

Global burden of ischaemic heart disease in the year 2000

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2004

1. Introduction

Ischaemic heart disease (IHD) was estimated to be the 5th leading cause of non-fatal burden in the world in 1990, accounting for 3.4 % of total YLD, after lower respiratory tract infections (8.2%), diarrhoeal diseases (7.2%), conditions arising during the perinatal period (6.7%) and unipolar major depression (3.7%) and before cerebrovascular disease (2.8 %). In the Version 1 estimates for the Global Burden of Disease 2000 study, published in the World Health Report 2001 (2), IHD is the 6th leading cause of YLDs at global level, accounting for 3.8% of total global YLDs, after lower respiratory tract infections (6.4%), conditions arising during the perinatal period (6.2%), HIV/AIDS (6.1%), unipolar major depression (4.4%) and diarrhoeal diseases (4.2%) and before cerebrovascular disease (3.1%). This draft paper summarises the data and methods used to produce the Version 2 estimates of IHD burden for the year 2000.

2. Case and sequelae definitions

Ischaemic (or ischemic) heart disease is characterized by reduced blood supply to the heart caused by disease of the blood vessels supplying the heart muscle. The two leading manifestations of ischaemic heart disease are angina pectoris and acute myocardial infarction (AMI). Coronary heart disease is a synonym for ischaemic heart disease; the term “coronary vessels disease” is sometimes also used to refer to IHD.

Table 1 lists the ICD-9 and ICD-10 codes defining IHD. However, even in countries where causes are assigned by medically qualified staff, there is often substantial use of cardiovascular disease categories lacking diagnostic meaning, such as cardiac arrest and heart failure (ICD-9 codes 427.1, 427.4, 427.5, 428, 429.0, 429.1, 429.2, 429.9, 440.9 and ICD-10 codes I47.2, I49.0, I46, I50, I51.4, I51.5, I51.6, I51.9, I70.9). The median percentage of deaths coded to ill-defined cardiovascular causes was around 5 percent for the death registration data held in the WHO Mortality Database.

The so-called cardiovascular “garbage codes” in ICD-9 and ICD-10 include heart failure, ventricular dysrhythmias, generalized atherosclerosis and ill-defined descriptions and complications of heart disease. IHD deaths may be assigned to these ill-defined cardiovascular codes because of insufficient clinical information at the time of death, local

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medical diagnostic practices or simply by error. The original GBD study (1) developed an algorithm for redistributing a proportion of the garbage coded deaths to IHD. For the GBD 2001, Lozano and others developed a revised method to estimate the fraction of IHD deaths assigned to ill-defined cardiovascular codes (2). As a result, from 50-95 per cent of deaths coded to CVD garbage codes have been redistributed to IHD in countries with high levels of garbage code use.

Table 1: GBD 2000 case and sequelae definitions for IHD

Cause category	GBD 2000 Code	ICD 9 codes	ICD 10 codes
Ischaemic heart disease	U106	410-414 ^a Proportion <i>Garbage codes</i> ^b	I20-I25 of: Proportion of: <i>Garbage codes</i> ^b
Sequela	Definition		
Acute myocardial infarction	Definite and possible episodes of acute myocardial infarction according to MONICA study criteria		
Angina pectoris	Cases of clinically diagnosed angina pectoris or definite angina pectoris according to Rose questionnaire		
Congestive heart failure	Mild and greater (Killip scale k2-k4)		

Angina pectoris is a pressure-like pain in the chest that is induced by exertion or stress and relieved within minutes after cessation of effort or using sublingual nitroglycerin. Unstable angina represents a spectrum of clinical states that fall between stable angina and acute myocardial infarction (MI). Chest pain is subjective and there is no "gold standard" for estimating the prevalence of angina in populations. Unstable angina is generally associated with hospital admission in developed countries but stable angina is also managed in the community.

The Rose Questionnaire (3), also sometimes referred to as the London School of Hygiene Cardiovascular Questionnaire, has been used in epidemiologic research as a standard, unbiased and validated measure of the prevalence of angina in general populations since its introduction in 1962. In comparison with clinical judgment, the questionnaire has been found to have 78-81% sensitivity and 94-97% specificity in men. The positive predictive value of Rose questionnaire angina is lower in younger women than in other population groups.

The questions on the Rose questionnaire are as follows:

Possible angina = affirmative response to

1. Have you ever had any pain or discomfort in your chest?
2. Do you get it when you walk uphill or hurry?
3. What do you do if you get it while you are walking?
4. If you stand still, what happens to it?
5. How soon is it relieved after standing still?
6. Where is the pain?

Rose angina can be sub-divided into 3 levels: definite angina grade 2 (severe), definite angina grade 1 (moderate), and possible angina (mild). Definite angina grade 1 refers to persons who gave positive and suitable answers to all standard Rose questions. Grade 2 is present when walking at an ordinary pace on a level ground also brought on chest pain. Possible angina refers to a person who experiences exertional chest pain (pain on walking uphill or hurrying), but all other criteria of definite angina are not fully met (some of the criteria can exist but not all of them).

The Canadian Cardiovascular Society (CCS) grading of angina is used to sub-divide angina according to the degree of exertion required to precipitate symptoms. This system has been used in clinical trials but has not been used in population-based studies.

Congestive heart failure (CHF), is a chronic long-term sequela for a number of cardiovascular diseases, including IHD, hypertensive heart disease, rheumatic heart disease, heart valve diseases and inflammatory heart diseases such as cardiomyopathy.

Killip and Kimball developed a scale for measuring the severity of CHF, with four classes:

- I: no clinical signs of heart failure
- II: crackles, S3 gallop and elevated jugular venous pressure
- III: frank pulmonary oedema
- IV: cardiogenic shock - hypotension (systolic < 90 mmHg) and evidence of peripheral vasoconstriction (oliguria, cyanosis, sweating)
(4)

Another widely used functional classification was developed by the New York Heart Association (5). The NYHA Functional Classification places patients in one of four categories based on how much they are limited during physical activity:

- | | |
|-----|--|
| I | No symptoms and no limitation in ordinary physical activity. |
| II | Mild symptoms and slight limitation during ordinary activity.
Comfortable at rest. |
| III | Marked limitation in activity due to symptoms, even during less-than-ordinary activity.
Comfortable only at rest. |
| IV | Severe limitations. Experiences symptoms even while at rest. |

3. Population studies of acute myocardial infarction

The WHO MONICA Project provided an outstanding opportunity for getting comparable data on IHD rates from different populations (6;7). In a recent MONICA publication on changes in IHD survival (8), the MONICA definition 1 for coronary events was used which includes the following diagnoses: definite non-fatal events, and definite, possible, and unclassifiable coronary deaths. Myocardial infarctions were divided into definite events (requiring either (1) progression of Minnesota codes on serial ECGs, or (2) cardiac enzymes levels twice the limit of normal.

There were 37 populations in 21 countries in four continents (see Table 2). The registration period differed slightly between studies from but ranges from mid 1980s to mid 1990s. The age group included was from 35 to 64 years. The case fatality rates are based on the

proportion of events that were fatal within 28 days. The present rates are based on the MONICA weights. The Swiss studies did not include data on women. The case-fatality rates are for first-events but which is likely to be a biased estimate as the classification is dependent on previous medical history, generally available for nonfatal events but variably missing for fatal cases.

In men the case-fatality ranges from 34 % in SWI-TIC to 83 % in POL-TAR, and in women it ranges from 34 % in CAN-HAL, ICE-ICE, and SWE-NSW to 88 % in POL-TAR (see also Figure 1 and 2). In the EME populations the mean CF is 0.44 (41922/95270) in men and 0.49 (11172/22844) in women. In the remaining populations the mean CF is 0.59 (22081/37320) in men and 0.65 (6762/10429) in women. The difference is highly significant, $p < 0.001$. Thus, there seem to be a higher CF in women than in men and poorer income populations have higher CF.

The concordance between the number of CHD deaths registered in official statistics and the number of fatal events in the MONICA studies are presented in Table 3. Using mean values the proportion of official statistics and MONICA registered deaths were 85% (1477/1730) in men and 80% (408/512) in women. It is not surprising that the numbers between the official statistics and the MONICA registers differ as patients with a myocardial infarction who died from the event but after day 28 could correctly be diagnosed with myocardial infarction as the cause of death in the death certificates, but be listed as non-fatal in the MONICA register. However, that would increase the number of events in the official statistics which is in contrast to the finding that in most populations more events were registered in the MONICA register. This may be due to miscoding to other disease categories.

Substantial efforts were also made to identify population studies of AMI incidence, case fatality, and survivor prevalence as well as incidence and prevalence for angina pectoris, particularly in developing countries. Appropriate surveys were identified by a MEDLINE search using the words myocardial infarction, angina, heart failure, cardiac failure, incidence, prevalence, occurrence and epidemiology; and by examining other reviews on the epidemiology of coronary heart disease. Very few studies were identified outside the developed country group, and an additional effort was made to examine available population data on Q wave prevalence with the aim of mapping from Q wave prevalence to prevalence of AMI survivors.

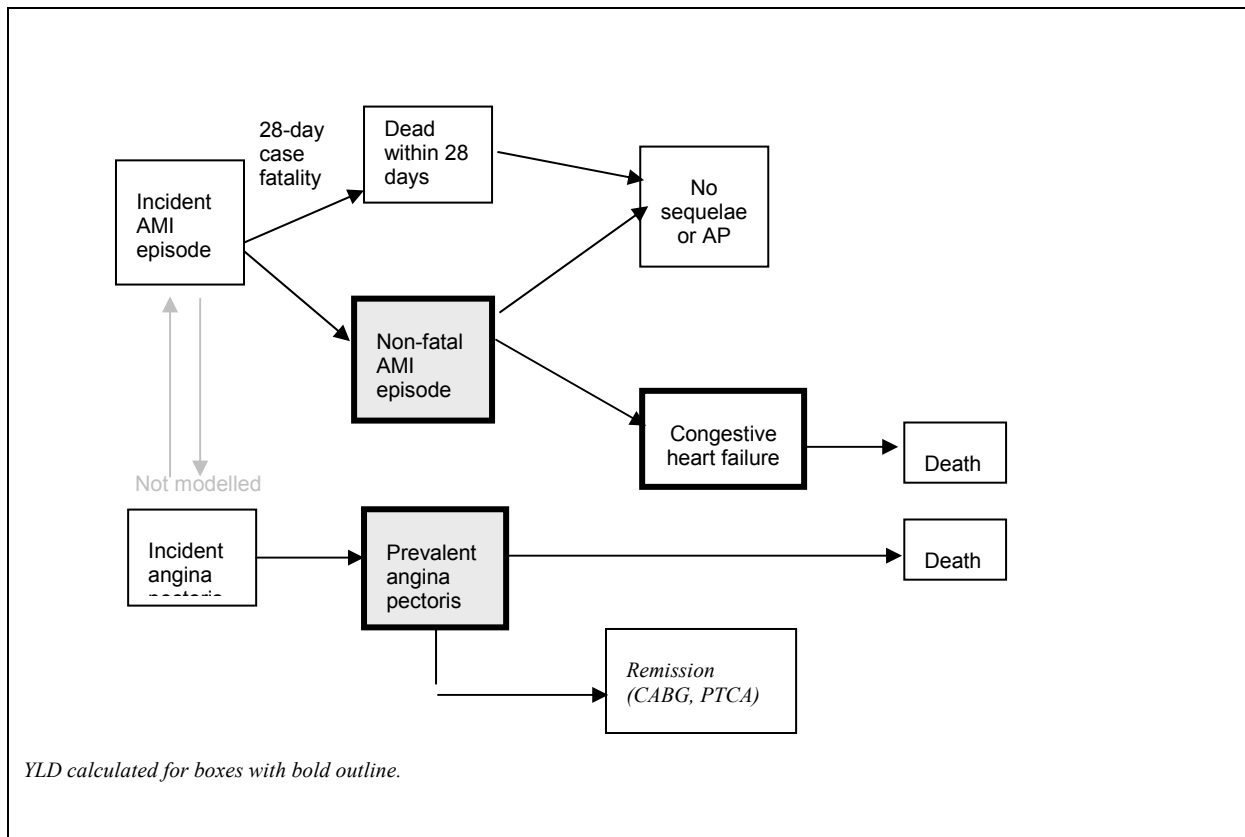
Difficulties in interpreting and ensuring internal consistency of incidence and prevalence estimates led us to develop a disease model for estimating IHD burden which started with IHD mortality estimates by region, age and sex, and used regional case fatality estimates to back-estimate the incidence of AMI and the incidence and prevalence of angina and CHF. These models and their empirical bases are described in the following sections.

Table 2: Summary of MONICA IHD results.

Population	Study period	No. nonfatal men	No. fatal men	Total number of events	28D CF (weighted)	No. nonfatal women	No. fatal women	28D CF (weighted)
AUS-NEW	1985-93	1,917	1,296	3,213	41	626	445	41
AUS-PER	1987-93	4,366	2,483	6,849	37	921	686	42
BEL-CHA	1983-92	1,005	991	1,996	50	224	332	59
BEL-GHE	1983-92	818	728	1,546	47	167	231	58
CAN-HAL	1984-93	1,544	901	2,445	38	449	229	34
CHN-BEI	1984-93	484	683	1,167	59	125	350	74
CZE-CZE	1984-93	2,842	3,105	5,947	53	586	749	54
DEN-GLO	1982-91	1,564	1,697	3,261	53	380	529	58
FIN-KUO	1983-92	1,855	1,542	3,397	46	402	258	39
FIN-NKA	1983-92	1,419	1,309	2,728	48	315	214	41
FIN-TUL	1983-92	1,042	986	2,028	49	221	212	49
FRA-LIL	1985-94	2,031	2,792	4,823	59	361	816	70
FRA-STR	1985-93	2,230	2,076	4,306	49	449	583	57
FRA-TOU	1985-93	1,983	1,294	3,277	40	228	333	60
GER-AUG	1985-94	1,425	1,734	3,159	55	268	496	65
GER-BRE	1985-92	1,594	1,542	3,136	50	379	429	52
GER-EGE	1985-93	1,952	1,930	3,882	50	351	632	63
ICE-ICE	1981-94	1,578	919	2,497	37	336	182	34
ITA-BRI	1985-94	2,902	1,948	4,850	41	382	424	53
ITA-FRI	1984-93	2,746	2,223	4,969	45	526	528	50
LTU-KAU	1983-92	1,439	1,678	3,117	55	302	367	54
NEZ-AUC	1983-91	2,740	2,649	5,389	50	699	745	51
POL-TAR	1984-93	799	3,711	4,510	83	138	1087	88
POL-WAR	1984-94	2,382	3,505	5,887	60	729	1075	59
RUS-MOC	1985-93	663	1,005	1,668	61	202	315	60
RUS-MOI	1985-93	1,565	2,507	4,072	63	369	793	67
RUS-NOC	1984-92	1,292	1,876	3,168	60	359	717	67
RUS-NOI	1984-93	451	653	1,104	60	130	296	71
SPA-CAT	1985-94	2,650	1,505	4,155	37	396	336	46
SWE-GOT	1984-94	1,757	1,376	3,133	44	412	358	45
SWE-NSW	1985-95	3,614	2,081	5,695	36	872	458	34
SWI-TIC	1985-93	987	474	1,461	34			
SWI-VAF	1985-93	1,831	1,091	2,922	38			
UNK-BEL	1983-93	3,594	2,476	6,070	41	1117	842	42
UNK-GLA	1985-94	2,823	2,627	5,450	48	1125	1018	46
YSA-STA	1980-92	1,333	1,182	2,515	48	417	488	54
YUG-NOS	1984-95	1,370	1,428	2,798	52	376	381	50

Table 3: Official statistics on CHD death versus MONICA CHD deaths.

Population	Study period	No. CHD deaths official stats men	No. fatal CHD events men	OS/MONICA	No. CHD deaths official stats women	No. fatal CHD events women	OS/MONICA
AUS-NEW	1985-93	1233	1296	0.95	401	445	
AUS-PER	1987-93	2292	2483	0.92	554	686	0.90
BEL-CHA	1983-92	587	991	0.59	168	332	0.81
BEL-GHE	1983-92	431	728	0.59	126	231	0.51
CAN-HAL	1984-93	814	901	0.90	186	229	0.55
CHN-BEI	1984-93	653	683	0.96	350	350	0.81
CZE-CZE	1984-93	3105	3105	1.00	761	749	1.02
DEN-GLO	1982-91	1171	1697	0.69	283	529	0.53
FIN-KUO	1983-92	1490	1542	0.97	248	258	0.96
FIN-NKA	1983-92	1280	1309	0.98	216	214	1.01
FIN-TUL	1983-92	949	986	0.96	205	212	0.97
FRA-LIL	1985-94	1433	2792	0.51	290	816	0.36
FRA-STR	1985-93	1180	2076	0.57	271	583	0.46
FRA-TOU	1985-93	751	1294	0.58	137	333	0.41
GER-AUG	1985-94	1438	1734	0.83	385	496	0.78
GER-BRE	1985-92	1182	1542	0.77	263	429	0.61
GER-EGE	1985-93	1539	1930	0.80	454	632	0.81
ICE-ICE	1981-94	901	919	0.98	178	182	0.98
ITA-BRI	1985-94	1789	1948	0.92	341	424	0.80
ITA-FRI	1984-93	1964	2223	0.88	479	528	0.91
LTU-KAU	1983-92	1940	1678	1.16	498	367	1.36
NEZ-AUC	1983-91	2575	2649	0.97	723	745	0.97
POL-TAR	1984-93	1968	3711	0.53	366	1087	0.34
POL-WAR	1984-94	1878	3505	0.54	572	1075	0.53
RUS-MOC	1985-93	1160	1005	1.15	389	315	1.23
RUS-MOI	1985-93	2914	2507	1.16	986	793	1.24
RUS-NOC	1984-92	1834	1876	0.98	691	717	0.96
RUS-NOI	1984-93	970	653	1.49	361	296	1.22
SPA-CAT	1985-94	1259	1505	0.84	240	336	0.71
SWE-GOT	1984-94	1309	1376	0.95	315	358	0.88
SWE-NSW	1985-95	2002	2081	0.96	401	458	0.88
SWI-TIC	1985-93	467	474	0.99			
SWI-VAF	1985-93	1064	1091	0.98			
UNK-BEL	1983-93	2488	2476	1.00	833	842	0.99
UNK-GLA	1985-94	2394	2627	0.91	942	1018	0.93
YSA-STA	1980-92	955	1182	0.81	347	488	0.71
YUG-NOS	1984-95	1293	1428	0.91	321	381	0.84

Figure 1. IHD disease model.

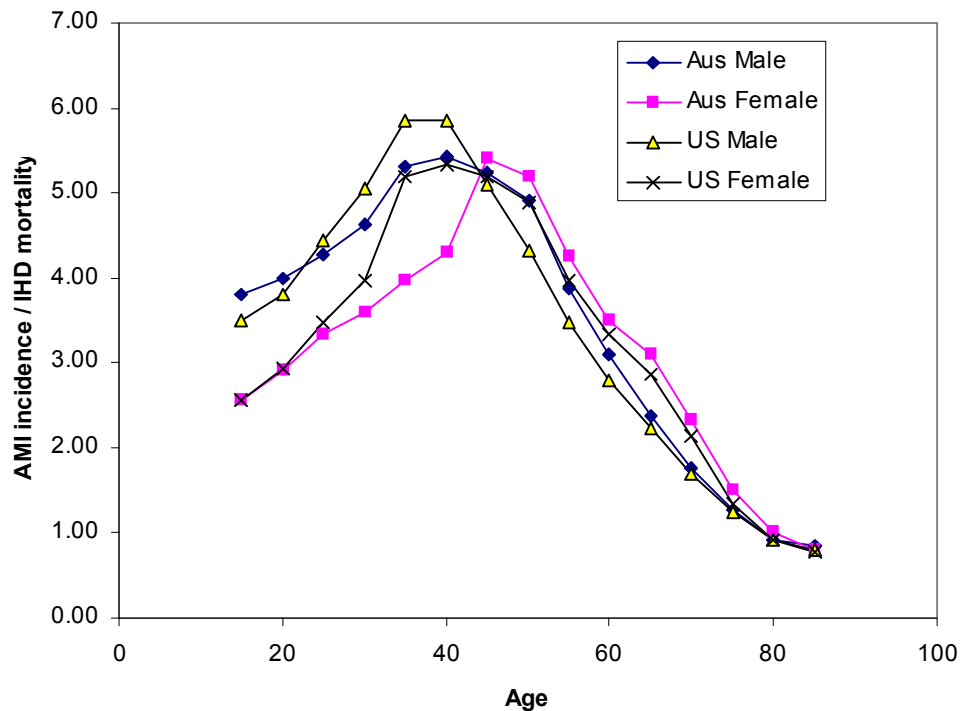
4. Disease model for ischaemic heart disease

The disease model for IHD assumes the starting point for this condition is either angina pectoris or an acute myocardial infarction (AMI). Although these two conditions relate to the same disease process, we model them independently due to insufficient data to do otherwise. We assume angina pectoris has recurring symptoms until death, with possible remission due to treatment (CABG or PTCA). AMI is assumed to result in one of the following: death, heart failure, new or continuing angina pectoris, or recovery with no residual disability. We model angina pectoris pre- and post-myocardial infarct together. Heart failure is assumed to follow immediately after AMI and last for the duration.

4.1 Estimation of AMI incidence

Both the Australian Burden of Disease Study (9) and the US Burden of Disease Study (10) estimated the population incidence of acute myocardial infarction for the year 1996. From these estimates and death registration data it is possible to calculate the ratio of incident cases of AMI to ischaemic heart disease deaths (Figure 2). Similar ratios can be calculated from the data for MONICA study populations in Europe, including Eastern Europe and former Soviet countries, and for China (Beijing) (Figure 3).

Figure 2. AMI incidence/IHD mortality for Australia and USA, 1996.



The Australian estimates for AMI incidence were based on the incidence of people admitted to hospital with AMI. National hospital morbidity data for 1886/197 were used to estimate separations with AMI as principal diagnosis. These data were further adjusted to reflect incorrect coding of AMI hospital episodes (9). For estimating incidence/mortality ratios for 2000, it was assumed that incidence was declining at one half the rate of mortality reflecting the combined impact of prevention and treatment.

The US study estimated the incidence of people admitted to hospital with AMI from the 1996 Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) and adjusted to reflect incorrect coding of AMI-related hospital episodes using unpublished data from the Atherosclerosis Risk in Communities (ARIC) study (11). The total incidence of AMI was estimated from this with an adjustment to include pre-hospital mortality. For the USA, there was mixed evidence of incidence trends and the incidence/mortality ratios from the US Burden of Disease and Injury Study for 1996 were assumed to apply to 2000 unchanged.

For the estimation of ratios for Europe (mortality strata A, B and C), and China, MONICA incidence data was used and projected forward to the year 2000 using the observed site specific incidence trends. The incidence data were based on MONICA Definition 1 plus 50% of the possible-nonfatal category (Figure 3). For other regions, the incidence/mortality ratios were estimated as shown in Table 4, based on the relationships implied by the incidence and mortality estimates in the GBD 1990 study (12).

Figure 3. Comparison of AMI incidence/IHD mortality ratios for Australia and USA, 1996 with ratios for EURO A, B, C and China from the MONICA study, early 1990s.

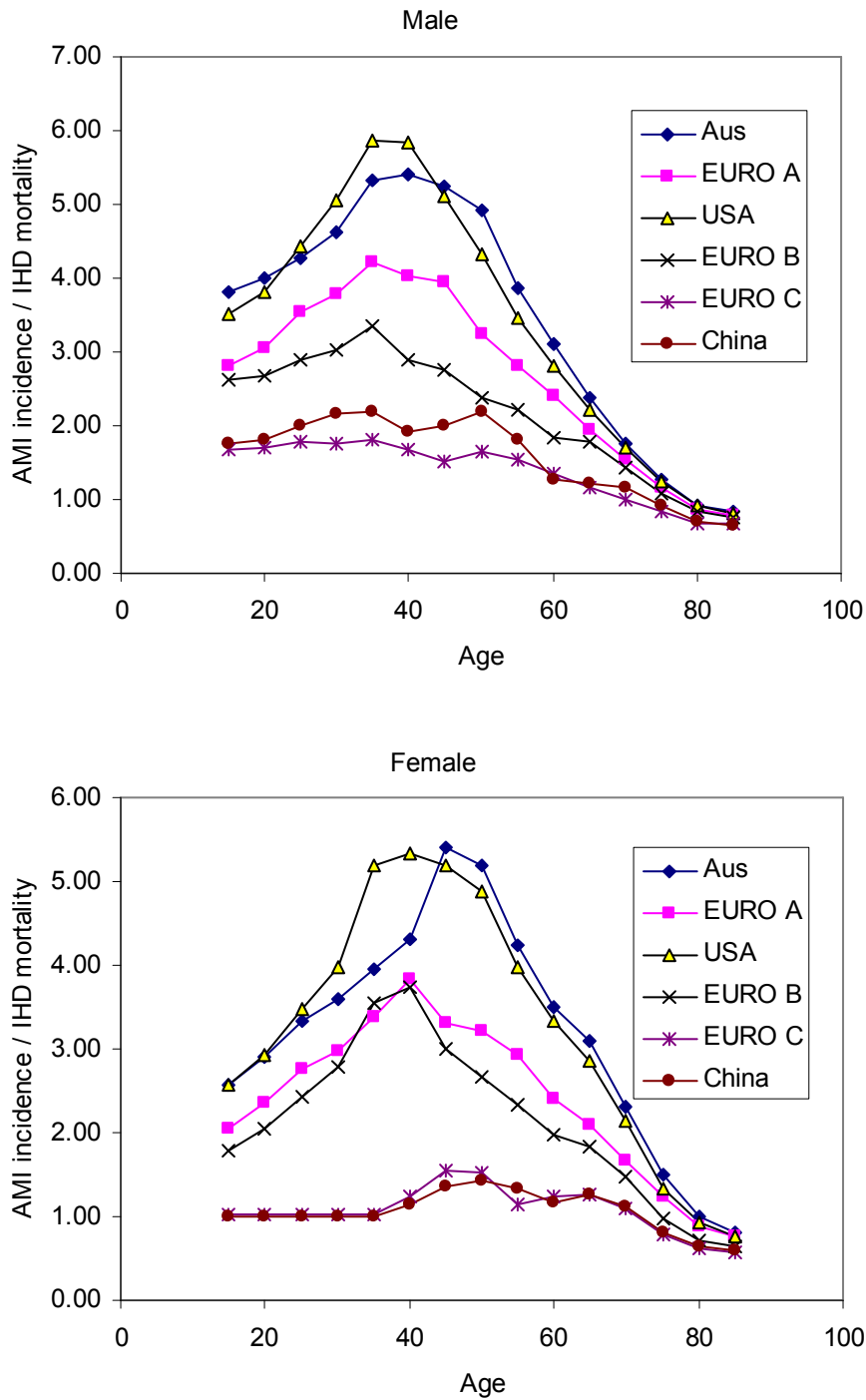


Table 4. Estimation of AMI incidence/IHD mortality ratios for other regions

Region	Incidence/mortality ratio
AFR D, AFR E	Ratios assumed 5% lower than those for China.
AMR B	Ratios assumed 2.5% higher than those for EUR B.
AMR D	Ratios assumed 2% lower than those for EUR B.
EMR B	Ratios assumed 4% higher than those for China.
EMR D	Ratios assumed 1% lower than those for China.
SEAR B, WPR B	Ratios assumed the same as those for China.
SEAR D	Ratios assumed 2% lower than those for China.

Table 5. Estimated CFR and first AMI/total AMI ratios, Australia, USA, Europe and China, 2000

All ages	USA	EURO A	EURO B	EURO C	Australia	China
MALES						
Case fatality						
Annual trend (%)	(a)	-1.2	0.4	1.3	(a)	1.1
1-day	35%	35%	48%	50%	35%	49%
28-day	42%	41%	60%	61%	42%	62%
First AMI / total AMI	0.70	0.68	0.50	0.58	0.70	0.76
FEMALES						
Case fatality						
Annual trend (%)	(a)	-1.2	-0.6	-0.2	(a)	1.3
1-day	36%	38%	42%	42%	37%	61%
28-day	42%	47%	59%	57%	46%	72%
First AMI / total AMI	0.75	0.68	0.5	0.58	0.7	0.763

(a) estimated case fatality rates for 1996 assumed to apply also in 2000

Table 6. Assumed case fatality rates and first AMI/total AMI ratios, GBD regions, 2000.

Region	1-day CFR		28-day CFR		First AMI / total AMI	
	Male	Female	Male	Female	Male	Female
AFRO D	49%	61%	62%	72%	0.80	0.80
AFRO E	49%	61%	62%	72%	0.80	0.80
AMRO A	35%	36%	42%	42%	0.70	0.75
AMRO B	48%	42%	60%	59%	0.50	0.59
AMRO D	50%	42%	61%	57%	0.58	0.65
EMRO B	49%	61%	62%	72%	0.76	0.81
EMRO D	49%	61%	62%	72%	0.76	0.81
EURO A	35%	38%	41%	47%	0.68	0.68
EURO B1	48%	42%	60%	59%	0.50	0.50
EURO B2	50%	42%	61%	57%	0.58	0.58
EURO C	50%	42%	61%	57%	0.58	0.58
SEARO B	49%	61%	62%	72%	0.76	0.81
SEARO D	49%	61%	62%	72%	0.76	0.81
WPRO A	35%	37%	42%	46%	0.70	0.70
WPRO B1	49%	61%	62%	72%	0.76	0.76
WPRO B2	49%	61%	62%	72%	0.76	0.81
WPRO B3	49%	61%	62%	72%	0.76	0.81

4.2 Estimation of the prevalence of 28-day AMI survivors

AMI incidence was computed for each region from estimated IHD mortality using the incidence/mortality ratios described in the previous section. The incidence of 28-day AMI survivors was estimated by applying regional age-sex-specific estimates of 28-day case fatality rates for AMI. The Australian and US Burden of Disease studies and the MONICA study were used to estimate 28 day case fatality rates (CFR), annual trends in CFR and the proportion of all AMI which were first AMI (Table 5). For B and C regions, assume 10% higher case fatality rate, for D and E regions assume 20% higher.

Regional estimates of 28-day CFR and ratio of first AMI to total AMI incidence for 2000 are shown in Table 6. These were used to estimate for each region the incidence of first AMI 28-day survivors. DISMOD II was then used to model the prevalence of AMI survivors by region, assuming the relative risk of mortality was 2.0 at all ages for AMI survivors. This relative risk was used by both the Australian and US Burden of Disease studies. Brand et al noted that neither pre-AMI nor post-AMI angina was associated with excess overall mortality (13). Rosengren et al (14) reported differently from Sweden indicating a RR of dying from CHD of 4 in first four years of follow-up of people with AP and 3.2 in the 4 years following. He gave no all cause mortality RRs for AP but the post-MI RRs of CHD mortality was twice that of all cause mortality. This figure is similar to the 1.6 reported from a 15-year follow-up study in the UK (15). Pending further information, an RR of 2 was used for AMI 28-day survivors. Table 7 shows the resulting age-standardized prevalences of 28-day AMI survivors, by GBD region for the year 2000 (version 2).

Table 7. AMI: age-standardized incidence, prevalence (28 day survivors) rate estimates for WHO epidemiological subregions, 2000 (Version 2).

Subregion	Age-std. Incidence/1000		Age-std. prevalence /1000	
	Males	Females	Males	Females
AFRO D	1.01	0.80	5.02	4.23
AFRO E	0.97	0.70	4.70	3.57
AMRO A	1.85	0.92	13.33	6.42
AMRO B	1.11	0.79	8.38	3.49
AMRO D	0.82	0.65	3.68	3.18
EMRO B	2.18	1.01	14.09	6.18
EMRO D	2.13	1.26	12.12	7.00
EURO A	1.41	0.57	9.20	3.00
EURO B1	2.13	1.36	8.34	4.66
EURO B2	3.51	2.55	14.23	9.23
EURO C	3.66	1.83	15.73	7.12
SEARO B	1.09	0.63	6.62	3.93
SEARO D	2.01	1.27	11.08	7.94
WPRO A	0.77	0.31	5.88	1.86
WPRO B1	0.46	0.31	2.33	1.62
WPRO B2	1.53	0.89	8.20	5.49
WPRO B3	1.00	0.43	6.35	2.59
World	1.41	0.86		

- Age-standardized to World Standard Population (16).

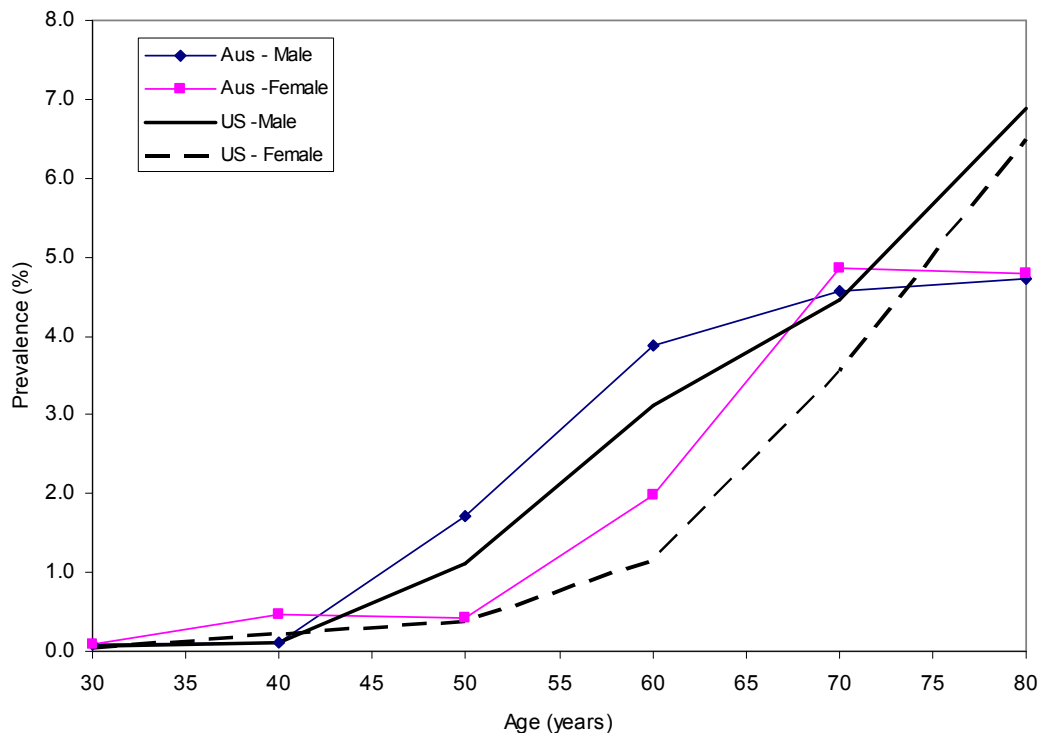
4.3 Estimation of the prevalence of angina pectoris by GBD region

The GBD 1990 study estimated a regression relationship between the prevalence of AMI survivors and the prevalence of angina pectoris (both pre- and post-AMI) using data from developed country studies, and then applied this regression relationship in other developing regions. For the GBD 2000 revisions, the same methodology was followed, but the regression relationships were re-estimated using data from the US Burden of Disease Study for the year 1996.

The Australian and US studies both estimated reasonably similar prevalences of angina pectoris in 1996 (Figure 4). The most recent Australian angina prevalence data were from the National Heart Foundation Risk Factor Survey of 1989, representing people currently under treatment for angina. These data are given in the table below. These prevalence estimates were adjusted to take into account the increased use of surgery for people with severe angina - either PTCA (stenting) or CABG (by-pass grafting). A comparison of the projected 1996 prevalence figures and the 1996 surgical intervention levels indicated a vascularisation rate of about 30% in men <55, 20% in men 55-74 while the rate in 75+ is much smaller; in women vascularisation rates were about 10% at all ages <75.

International findings suggest that a relatively high prevalence of AP is found in women while serious consequences such as AMI events and death are far less common, indicating that either AP in women is milder or that prevalence is overestimated. This is not unlikely given that Garber et al (17) found in a validation study 75% false positives in women who reported AP on the Rose questionnaire compared to 27% in men reporting AP; false negatives in females were 29% and 53% in males.

Figure 4. Estimated angina pectoris prevalence for Australia and USA, 1996.



In the US study, both the National Health and Nutrition Examination Survey III (NHANES III) and the National Health Interview Survey (NHIS) provided estimates of angina prevalence, the former being derived using the Rose algorithm and the latter being based on response to the question ‘have you ever been told by a doctor you have angina?’ When the Rose-positive group was restricted to include only those taking anti-anginal medication, there was a reasonable degree of convergence between both sources. Age-specific estimates from pooled NHIS data for the period 1991 to 1996 were the most plausible, however, and were therefore used in preference to those from NHANES III.

The US estimates were plotted against the prevalence of AMI survivors by age and a strong linear relationship was observed (Figure 5). Ordinary least squares regression was used to estimate separate relationships for males and females. The results are shown in Table 8. Unlike the GBD 1990, the same regression relationship was used for all age groups.

Figure 5. Plot of prevalence of angina pectoris versus prevalence of AMI survivors, USA, 1996.

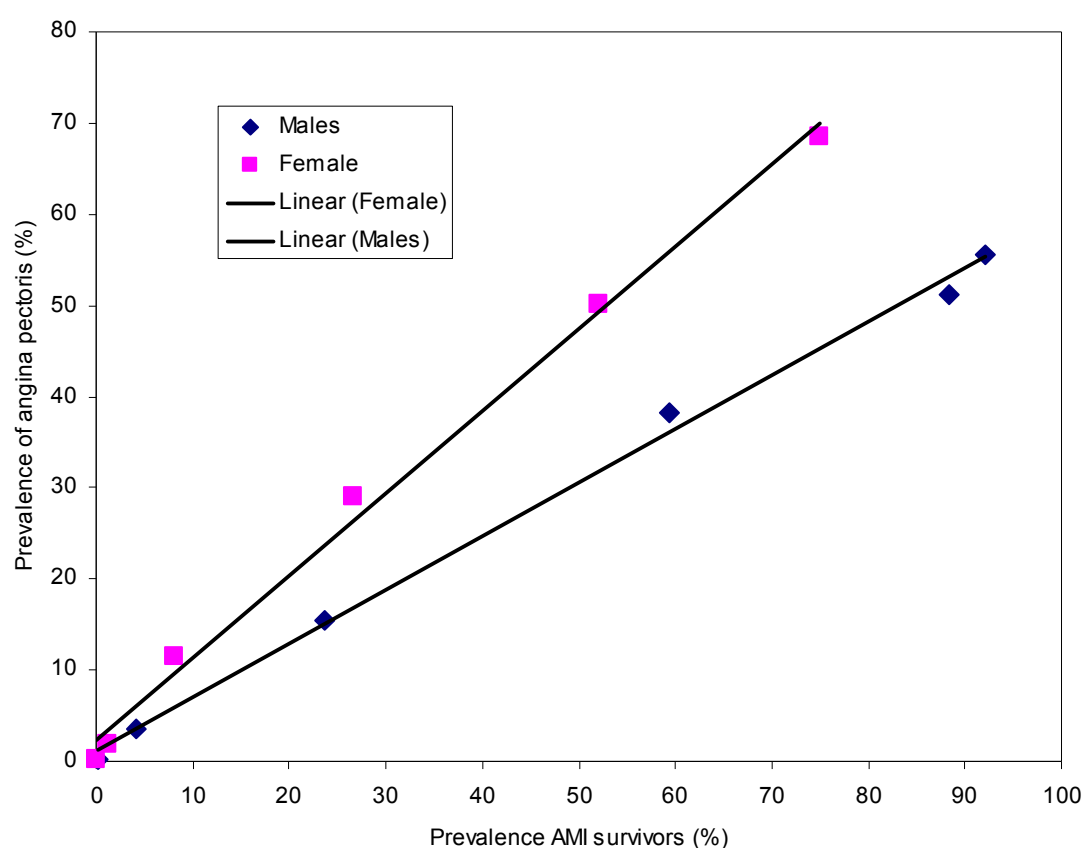


Table 8. Comparison between GBD 1990 and GBD 2000 disease models for angina pectoris. Pm is the prevalence (per cent) of ever having had AMI (AMI survivors) and Pa is the prevalence of angina pectoris (per cent).

GBD 1990	GBD 2000
$P_a = 0.695 * P_m + 0.125$ (ages 15-44)	Prev angina = $0.589 * P_m + 1.112$ (males)
$1.39 * P_m + 0.025$ (ages 45+)	$0.906 * P_m + 2.215$ (females)

These regression relationships were used together with estimated regional prevalences of AMI survivors to estimate angina pectoris prevalence by age, sex and region. Estimates of angina incidence and duration were modeled in DisMod II assuming a relative risk of 2 for mortality and remission rates of zero in all regions except the A regions. For EUR A and WPR A, remission rates were assumed to range from 15% in older males to 30% in males aged less than 45 years, based on estimates in the Australian and US Burden of Disease studies. Female remission rates were assumed to be one third of male remission rates. from NHIS prevalence figures.

The resulting estimated prevalence rates by region in 2000 are shown in Figures 6 and 7.

Figure 6. Angina pectoris prevalence rates, age group and sex, broad regions, 2000.

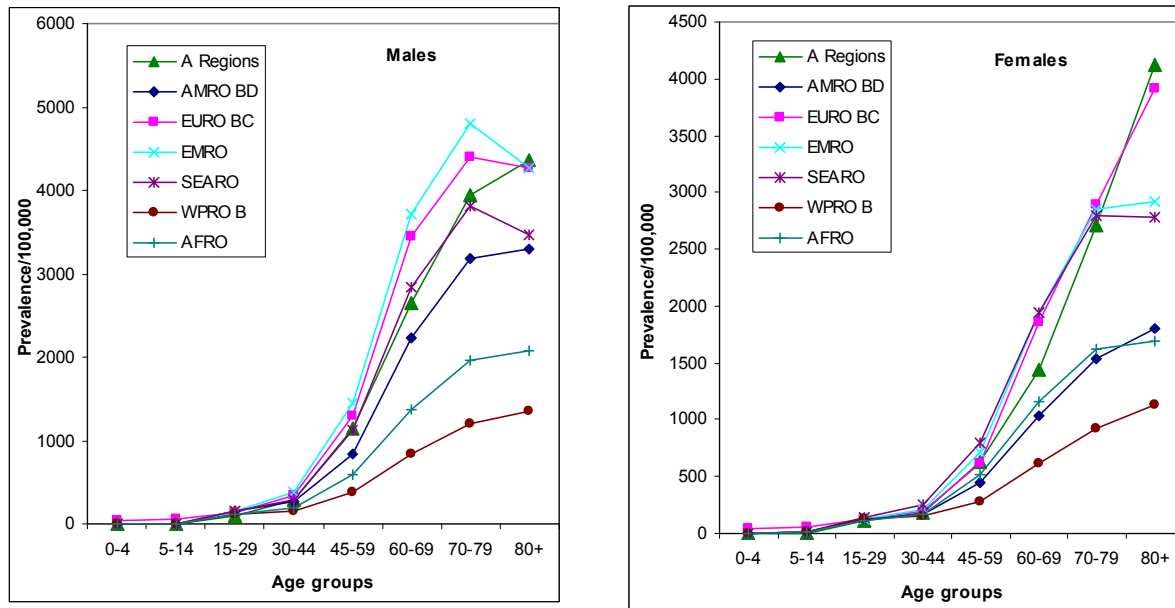
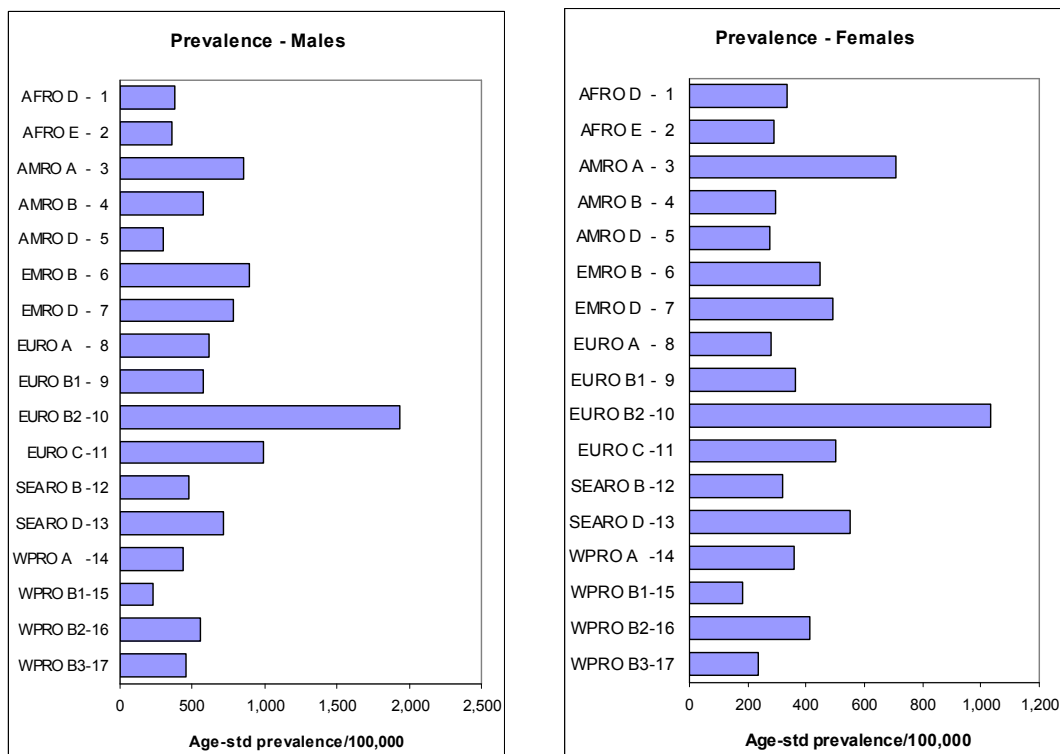


Figure 7. Age-standardized rates for prevalence rates for angina pectoris, by GBD region, 2000.



4.4 Estimation of the incidence and duration of congestive heart failure

Results from the Framingham study suggested that 20 per cent of patients who survived AMI developed heart failure (18;19). This figure is confirmed by a more recent unpublished figure of 17% from the ARIC study. The ARIC figure was used as the relevant proportion for all ages in A regions. For other regions, the assumptions shown in Table 9 were used to compute the incidence of congestive heart failure from the incidence of AMI for each region. Average duration of heart failure was taken from the GBD 1990 estimates (12).

Table 9. Proportion of AMI cases who develop congestive heart failure

Region	Proportion
A regions	17% (ARIC data).
B regions	20% (Framingham data)
C & D regions (except AFR D)	20%
E regions plus AFR D	25% (Mauritius NBD 1993 assumed 33%)

5. Disability weights

The Australian and US Burden of Disease studies used Dutch disability weights for different severity levels of angina, together with assumptions on the severity distribution of angina in the population to compute YLD for angina (the dominant sequela contributing to IHD YLD). For the GBD 2000, the GBD 1990 disability weights were used. These are summarized in Table 10.

Table 10. GBD disability weights (DW) for ischaemic heart disease sequelae

Sequela	Average DW	Regional variation	Source
AMI	0.437	0.405 - 0.477	GBD 1990: untreated 0.491, treated 0.395
Angina pectoris	0.137	0.108 - 0.207	GBD 1990: untreated 0.227, treated 0.095
Congestive heart failure	0.234	0.186 - 0.300	GBD 1990: untreated 0.323, treated 0.171

6. Global burden of IHD in 2000

General methods used for the calculation of DALYs are given elsewhere (20). The tables and graphs below summarize the global burden of IHD estimates for the GBD 2000 and compare them with the IHD estimates from the GBD 1990 (21).

7. Conclusions

These version 2 estimates for the GBD 2000 were used as the basis for revisions for the GBD 2002 estimates published in the World Health Report 2003 (22) and for the GBD 2001 estimates published in the Disease Control Priorities Project (Edition 2, due 2006). As new information becomes available, and more detailed studies are carried out at national level, it is planned to revise and update the disease models and estimates for ischaemic heart disease in the Global Burden of Disease study.

Table 11. IHD: global total YLD, YLL and DALY estimates, 1990 and 2000.

	<i>Males</i>	<i>Females</i>	<i>Persons</i>
YLD('000)			
<i>GBD1990</i>	3,277	1,828	5,105
<i>GBD2000</i>	2,558	1,943	4,501
YLL('000)			
<i>GBD1990</i>	23,093	18,501	41,595
<i>GBD2000</i>	30,743	21,653	52,397
DALY('000)			
<i>GBD1990</i>	26,370	20,329	46,700
<i>GBD2000</i>	33,301	23,596	56,898

Table 12. IHD : 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	0.49	0.37	5.1	4.2	144	1,573	1,717
AFRO E	0.38	0.33	4.4	3.6	122	1,382	1,504
AMRO A	1.22	1.04	11.9	6.9	357	2,947	3,304
AMRO B	0.72	0.46	6.8	4.2	264	2,466	2,730
AMRO D	0.30	0.28	3.4	2.2	21	201	222
EMRO B	1.07	0.68	11.4	6.6	122	1,257	1,379
EMRO D	0.90	0.59	12.5	8.4	106	1,483	1,589
EURO A	1.02	0.50	11.0	5.8	310	3,453	3,763
EURO B1	0.82	0.58	17.7	10.8	118	2,388	2,506
EURO B2	1.87	1.17	18.2	13.1	79	809	887
EURO C	1.71	1.05	42.1	24.4	330	7,932	8,262
SEARO B	1.01	0.81	8.9	6.6	359	3,056	3,415
SEARO D	1.25	1.02	13.5	11.2	1,536	16,668	18,204
WPRO A	0.76	0.53	5.8	2.8	96	645	741
WPRO B1	0.38	0.29	3.9	3.3	454	4,919	5,373
WPRO B2	0.98	0.67	9.1	6.9	119	1,147	1,266
WPRO B3	1.79	0.95	11.3	6.0	11	71	82
World	0.86	0.64	10.1	7.2	4,547	52,397	56,945

Figure 8. IHD YLD rates, by sex, broad regions, 1990 and 2000.

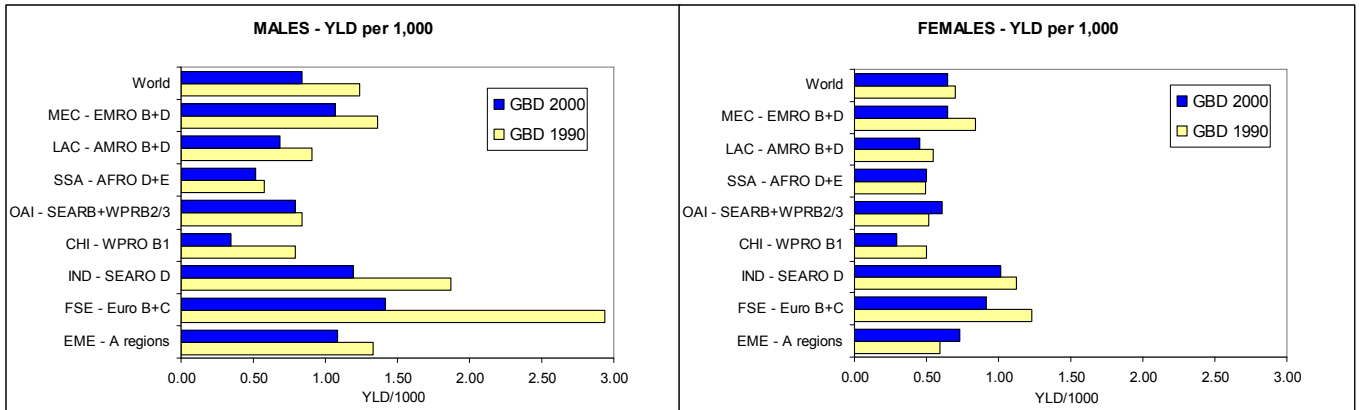
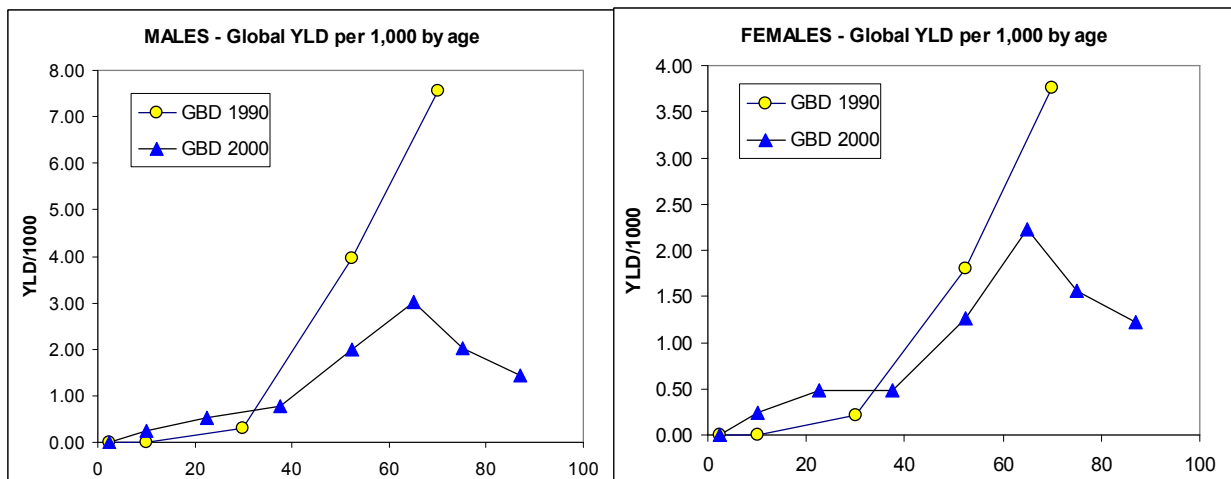


Figure 9. Global IHD YLD rates, by age and sex, 1990 and 2000.



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