Global burden of Iron Deficiency Anaemia in the year 2000

Tanuja Rastogi, Colin Mathers

This draft was prepared in 2002. It is to be superseded by work in progress and will be updated in due course..

1. Introduction

Iron deficiency anaemia (IDA) was estimated to be the 14th leading cause of disease burden in the world in 1990, accounting for 1.8% of total DALYs (Murray & Lopez, 1996). Iron deficiency anaemia is a condition where blood haemoglobin levels are lower than normal with the dominant cause being iron deficiency (Baker and DeMaeyer, 1979; GBD 1990 IDA Chapter, 1995).

The following grades of IDA and sequelae were measured for the GBD 2000:

1. Mild anaemia: Haemoglobic levels (g/L) of: 100-109 (pregnant women); 110-119 (children and women); and 120-129 (men)
2. Moderate anaemia: Haemoglobic levels (g/L) of: 70-99 (pregnant women); 80-109 (children and women); and 90-119 (men)Severe anaemia: Haemoglobic levels (g/L) of: < 70 (pregnant women); < 80 (children and women); and < 90 (men)Cognitive impairment: Delayed psychomotor development, impaired performance or language skills, motor skills and co-ordination that is equivalent to a 5 – 10 point deficit in IQ.

'Very severe anaemia' has not been estimated as a separate category. While estimated in GBD 1990, it is not officially defined in the nutrition literature and there is no general consensus of cut-off points. Such cases of extremely low haemoglobin levels are accounted for within the 'severe anaemia' category.

2. Case and sequelae definitions

The case definition and sequelae used for VAD are given below.

Table 1. Case and sequelae definitions for Vitamin A deficiency

Cause category	GBD 2000 Code	ICD 9 codes	ICD 10 codes
Iron deficiency anaemia	U057	280-285	D50-D64
Case/Sequelae	**Definition**		
Iron-deficiency anaemia			
Mild	Haemoglobin of 100-109 g/l in pregnant women, 110-119 g/l in children and adult women and 120-129 g/l in adult men.		
Moderate	Haemoglobin of 70-99 g/l in pregnant women, 80-109 g/l in children and adult women and 90-119 g/l in adult men.		
Severe	Haemoglobin of <70 g/l in pregnant women, <80 g/l in children and adult women and <90 g/l in adult men.		
Cognitive impairment	Delayed psychomotor development, impaired performance on language skills, motor skills and co-ordination that is equivalent to a 5-10 point deficit in IQ.		

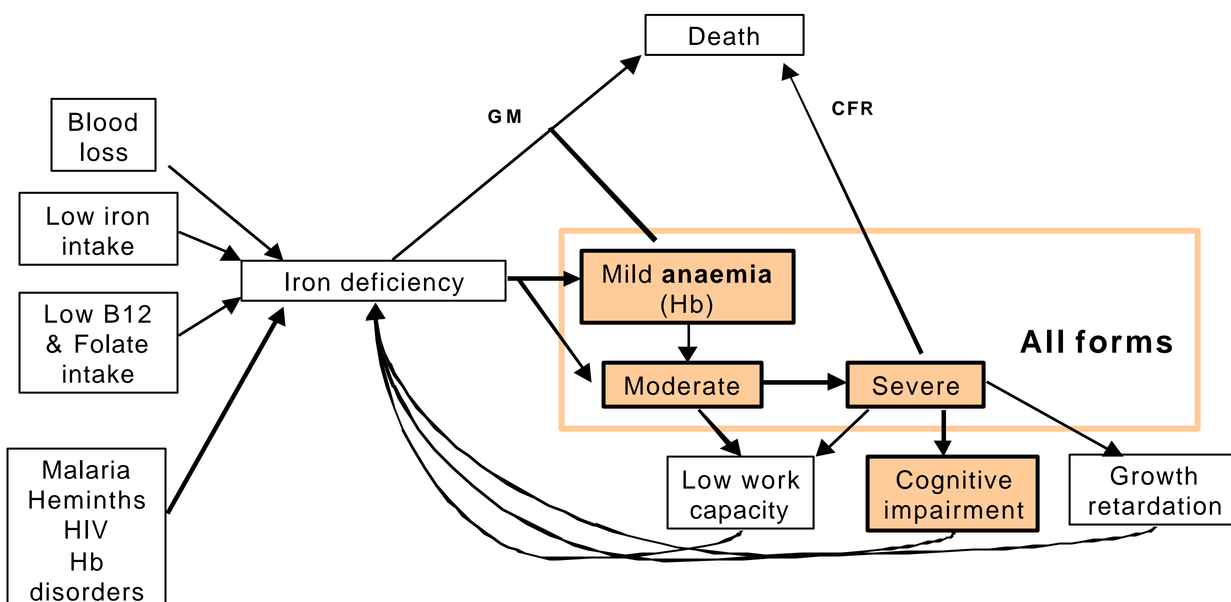
3. Disease model

IRON DEFICIENCY ANAEMIA

4. Methods

Country-specific prevalence estimates were obtained and used to calculate regional age and sex-specific prevalence rate estimates for mild, moderate and severe anaemia as well as incidence rate of cognitive impairment in children less than five (age group in whom incident cases are expected to develop). The primary data source was the WHO Nutrition and Health for Development Program. The program is in the process of developing and refining a comprehensive database of country-specific prevalence estimates of both clinical and sub-clinical IDA from national level and sub-national nutrition surveys (MDIS IDA database, 2002).

Country-specific estimates for overall anaemia prevalence were provided from the MDIS -IDA database. All prevalence estimates were reviewed with priority being given to the most recent national level estimates (majority are obtained from studies conducted in last 10 years). Although mean haemoglobin levels of anaemic populations were provided, prevalence estimates were not available for different grades of anaemia or for iron deficiency anaemia, as it is often not measured directly in nutrition surveys. Anaemia prevalence estimates were provided for preschool age children (males and females <5 years), school age children (males and females 5-14 years) and women. Minimal data were available on men (15+ years). When reported prevalences were



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missing, the regional average that was calculated from available data within each group was applied to countries with no known estimates. While the MDIS IDA database provided estimates for most regions, there was very limited data for the EURO region. In this region, GBD 1990 estimates were assessed to see if they were still applicable given changes in health conditions in countries, such as adult and infant mortality levels. If there was no significant change then estimates were applied

As mentioned above, iron deficiency is the major cause of anaemia (DeMaeyer, 1979). After review of the literature and consultation with the WHO Nutrition program (deBenoist communication, 2002), in non-malaria endemic regions a proportion of 60% of anaemia due to IDA was deemed appropriate. For malaria endemic regions, approximately 50% of anaemia attributable to iron deficiency was recommended. This is similar to prior research on IDA by DeMaeyer and Adiels-Tegman where it was estimated that 50% of anaemia in women and children is attributable to iron deficiency (DeMaeyer and Adiels-Tegman, 1985). Countries were then classified as malaria-endemic or non-malaria endemic (GBD 1990 IDA Chapter, 1990; Bulletin of the WHO, 1999) and anaemia estimates were then adjusted according to malaria status to IDA prevalence estimates.

As data on anaemia subtypes was limited, methods were developed to separate overall IDA to mild, moderate and severe anaemia. First, national-level demographic and health surveys with estimates by anaemia grade were evaluated including data from India (2000), Egypt (2000) and Kyrgyz Republic (1997). Data from India indicated that among children the proportions of anaemic in mild, moderate, severe grades were 0.31, 0.62, 0.07, among young women the proportions were 0.65, 0.32, 0.03, and women 0.69, 0.27, 0.04, respectively (India DHS, 2000). DHS data from Egypt indicates that among children less than 5 years, the proportion of anaemic in mild, moderate, severe grades were 0.60, 0.37, 0.03, among children ages 11-19, the proportions were 0.927, 0.07, 0.003, among young women the proportions were 0.85, 0.147, 0.003, and last among women the proportion of anaemic in mild, moderate, severe grades were 0.82, 0.16, 0.02 (Egypt DHS, 2000). Data from Kyrgyz Republic (DHS, 1987) indicated that among children less than 3 years, the proportions of anaemic in mild, moderate, severe

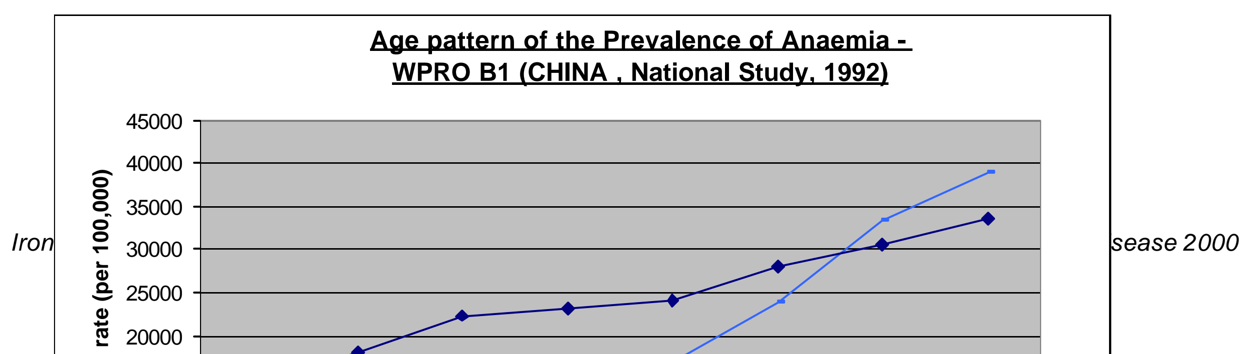
grades were 0.494, 0.479, 0.027, among young women, the proportions were 0.76, 0.22, 0.03, and among women 0.69, 0.26, 0.05. As India constitutes a major portion of SEARO D, data from India was applied to the region to obtain prevalence estimates by subtype. Similarly, the Egypt DHS data was applied to estimates in the EMRO B & D regions, and last DHS data from Kyrgyz Republic was applied to the EURO B2 region For the remaining regions and gender/age age groups where subtype information was not available, data from GBD 1990 on subtypes was applied. Table 2 illustrates these proportions.

Table 2: Proportion of anaemia in different grades- GBD 1990 estimates

Regions	MILD	MODERATE	SEVERE
EME	0.399	0.563	0.035
FSE	0.400	0.562	0.035
INDIA	0.400	0.562	0.035
CHINA	0.400	0.562	0.035
OAI	0.393	0.568	0.035
SSA	0.435	0.523	0.038
LAC	0.400	0.562	0.035
MEC	0.400	0.562	0.035
WORLD	0.403	0.559	0.035

IDA is a condition that is both age and gender specific. Therefore, it is necessary to have regional prevalence estimates that are specific for both males and females and by age. Age patterns of anaemia were examined from different nutritional surveys including a national study from China (1992). This age pattern was applied to the WPRO B1 region.

Figure 1:



Given limited data on adults in other regions on the prevalence of IDA by age - particularly males, data from GBD 1990 was reviewed in order to establish a relationship between different age groups. As current data from the MDIS database was more readily available on child-bearing age females (15-44) (studied more extensively in nutritional surveys), we examined the relationship between other age/gender groups to females in this group. After a review of other national level studies as well as the age and gender pattern from the GBD 1990, the following assumptions were made on the prevalence of IDA by age and gender:

Estimates originated with the prevalence reported for females (15-44) from nutritional surveys (MDIS database estimates):

- **Prevalence of anaemia in females (45+) = Prevalence in females (15-44) x (region-specific proportion)**
- **Prevalence among males (60+) = Prevalence of anaemia in females (45+)**
- **Prevalence of anaemia in males (15-54) = Region-specific fraction of the prevalence in males (60+)**

The fractions and proportions that were used were region-specific and derived from either the GBD 1990 estimates or nutrition surveys. As mentioned, original data was

available for children (males and females) less than 5 years (preschool age children data) and for children 5-14 years (school age children).

A certain proportion of severe anaemic will progress to develop cognitive impairment. While the literature on IDA suggests that iron deficiency identifies children at concurrent or future risk of poor development (Grantham-McGregor, 2001), the exact proportion of anaemic that develop cognitive impairment is not reported. However, data from the GBD 1990 indicated that 20% of preschool age children (less than 5 years) with severe anaemia would develop cognitive impairment. This was used to estimate the incidence in children less than 5 years. Incident cases of cognitive impairment is expected to develop in children less than 5 years as it is a period of developmental growth when iron deficiency anaemia can have an impact.

Figures 2 and 3 present the total prevalence rate (per 100,000) of total IDA and the incidence rate of cognitive impairment by regions with a comparison of GBD 1990 and GBD 2000 estimates.

Figure 2. Total IDA prevalence rate (per 100,000), by regions, 1990 and 2000

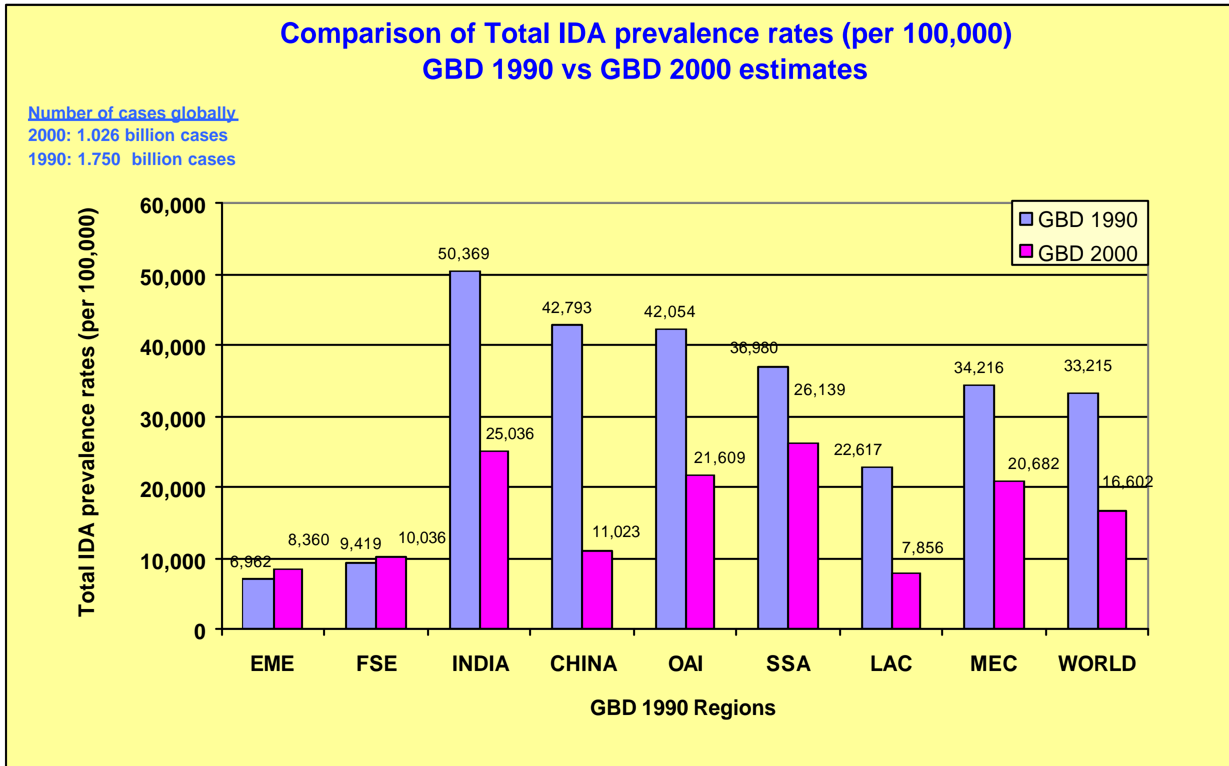
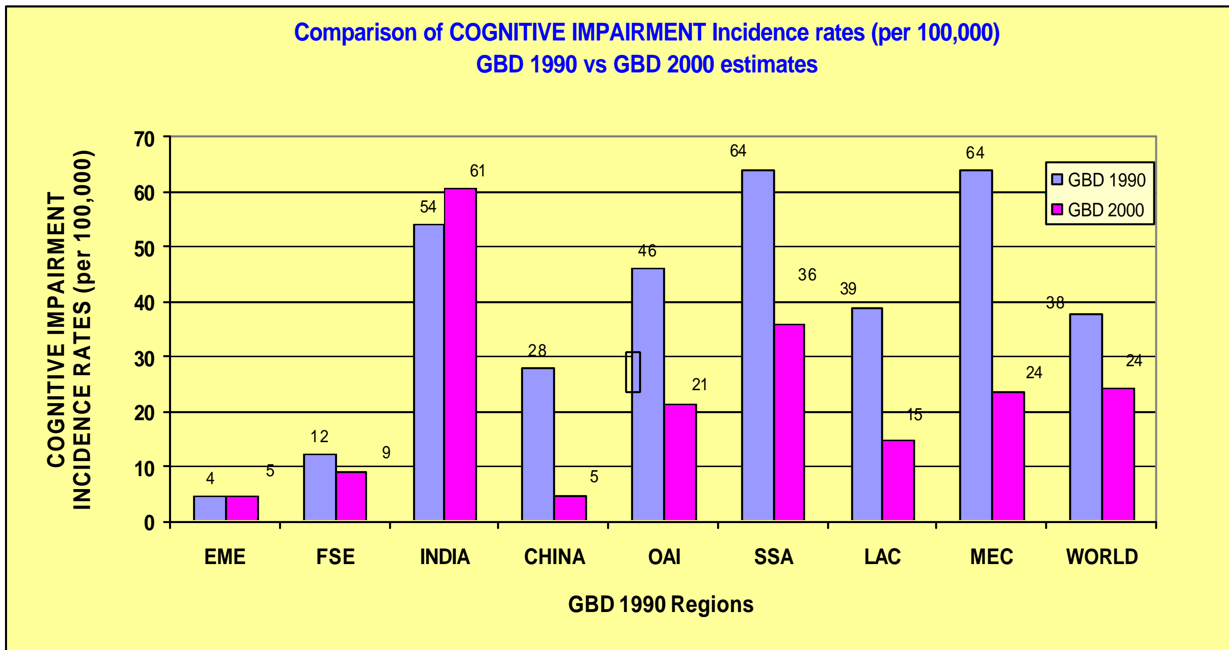


Figure 3. Cognitive impairment incidence rate (per 100,000), by regions, 1990 and 2000



5. Health state descriptions and disability weights

Table 4. Disability weights for Iron deficiency anaemia

Stage/sequela	GBD 1990	Netherlands Study	Australian BOD Study
Mild IDA	0 (untreated) 0 (treated)		
Moderate IDA	0.011-0.012 (untreated) 0.011-0.012 (treated)		
Severe IDA	0.087-0.093 (untreated) 0.087-0.093 (treated)		
Cognitive impairment	0.024 (untreated) 0.024 (treated)		

6. Global burden of Iron deficiency anaemia in 2000

The tables and graphs below summarise the global burden of IDA estimates for the GBD 2000 compared to the IDD estimates from the GBD 1990 (Murray & Lopez, 1996).

Table 5. Global total of YLD, YLL and DALY

	Males	Females	Persons
YLL ('000)			
GBD 1990	1063.993	1562.832	2626.825
GBD 2000	894.9858	1051.416	1946.401
YLD ('000)			
GBD 1990	9747.733	12238.81	21986.54
GBD 2000	3911.844	5518.283	9430.127
DALY ('000)			
GBD 1990	10811.73	13801.64	24613.37
GBD 2000	4806.83	6569.698	11376.53

Table 6. YLD, YLL and DALY estimates 2000.

	YLD/100,000		*YLL/100,000*		*Total YLD*	*Total YLL*	*Total DALYs*
	Males	*Females*	*Males*	*Females*	*('000)*	*('000)*	*('000)*
AFRO D	242.9	267.4	50.3	70.4	852	202	1,054
AFRO E	199.8	203.5	85.0	114.5	681	337	1,018
AMRO A	122.9	141.6	11.8	12.6	410	38	447
AMRO B	31.8	47.7	47.9	42.3	176	199	376
AMRO D	106.8	325.6	53.9	71.3	154	45	199
EMRO B	197.5	251.5	22.7	18.0	312	29	340
EMRO D	111.4	196.7	32.5	39.1	212	49	261
EURO A	33.1	91.2	9.6	9.7	258	40	298
EURO B1	39.1	75.4	19.2	18.3	95	31	126
EURO B2	155.1	473.2	65.0	89.3	161	39	200
EURO B3	56.4	94.3	10.6	9.9	188	25	213
SEARO B	192.8	262.0	28.1	29.1	897	113	1,010
SEARO D	184.4	234.3	40.9	47.0	2,813	591	3,404
WPRO A	33.0	94.7	0.0	0.0	96	0	96
WPRO B1	87.6	135.7	8.6	8.3	1,507	114	1,621
WPRO B2	211.5	627.2	27.6	85.1	599	80	679
WPRO B3	240.5	325.9	151.7	261.8	19	14	33
World	***128.5***	***183.9***	***29.4***	***35.0***	***9,430***	***1,946***	***11,377***

Figure 4:

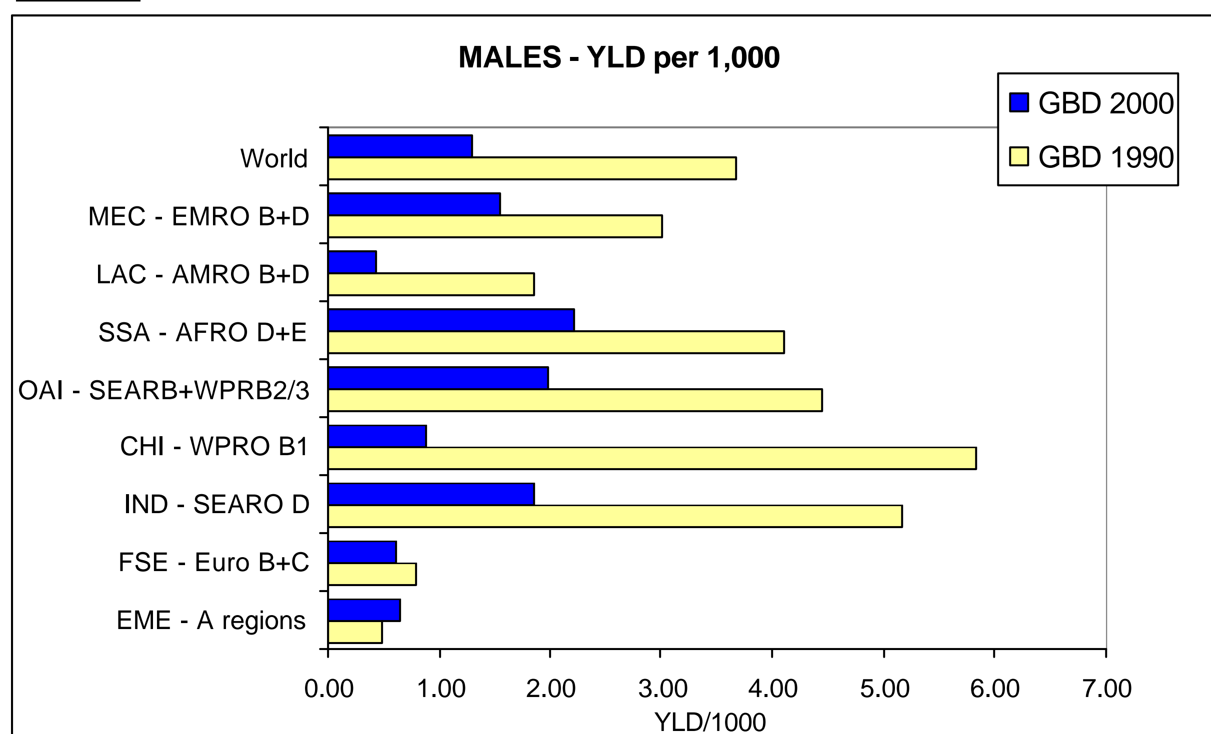
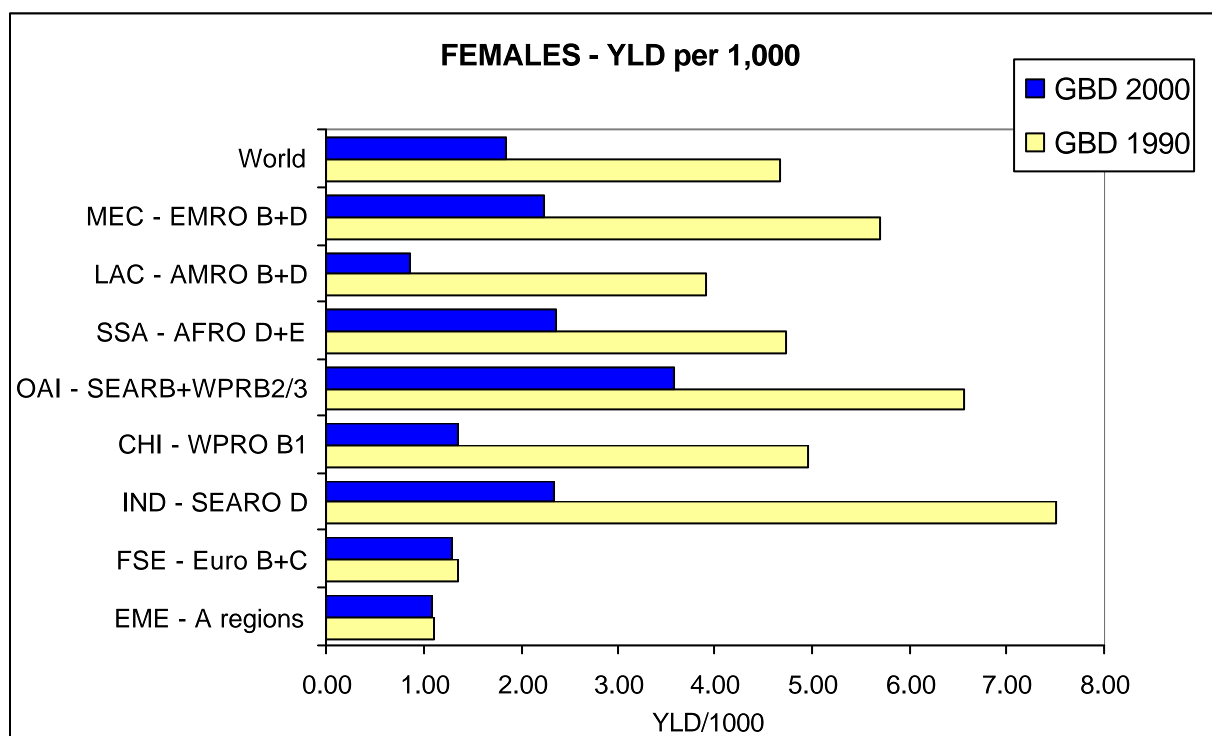


Figure 5:



7. Uncertainty analysis

General methods for uncertainty analysis of estimates for the Global Burden of Disease 2000 are outlined elsewhere. Uncertainty analysis for Iron deficiency anaemia has not yet been completed.

8. Conclusions

Given limited country or regional data on the age and gender distribution of IDA as well as the proportion of anemic individuals who are mild, moderate or severely anaemic, future efforts should focus on these areas. Additionally, the proportion of individuals with severe anaemia who progress on to develop cognitive impairment needs to be evaluated. Last, other effects of severe anaemia should be examined in the future including reduced work capacity.

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

Acknowledgements

We particularly wish to thank collaborators and people who assisted including Dr. Bruno de Benoist, Maria Andersson and Ines Egli in the WHO Nutrition and Health for Development Program.

The authors also thank the many staff of the Global Program on Evidence for Health Policy who contributed to the development of life tables and cause of death analysis. In particular we thank Omar Ahmad, Brodie Ferguson, Mie Inoue, Alan Lopez, Rafael Lozano Doris Ma Fat, Christopher Murray and Chalapati Rao. This study has been supported by a grant from the National Institute on Aging, USA.

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