 elderly Nigerians and compared them with those of 2212 African Americans living in Indianapolis, studied simultaneously using similar methodology. The overall age-adjusted prevalence rates of dementia and Alzheimer's disease in Ibadan were 2.29% and 1.41%, respectively. These rates were much lower than the respective values of 8.24% and 6.24% obtained for African Americans. In Ibadan, Alzheimer's disease accounted for 64.3% of the cases.

Jorm and Jolley (17) have carried out a meta-analysis of the age-specific incidence of all dementias, including AD and vascular dementia based on data from 23 published studies reporting age-specific incidence data. The incidence of both dementia and AD rose exponentially up to the age of 90 years, with no sign of leveling off. The incidence rates for vascular dementia varied greatly from study to study, but the trend was also for an exponential rise with age. There was no sex difference in dementia incidence, but women tended to have a higher incidence of AD in very old age, and men tended to have a higher incidence of vascular dementia at younger ages. East Asian countries had a lower incidence of dementia than Europe, and also tended to have a lower incidence of AD.

As noted by Mathers et al. (18), the incidence rates estimated in this meta-analysis are not consistent with the prevalence rates estimated previously by the same authors (7). We thus examined the incidence rates estimated in the EURODEM study for European populations in the 1990s, shown

above in Table 3.2 (11). As described below in Section 4, the EURODEM incidence and prevalence rates are consistent with estimated relative risks of mortality for dementia cases.

The incidence and prevalence of dementia increase sharply with advancing age. No difference is noted in overall age-adjusted incidence rates by gender. Rochester studies provide the only 25-year time trend analyses of the incidence of dementia in the United States. Time trends over three prevalence dates indicate an increase in prevalence in this community. (19)

Incidence rates of Alzheimer disease (AD) were higher in women than in men in several recent European and Asian studies. Cohort studies in the United States, on the other hand, have consistently reported no difference in incidence across sex. Cases were ascertained through the medical records linkage system of the Rochester Epidemiology Project, which encompasses the records of all medical care providers (including outpatient clinics, hospitals, general practitioners, and nursing homes) in Rochester. For both dementia and AD, incidence rates increased steeply with age, and there were no consistent differences between men and women (20). Contrary to observations from European and Asian populations, women were not at increased risk of incident AD in Rochester. Our findings, based on a medical records linkage system, corroborate findings from several other US studies that involved the direct contact of cohort members. The consistency of findings across study designs suggests that sex or sex-related exposures do not consistently play a major role in AD causation in American populations.

4. Disease model

DISMOD was used to develop consistent incidence and prevalence rates by age and sex for the European region. Remission was assumed to be zero, and cause-specific mortality was modelled in terms of relative risks (RR) rather than case fatality rates (because dementia cases may have higher relative risk of mortality from general causes).

The Rochester study found that people with dementia had a poorer survival than others of the same age and sex and that the relative risk of mortality is greater for earlier onset cases (21). Survival data quoted in Henderson and Jorm (22) are consistent with a mortality RR of 1.6 for 5-year mortality after medical diagnosis and 1.8 for 10-year mortality after medical diagnosis. A survival study of vascular dementia in Rochester, Minnesota (23) found that patients with VaD had worse mortality than referent subjects (RR 2.7). Patients with VaD had a higher RR of death (RR, 2.7) than patients with dementia overall (RR, 1.8) or patients with Alzheimer disease (RR, 1.4). The EURODEM study of dementia prognosis in Europe (24) found that prevalent cases of dementia had an average relative risk of mortality of 2.38. We modelled mortality RR as 2.38 up to age 85, then declining to 1.8 in 90+ females and 1.6 in 90+ males (see Table 4.1).

With these assumptions, the EURODEM incidence and prevalence rates by age are very consistent for both sexes (see Table 4.1).

The resulting incidence rates by age and sex, together with the mortality RRs were then used to model dementia prevalence in other regions as summarized in Table 4.2. The resulting prevalence rates are also very consistent with those found in the earlier meta-analysis of Jorm et al. (7) for Australasia and North America. The European incidence rates were adjusted to match observed prevalence rates where necessary for other regions.

The increase of dementia prevalence compared to the GBD 1990 estimates is due to the EURODEM study on prevalence in Europe as well as the Rotterdam study and Canadian study that provided better information of the disease in the over 65 year old population (GBD 90 was 60+ with

no details). Prevalence estimates for A regions reflect this. In China the combination of rural and urban studies provided better information. Two new studies done in the past 5 years gave better information in India. A newly published population study in Nigeria allowed making better estimates for Africa. The disability weight for dementia remains unchanged from the GBD 1990 value of 0.625.

Table 4.1: DISMOD model of dementia incidence and prevalence rates of dementia based on the EURODEM meta-analyses for European studies (10;11)

Age groups	Inputs to DISMOD			DISMOD outputs	
	Incidence per 1,000	Prevalence per 1,000	Mortality RR	Incidence per 1,000	Prevalence per 1,000
Males					
0-4	0.055	0.14	2.38	0.040	0.2
5-9	0.009	0.31	2.38	0.009	0.4
10-14	0.009	0.31	2.38	0.009	0.4
15-19	0.009	0.42	2.38	0.009	0.4
20-24	0.009	0.42	2.38	0.009	0.5
25-29	0.009	0.42	2.38	0.009	0.5
30-34	0.009	0.55	2.38	0.009	0.6
35-39	0.009	0.55	2.38	0.009	0.6
40-44	0.009	0.55	2.38	0.009	0.6
45-49	0.05	1.19	2.38	0.1	0.8
50-54	0.1	1.19	2.38	0.1	1.1
55-59	0.25	1.19	2.38	0.2	1.9
60-64	1.5	4	2.38	1.3	5.5
65-69	2.4	16	2.38	2.5	13.2
70-74	6.4	29	2.38	6.4	30.2
75-79	13.7	56	2.38	13.5	59.9
80-84	27.6	110	2.38	27.8	107.2
85-89	38.8	128	1.8	37.3	147.8
90-94	40.1	221	1.8	40.7	199.6
95-99	40.1	221	1.6	39.9	226.7
100+	40.1	221	1.6	40.2	218.3
Females					
0-4	0.055	0.14	2.38	0.038	0.2
5-9	0.009	0.31	2.38	0.009	0.4
10-14	0.009	0.31	2.38	0.009	0.4
15-19	0.009	0.42	2.38	0.009	0.4
20-24	0.009	0.42	2.38	0.009	0.5
25-29	0.009	0.42	2.38	0.009	0.5
30-34	0.009	0.55	2.38	0.009	0.6
35-39	0.009	0.55	2.38	0.009	0.6
40-44	0.009	0.55	2.38	0.009	0.7
45-49	0.05	1.19	2.38	0.051	0.8
50-54	0.1	1.19	2.38	0.1	1.2
55-59	0.25	1.19	2.38	0.2	1.9
60-64	1.5	4	2.38	1.3	5.7
65-69	2.5	10	2.38	2.3	13.7

70-74	4.7	31	2.38	4.8	28.6
75-79	17.5	60	2.38	16.6	70.8
80-84	34.1	126	2.38	33.1	140.9
85-89	53.8	202	2	52.2	227.2
90-94	81.7	308	2	80.4	320.3
95-99	81.7	308	1.8	79.0	342.4
100+	81.7	308	1.8	81.0	310.4

Table 4.2: Dementia incidence/prevalence models and assumptions - summary

AFRO D	Incidence rates from AMRO A adjusted by factor 0.75 to give incidence ratio 60+ consistent with Ibadan study
AFRO E	Same incidence rates as AFRO D
AMRO A	Incidence rates and RR from Europe. Gives prevalence 7% in 65+ consistent with US studies
AMRO B	Incidence rates and RR same as USA
AMRO D	Incidence rates and RR same as USA
EMRO B	Incidence rates same as AFRO
EMRO D	Incidence rates same as AFRO
EURO A	Consistent model of incidence, prevalence and RR from the European meta-analyses
EURO B1	Incidence rates and RR same as EURO A
EURO B2	Incidence rates and RR same as EURO A
EURO C	Incidence rates and RR same as EURO A
SEARO B	Incidence rates and RR same as WPRO B1 (China)
SEARO D	Incidence rates same as AFRO
WPRO A	Incidence rates and RR from Europe. Gives prevalences consistent with Jorm 1987 met-analysis
WPRO B1	Incidence rates and RR from Europe. Gives prevalences 50+ and 70+ consistent with literature for Chinese populations
WPRO B2	Incidence rates and RR same as WPRO B1 (China)
WPRO B3	Incidence rates and RR same as WPRO B1 (China)

5. Incidence, prevalence and mortality estimates for 2000

Table 5.1 summarises the resulting dementia incidence and prevalence rates for the GBD epidemiological regions, and also shows the estimated dementia mortality rates (direct mortality due to dementia, not including attributable mortality due to other causes). Figure 5.1 summarises the age patterns across the GBD regions.

Figure 5.1 Age-specific dementia incidence rate estimates, WHO epidemiological subregions, by sex, 2000.

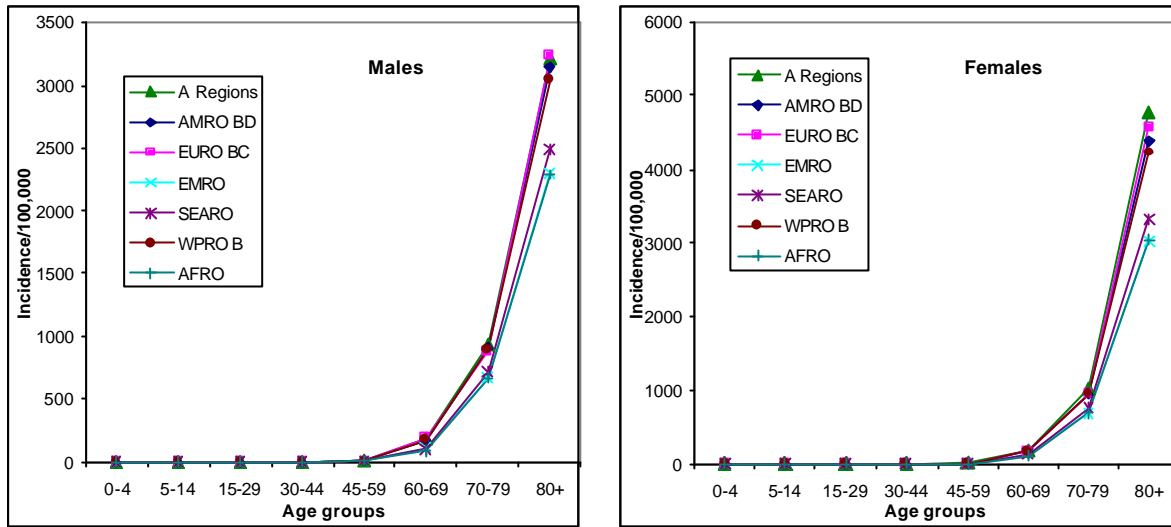


Table 5.1 Dementia: age-standardized incidence and prevalence estimates for WHO epidemiological subregions, 2000.

Subregion	Age-std. Incidence/100,000		Age-std. prevalence/100,000		Age-std. mortality/100,000	
	Males	Females	Males	Females	Males	Females
AFRO D	67.2	81.0	212.6	247.0	1.2	1.5
AFRO E	67.6	79.4	207.9	235.3	1.5	2.3
AMRO A	97.7	122.8	443.4	554.7	11.2	14.8
AMRO B	95.8	115.5	394.8	475.0	3.1	3.3
AMRO D	94.3	113.3	356.0	422.8	1.2	0.9
EMRO B	69.9	82.3	264.3	295.4	2.4	2.3
EMRO D	67.1	80.3	227.2	269.3	2.0	1.8
EURO A	97.8	124.8	468.7	602.0	8.6	9.8
EURO B1	96.7	117.5	372.1	441.2	1.5	1.5
EURO B2	95.0	118.1	353.6	435.6	2.3	1.5
EURO C	88.7	117.1	295.0	413.3	1.9	1.3
SEARO B	93.8	108.9	354.2	395.8	5.7	12.7
SEARO D	66.9	81.9	220.8	288.4	13.5	11.1
WPRO A	96.8	120.3	465.7	611.6	2.4	2.6
WPRO B1	93.6	113.1	354.9	445.2	3.8	5.9
WPRO B2	93.8	112.2	354.2	390.8	10.0	7.6
WPRO B3	92.9	106.2	340.6	385.4	9.8	17.6
World	88.8	112.4	358.6	466.9	6.7	7.7

- Age-standardized to World Standard Population (25).

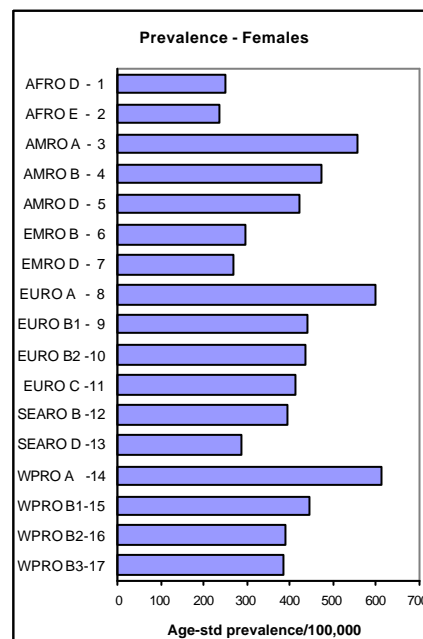
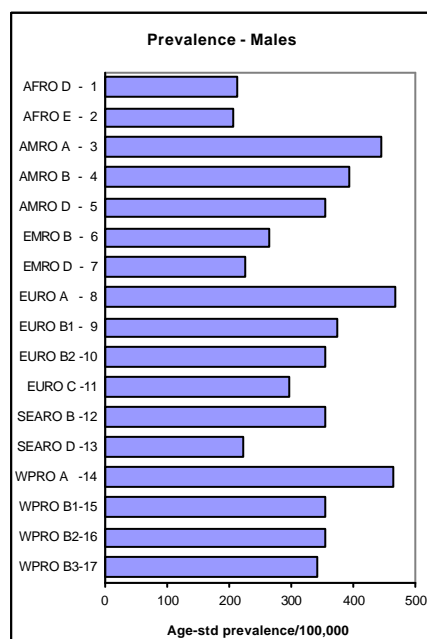


Figure 5.2 Age-standardized dementia prevalence rate estimates, WHO epidemiological subregions, by sex, 2000.

6. Global burden of dementia in 2000

General methods used for the estimation of the global burden of disease are given elsewhere (25). The tables and graphs below summarise the global burden of dementia estimates for the GBD 2000 and compare them with the dementia estimates from the GBD 1990 (3).

Table 6.1: Dementia: global total YLD, YLL and DALY estimates, 1990 and 2000.

	<i>Males</i>	<i>Females</i>	<i>Persons</i>
YLD('000)			
<i>GBD1990</i>	2,938	4,126	7,064
<i>GBD2000</i>	3,188	5,310	8,498
YLL('000)			
<i>GBD1990</i>	656	780	1,435
<i>GBD2000</i>	567	830	1,397
DALY('000)			
<i>GBD1990</i>	3,594	4,906	8,500
<i>GBD2000</i>	3,755	6,140	9,895

Table 6.2: Dementia: YLD, YLL and DALY estimates for WHO epidemiological subregions, 2000.

Subregion	YLD/100,000		YLL/100,000		YLD	YLL	DALY
	Males	Females	Males	Females	('000)	('000)	('000)
AFRO D	39.6	49.5	5.2	10.4	149	26	175
AFRO E	34.9	44.2	5.6	10.1	134	27	160
AMRO A	226.4	404.5	47.3	84.0	980	204	1,184
AMRO B	106.0	154.0	9.2	10.5	576	43	619
AMRO D	81.4	106.2	4.9	3.3	67	3	70
EMRO B	59.7	68.6	5.9	5.4	89	8	97
EMRO D	47.7	65.8	4.5	5.0	78	7	85
EURO A	276.6	531.4	47.3	75.4	1,671	253	1,924
EURO B1	137.0	218.4	9.9	11.7	296	18	314
EURO B2	81.1	132.0	30.5	14.9	54	12	66
EURO C	105.2	284.7	19.7	15.2	493	43	535
SEARO B	87.9	110.7	23.4	48.8	392	142	534
SEARO D	50.3	75.8	22.9	26.8	845	334	1,179
WPRO A	309.1	588.3	14.6	19.7	674	26	700
WPRO B1	109.0	166.3	12.0	20.5	1,858	219	2,078

WPRO B2	81.4	110.1	19.3	24.6	136	31	167
WPRO B3	66.6	82.8	23.3	37.4	5	2	7
World	104.7	177.0	18.6	27.7	8,498	1,397	9,895

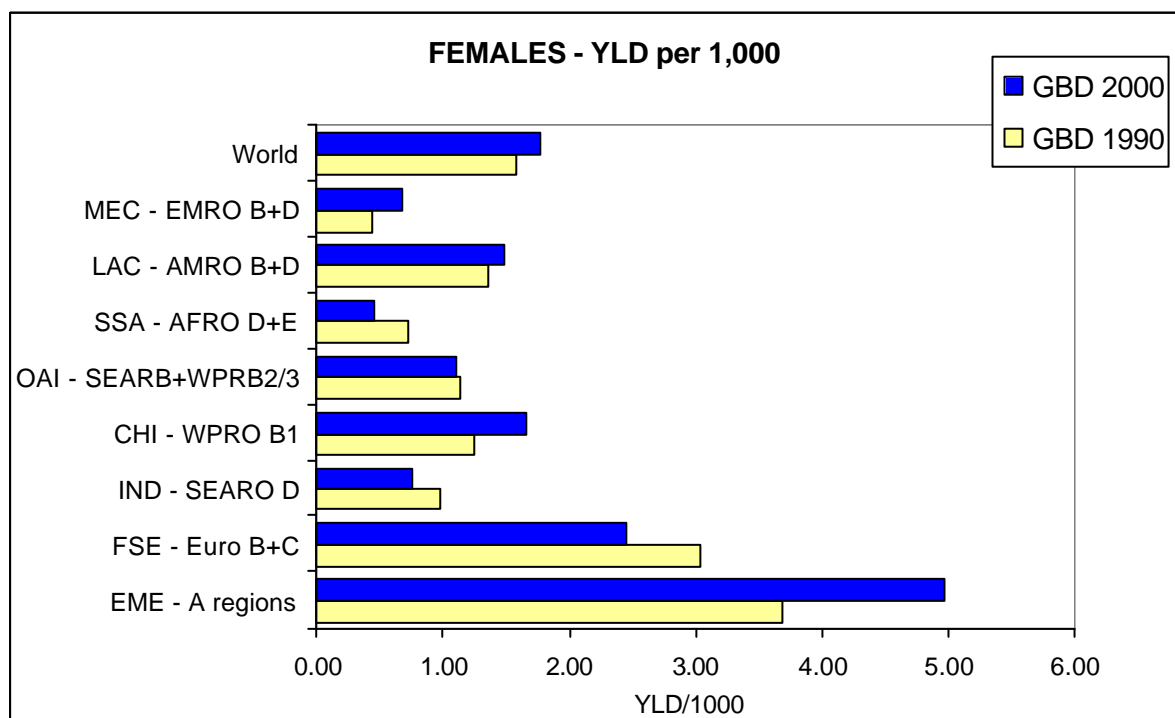
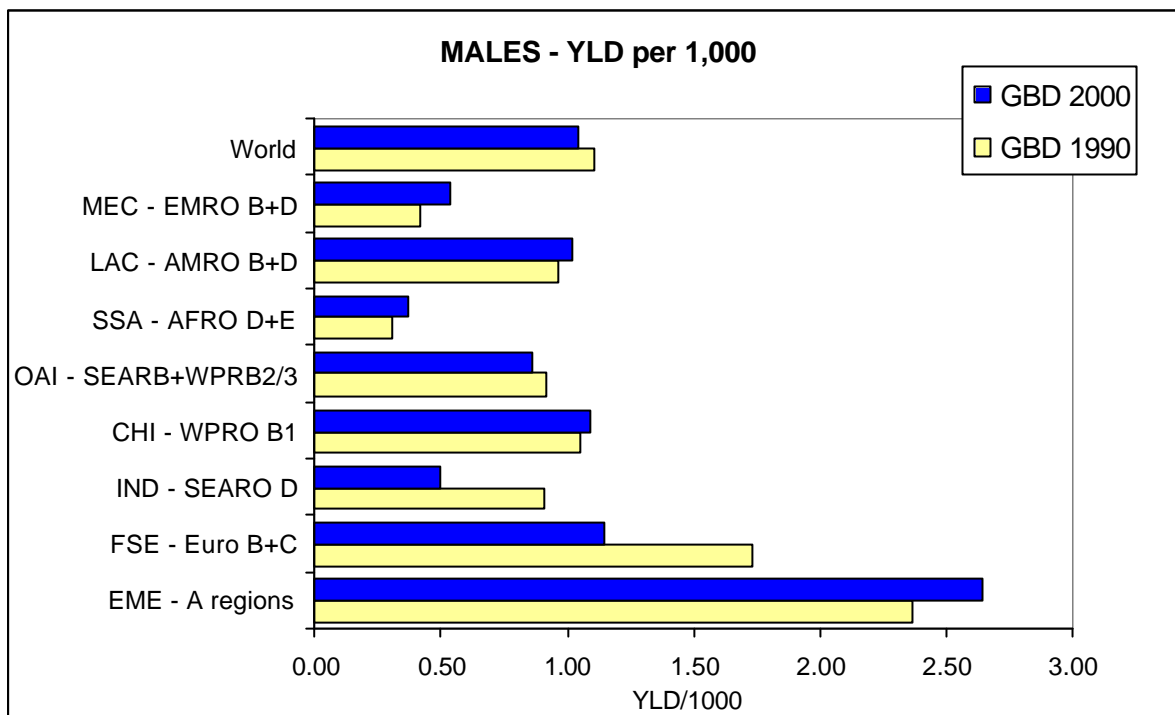


Figure 6.1: Total YLD rates, by sex, broad regions, 1990 and 2000.

7. Conclusions

These are version 2 estimates for the GBD 2000. Apart from uncertainty analysis, and any new or revised epidemiological data or evidence, the only further revisions of these estimates will involve revision of disability weights using information from the 2002-2003 World Health Survey.

We welcome comments and criticisms of these draft estimates, and information on additional sources of data and evidence. Please contact Colin Mathers (EBD/GPE) on email mathersc@who.int.

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