

Global burden of maternal haemorrhage in the year 2000

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1. Introduction

Maternal haemorrhage consists of bleeding from the genital tract during pregnancy (ante-partum), during or after the delivery of the infant (intra- and postpartum). Although in developed countries ante-partum haemorrhage is no longer a major cause of maternal mortality, it is still an important cause of maternal and perinatal morbidity¹. By contrast, postpartum haemorrhage continues to be a major cause of maternal death both in the developing as well as in the developed world¹.

The causes of obstetric haemorrhage differ, depending on whether the haemorrhage occurs ante-partum, intra- or postpartum. Ante-partum haemorrhage is caused in approximately half of the cases by placenta praevia or placental abruption. In the rest of the cases no precise cause can be identified (haemorrhage of uncertain origin)¹. The most frequent causes of postpartum haemorrhage are retained placenta and uterine atony¹. In rare cases, inherited bleeding disorders, like haemophilia, von Willebrand disease, or factor IX deficiency, may cause severe postpartum haemorrhage, with an increased risk of death². The consequences of bleeding depend on the amount of blood loss, the previous health state of the mother and the availability of treatment (uterotonics or blood transfusions). There may be an increased risk of death and cardiovascular arrest in women who are already anaemic.

Maternal haemorrhage ranked 59th in GBD 1990 in terms of DALYs and its burden represented 0.3% of all conditions and 11.9% of the burden of all maternal conditions³⁷. This draft paper summarises the data and methods used to produce the Version 2 estimates of maternal haemorrhage burden for the year 2000.

2. Case and sequelae definitions

Agreement on the criteria for the inclusion of an individual as a case of maternal haemorrhage has not been easily achieved. There are problems in actually measuring the blood loss during delivery and in the postpartum period. Physicians tend to underestimate the quantity of blood loss. Prasertcharoensuk et al³ studied 228 pregnant women who had a vaginal delivery at Srinagarind hospital, Thailand. They reported an incidence of 3.51% in primary postpartum haemorrhage (defined as 1000ml or more) by direct measurement, compared to only 0.44% by visual estimation³. Although the formal definition of postpartum haemorrhage is blood loss of 500ml or more within 24 hours after delivery and/or within

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42 weeks following delivery, GBD 2000 considered only blood loss of 1000ml or more, because it has greater clinical significance.

The sequelae considered for postpartum haemorrhage in GBD 1990 were Sheehan's syndrome and severe postpartum anaemia. Sheehan's syndrome consists of pituitary necrosis following haemorrhagic shock during delivery. The symptoms comprise chronic weakness, premature old age, amenorrhoea and mental changes, including apathy and confusion. These symptoms may never be severe and may be delayed for several years.¹ A recent literature search could not identify any follow-up studies on the survivors of haemorrhagic shock, but just a few case reports^{4,5,6,7,8,9,10}. On the basis of this evidence, Sheehan's syndrome makes a very small contribution to the burden of postpartum haemorrhage, therefore, the GBD 2000 includes only severe postpartum anaemia as sequelae of severe PPH.

A more common complication of haemorrhage is thus anaemia. While healthy pregnant women can tolerate a loss of even 1000ml of blood well, women with a poor health condition, particularly anaemic women, may suffer serious consequences. Therefore women who are already moderately anaemic during pregnancy and who lose more than 1000ml blood are thought to become severely anaemic, a state that impairs their health status and their day-to-day life for a period of time depending on the availability of treatment.

Table 2.1. GBD 2000 case and sequelae definitions for maternal haemorrhage

Cause category	GBD 2000 Code	ICD 9 codes	ICD 10 codes
Maternal haemorrhage	U126	640, 641, 666	O44-O46, O67, O72

Sequela	Definition
Cases	Bleeding from the genital tract of 1000 ml or more following the delivery of the baby, within the first 24h, or more than 24h but less than 6 weeks from delivery
Severe postpartum anaemia	Haemoglobin level below 70 g/l following delivery, due to severe postpartum haemorrhage

3. Population incidence studies

Appropriate studies were identified by a MEDLINE and PubMed search, using the words "postpartum haemorrhage", "incidence", "prevalence", and "epidemiology" and by tracking references from the papers identified in this way. In addition, we examined regional offices literature databases and statistics, performed a key word search of major obstetric and gynaecology journals and consulted with experts for unpublished work.

In general, the information required to estimate regional incidence of postpartum haemorrhage is patchy. Different types of data sources may report on the condition. **Hospital statistics** usually report episodes of maternal haemorrhage, using ICD-9 or ICD-10 codes for classification. They point towards the incidence of the condition among women delivering in hospitals, and are therefore reliable only for developed countries, where most deliveries take place in hospitals.

Table 3.1. Sensitivity and specificity of postpartum haemorrhage as recalled and reported to interviewers

	Philippines 1995 ¹¹	Bolivia 1998 ¹²	Ghana 1996 ¹³	Indonesia 1997 ¹⁴
Questions	“excessive bleeding around delivery OR bleeding was a serious problem OR manual evacuation of placenta”	“thought she would die” (for sensitivity) “fainted” (for specificity)		“excessive bleeding during labour or delivery”
Sensitivity	0.70	0.87	0.70	0.51
Specificity	0.78	0.89	0.91	0.90

Adapted from ref. 11

Hospital statistics are not a reliable source of data for developing countries, because many women may not have access to or die on route to health facilities. **Self-reported maternal morbidity** tends to overestimate the incidence of conditions under study, and the results very much depend on the sensitivity and specificity of the instrument. Several attempts have been made to validate the results of self-reported maternal morbidity, and some of them compared the results from interviewing women shortly after hospital delivery with hospital-case notes. Table 3.1 presents the sensitivity and specificity of postpartum haemorrhage as recalled and reported to interviewers in these studies. Comparisons are difficult, as studies may have used different definitions and study design, and their results may not be generalized to the population who does not deliver in hospital. Thus, self-reported maternal morbidity cannot provide exact estimates of prevalence and incidence. However, until a more comprehensive data collection on all deliveries, especially in the developing world, will become feasible, self-reports in response to well-designed and well-worded interviews may be the only way to collect information about maternal morbidity¹⁵.

Very few **community-based incidence studies** have been conducted on maternal conditions, and they do not cover all the regions of the world. The MOMA study¹⁶ is a population-based survey of a cohort of 20,326 pregnant women conducted between 1994-1996 in six West African countries using the same methodology. Each pregnant woman had four contacts with the obstetric survey team: at inclusion, between 32 and 36 weeks of amenorrhoea, during delivery and 60 days postpartum. Using a restricted definition of severe haemorrhage (prepartum, peripartum and postpartum haemorrhage leading to blood transfusion or hospitalization for more than 4 days or to hysterectomy, caesarean-section or death), the authors found an incidence of 1.74 per 100 deliveries¹⁶.

Table 3.2 summarises the epidemiological studies on the incidence of postpartum haemorrhage, after excluding self-reported studies, for the reason mentioned above. As shown, studies have used different definitions and different methodologies, which makes their comparison difficult.

Table 3.2. Incidence studies for postpartum haemorrhage

Region	Study population	Type of study	Years	Sample size	Diagnostic criteria	Incidence per 100 live births	Ref.
AFRO D							
Niger	Niamey, 6 maternity wards	Hospital-based longitudinal study	1997	3625 deliveries	Severe haemorrhage with hypovolemic shock requiring urgent blood transfusion	0.52	17
Burkina Faso, Mali, Mauritania, Niger, Senegal, Cote d'Ivoire*	Ouagadougou, Bamako, Nouakchott, Niamey, Kaolack region, Abidjan*	Population-based, multicentre door-to-door census of all pregnant women	Dec 1994- June 1996	20326 women; 19,694 live births	Severe pre-partum haemorrhage leading to blood transfusion or hospitalization for more than 4 days or to hysterectomy, C-section or death	1.31	16
Senegal	2 urban areas (Saint Louis and Kaolack)	Population-based study on a cohort of pregnant women	1994-1996	3,476 live births	Haemorrhage (pre-, intra- or postpartum) leading to transfusion, hospitalisation longer than 4 days, transfer, caesarean section, hysterectomy or death)	1.75	18
AFRO E							
Uganda	Mulago hospital	Cross-sectional hospital based	March-August 1997	9043 deliveries	Diagnosis of antepartum haemorrhage in the hospital case notes	0.67	19
South Africa	Kalafong and Pretoria Academic hospitals (catering for delivery among indigenous women in Pretoria Health region)	Prospective descriptive multicentre study: audit of maternal near miss (daily case notes review)	Sep 1996- Aug 1997	13429 deliveries	Near miss = a woman with severe organ dysfunction or organ failure during pregnancy or within 6 weeks after delivery	0.18	20

Table 3.2 (continued). Incidence studies for postpartum haemorrhage

Region	Study population	Type of study	Years	Sample size	Diagnostic criteria	Incidence per 100 live births	Ref.
EURO A							
Austria, Belgium, Finland, France, Ireland, Italy, UK	Upper Austria, Brussels, Part of Finland, Lorraine, Champ/Arden. Centre, Cork, Puglie, SE Thames	Blood loss ≥ 1500 ml if measured or blood loss requiring plasma expanders and/or blood 2500 ml in 24 h or the same expressed in packed cells, or blood loss resulting in death	1995-1997	161,956 deliveries	Prospective hospital based	0.55	21
UK	South East Thames Region; 19 maternity units	estimated blood loss >1500 ml or peripartum fall of haemoglobin ≥ 40 g/l or acute transfusion of 4 or more blood units	1988-1997	48,865 deliveries	retrospective hospital based study	0.67	22
Norway	Rogaland Central Hospital	Diagnosed blood loss of 500 ml or more after delivery (and 1500 ml or more)	1997-1997	11681 vaginal deliveries	Retrospective analysis of a hospital database of vaginal deliveries	9.6 (0.8)	23
SEARO							
Thailand	Srinagarind hospital	Postpartum loss of blood of at least 1000 ml	Dec 1997-March 1998	228 pregnant women	Hospital prospective, estimation and direct measurement of blood loss	3.51	3

As shown, studies have used different definitions and different methodologies, which makes their comparison difficult. A multicentre randomized trial of Misoprostol in the management of the third stage of labour was conducted by WHO in 9 hospitals in Argentina, China, Egypt, Ireland, Nigeria, South Africa, Switzerland, Thailand and Vietnam, to determine whether misoprostol is as effective as oxytocin in the prevention of blood loss during the third stage of labour²⁴. The MISO trial used a standard and comprehensive method of measuring blood loss across all centres, and it was considered to be representative in terms of results for hospital settings.

Using data from the MISO trial, overall incidence of severe post-partum hemorrhage (PPH) was calculated as a function of:

- the incidence of PPH within 1 hour for births actively managed by a skilled birth attendant;
- the incidence of PPH within 1 hour for births managed expectantly by a skilled birth attendant;
- incidence of PPH within 1 hour for births without skilled attendance;

- the ratio of PPH within 1 hour to PPH \geq 1 hour and $<$ 6 weeks post-partum;

Regional variation in the incidence of severe PPH was therefore based on adjustments by treatment coverage only. No adjustments have been made for other risk factors for PPH.

The incidence of PPH within 1 hour post-partum in those who were actively managed was estimated from the MISO trial, where PPH incidence, defined as $>$ 1000ml of blood loss in the oxytocin arm of the MISO trial was 2.85%. A Cochrane review demonstrated that active management with oxytocin results in a relative risk of 0.33 for blood loss \geq 1000ml within the first 24 hours compared to expectant management. Based on this evidence, we assumed that the incidence of PPH in those who are managed expectantly by a skilled birth attendant would be twice as high or 5.7% of births. It was further assumed that births without skilled attendance would be twice as high again or 11.4% of births.

In terms of treatment coverage, there is limited data on the use of active management components by region. A recent international survey is unlikely to be representative as it was based on university hospitals with a small sample size. Other questionnaire based surveys have shown that routine third stage prophylaxis using oxytocin was practiced in 47% of delivery units in Norway, while another questionnaire study in Texas showed the 94% of obstetricians used oxytocics in managing third stage of labor, but only 14.8% administered the oxytocics before delivery of placenta. Due to the limited data on active management coverage, we assumed for A regions that 50% of births within facilities would be actively managed, and 20% for all other regions. Births managed by a skilled birth attendant were assumed to be managed expectantly.

Estimates of PPH from the MISO trial are only partial incidence as blood loss is only measured up to 1 hour post-partum. In the expectant management arm of the Cochrane review, there were 37 cases of primary PPH (up to 24 hours post-partum) and 23 cases of secondary PPH. A study secondary PPH at a district general teaching hospital in the UK demonstrated an incidence of 0.8% of secondary PPH in women delivering vaginally. Adjustments for secondary PPH are problematic, as secondary PPH is not likely to be as severe as primary PPH. For the purposes of these estimates we assumed that PPH cases within the 1st hour account for 90% of all severe PPH cases. Using the estimates of incidence according to the type of management for PPH as well as estimates of treatment coverage, estimates of severe PPH were calculated by region (Table 3.3). More comparable data are required in order to assess the epidemiology of postpartum haemorrhage more precisely.

The major consequence of severe postpartum haemorrhage is postpartum anaemia. The consequences will be more severe in women who are already anaemic during pregnancy. In the calculation of the burden of severe anaemia we started with the prevalence of moderate anaemia during pregnancy (defined as haemoglobin level between 70-90g/l) and considered that if a moderately anaemic pregnant woman lost 1000ml of blood or more, she would become severely anaemic. Data on prevalence of moderate anaemia during pregnancy was provided by the Reproductive Health and Research department at WHO, which maintains a database on anaemia during pregnancy. It was complemented with data from the Nutrition for Health and Development programme at WHO. Only community-based surveys and studies from antenatal clinics have been used in the calculations of regional-weighted averages of prevalence of moderate anaemia. We also considered that some of the severely anaemic women may have access to transfusions, as is the case in developed countries. Due to the lack of data on transfusions in some regions, we have relied on expert opinion for the proportion of women transfused. Table 3.4 presents the assumptions and calculations of the estimates for severe postpartum anaemia. More evidence is required on the availability and access to transfusions in developing countries in order to better estimate the burden of severe postpartum anaemia in those settings.

Table 3.3. Estimated incidence rates for postpartum haemorrhage and the proportion of deliveries with skilled birth attendance

WHO regions	Estimated incidence of severe postpartum haemorrhage (per 100 live births)	Proportion of deliveries with skilled birth attendance (per 100 live births)
AFRO D	9.7	46
AFRO E	9.8	45
AMRO A	6.4	99
AMRO B	7.0	89
AMRO D	9.3	52
EMRO B	7.1	87
EMRO D	9.7	47
EURO A	6.4	99
EURO B1	7.1	87
EURO B2	6.8	93
EURO C	6.4	99
SEARO B	8.6	64
SEARO D	10.5	34
WPRO A	6.3	100
WPRO B1	8.1	72
WPRO B2	9.0	57
WPRO B3	8.6	64

Table 3.4. Assumptions and calculation of incidence of severe postpartum anaemia

WHO region	Prevalence moderate anaemia (% of pregnancies)	Incidence of severe postpartum haemorrhage (% of live births)	Proportion with treatment/transfusion (expert opinion)	Proportion severe postpartum haemorrhage with severe postpartum anaemia	Estimated rate of severe postpartum anaemia (% of live births)
AFRO D	21	9.7	0	21.0	2.0
AFRO E	17	9.8	0	17.0	1.7
AMRO A	1	6.4	100	0.0	0.0
AMRO B	6	7.0	70	1.8	0.1
AMRO D	21	9.3	30	14.7	1.4
EMRO B	21	7.1	75	5.3	0.4
EMRO D	20	9.7	0	20.0	1.9
EURO A	1	6.4	100	0.0	0.0
EURO B1	1	7.1	100	0.0	0.0
EURO B2	25	6.8	90	2.5	0.2
EURO C	1	6.4	100	0.0	0.0
SEARO B	15	8.6	75	3.8	0.3
SEARO D	20	10.5	10	18.0	1.9

WPRO A	1	6.3	100	0.0	0.0
WPRO B1	10	8.1	75	2.5	0.2
WPRO B2	6	9.0	75	1.5	0.1
WPRO B3	20	8.6	75	5.0	0.4

4. Risk factors for the development of maternal haemorrhage

Although maternal haemorrhage cannot be predicted, many risk factors have been found to be associated with an increased incidence of the condition, such as increased maternal age, multiple gestation (twins), macrosomia, hydramnios, history of bleeding during pregnancy, previous third stage complications, prolonged labour, and restricted use of uterotonics^{1,23,25,26}. Unfortunately, the risk factors arising antenatally are poorly predictive, and most women with postpartum haemorrhage have no identifiable risk factor during pregnancy. Other factors, such as primigravidity and grand multiparity, are very common and therefore not highly specific when used in screening¹. The consequences of severe bleeding can be prevented by an active management of the third stage of labour, using uterotonics (oxytocin, misoprostol), and by blood transfusions. In places where these drugs and blood are not readily available, postpartum haemorrhage remains a serious problem.

Table 5.1. Proportion of maternal deaths due to haemorrhage – community studies

WHO Region/Country	Setting	Type of study	Period of study	Number of maternal deaths	% due to haemorrhage	Ref
AFRO D						
Gambia	A rural area	RAMOS	Jan 1993 Dec 1998	18	33.3	27
Guinea-Bissau	the 5 northern regions of Guinea-Bissau	RAMOS	1989-1996	111	37.2	28
Ghana	Ejisu health district	community based survey of maternal mortality	1985-1990	44	47.8	29
Burkina Faso, Mali, Mauritania, Niger, Senegal, Cote d'Ivoire	5 urban areas and 1 rural area	population based prospective study	1994-1996	55	30.9	30
AMRO B						
Mexico	3 states in Mexico	Verbal autopsy	1995	145	25.0	31
SEARO D						
Bangladesh	Matlab area, Bangladesh	Verbal autopsy in demographic surveillance system	1987-1993	174	22.4	32

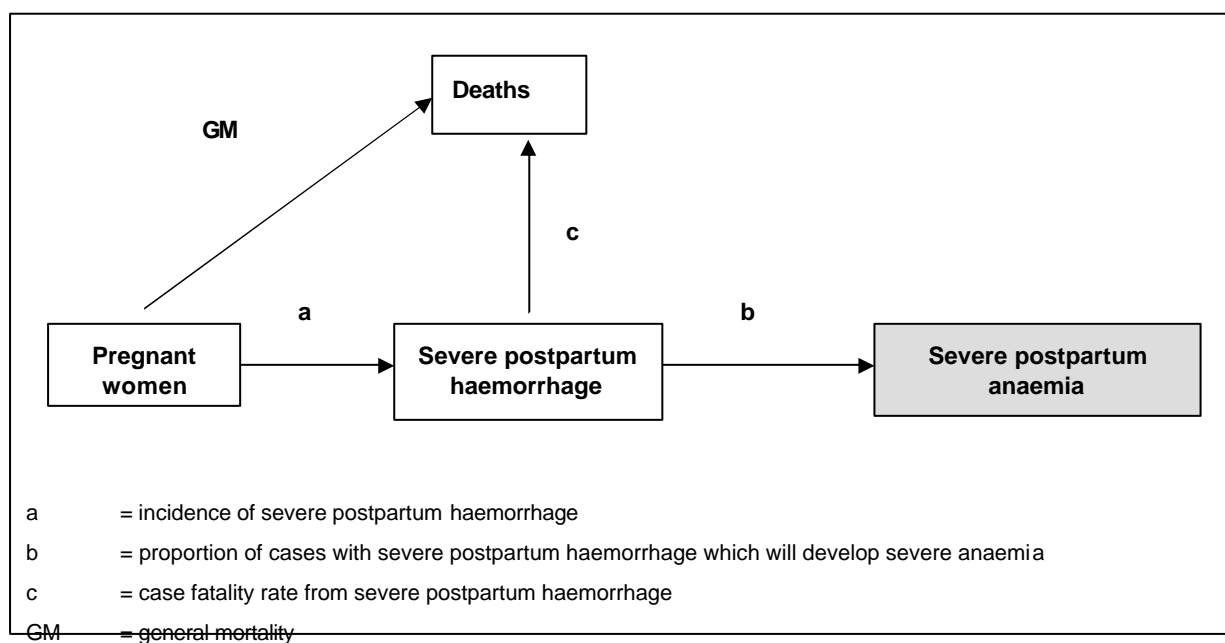
5. Mortality and case fatality

Postpartum haemorrhage is still a major cause of maternal deaths in developing as well as in developed countries. However, very few studies attempted to evaluate the case fatality rate of postpartum haemorrhage, and these studies have used different definitions and different methodology^{16,17,33}. In countries where surveys of maternal mortality have been conducted (either using sisterhood or verbal autopsy methods), it has been observed that deaths due to haemorrhage account for about 30% of all maternal deaths (Table 5.1). However, even in developed countries, where oxytocic drugs and skilled professionals are available, deaths may still occur because of failure to use standard treatment protocols and the general panic induced by this severe emergency. Thus, data from vital registration systems in developed countries show that on average haemorrhage is responsible for about 17% of all maternal deaths³⁴. Methods used to produce maternal mortality estimates for this Version 3 estimates of GBD 2000 are described in Mathers et al³⁵. For countries without good vital registration data or recent surveys of maternal mortality, Version 3 of the GBD 2000 uses vital events data and estimates of total maternal mortality based on the analyses for 1995 by Hill and AbouZahr³⁶. Mortality due to maternal haemorrhage is derived using estimations of its proportion of total maternal mortality from available cause of death data in each region. Work is currently under way to revise and update the estimates of total maternal mortality for 2000 in WHO Member States.

6. Disease model for maternal haemorrhage

Figure 6.1 shows the disease model for maternal haemorrhage.

Figure 6.1. Maternal haemorrhage disease model.



Years lived with disability (YLDs) were calculated for the box shaded in gray

Compared to GBD 1990, this current version of estimates for GBD 2000 did not consider Sheehan's syndrome as a sequelae of postpartum haemorrhage. Moreover, the definition used by GBD 2000 has changed (Table 6.1) to account for the higher clinical significance of severe postpartum haemorrhage.

Table 6.1. Comparison between GBD 1990 and GBD 2000 disease models

	GBD 1990	GBD 2000
Stages/Sequelae	Maternal haemorrhage (>500 ml blood)	Severe postpartum haemorrhage (1000 ml or more of blood loss)
	Sheehan's syndrome	
	Severe postpartum anaemia	Severe postpartum anaemia
Incidence rates	10% of all live births	
Mortality	25% of maternal deaths (proportional mortality model)	25% of maternal deaths (proportional mortality model)
Disability weight for severe anaemia	0.087	0.087

7. Regional incidence and mortality estimates

Table 7.1. Maternal haemorrhage: incidence, prevalence and mortality rate estimates for WHO epidemiological sub-regions, 2000.

Subregion	Incidence of postpartum haemorrhage (per 1000 women 15-49 years)	Prevalence of severe postpartum anaemia (per 1000 women 15-49 years)	Mortality from postpartum haemorrhage (per 100 000 women 15-49)
AFRO D	16.49	6.44	34.92
AFRO E	16.91	5.42	38.96
AMRO A	3.32	0.00	0.04
AMRO B	5.37	0.07	1.28
AMRO D	9.84	1.06	12.01
EMRO B	7.28	0.28	3.18
EMRO D	11.16	1.62	8.67
EURO A	2.72	0.00	0.04
EURO B1	3.85	0.00	0.82
EURO B2	4.80	0.06	0.93
EURO C	2.11	0.00	0.25
SEARO B	6.65	0.18	4.13
SEARO D	11.98	4.15	18.68
WPRO A	2.77	0.00	0.08
WPRO B1	4.50	0.09	1.38
WPRO B2	7.79	0.08	6.89

8. Global burden of maternal haemorrhage in 2000

General methods used for the estimation of the global burden of disease are given elsewhere³⁷. The tables and graphs below summarise the global burden of maternal haemorrhage estimates for the GBD 2000 and comparisons with the GBD 1990³⁸.

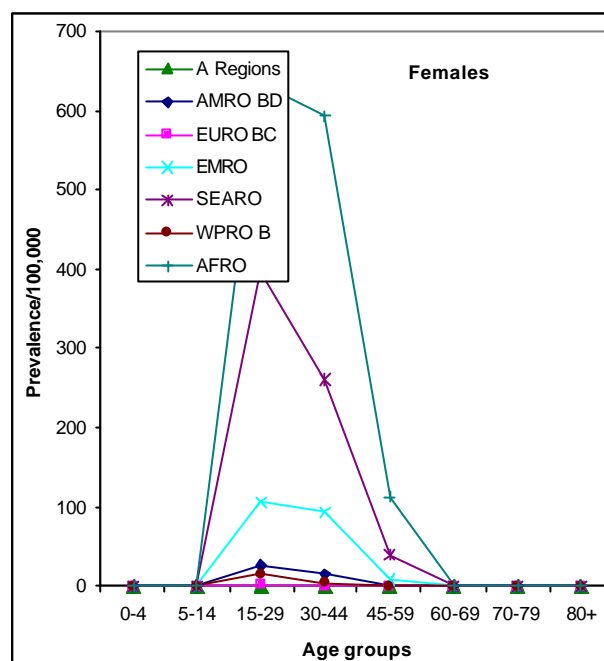
Table 8.1. Maternal haemorrhage: global total YLD, YLL and DALY estimates, 1990 and 2000.

	<i>GBD 1990</i>	<i>GBD 2000</i>
Deaths ('000)	114	143
YLD('000)	237	345
YLL('000)	3,327	4,073
DALY('000)	3,564	4,418

Table 8.2. Maternal haemorrhage: YLD, YLL and DALY estimates for WHO epidemiological subregions, 2000.

Subregion	YLD/100,000	YLL/100,000	YLD ('000)	YLL ('000)	DALY ('000)
AFRO D	42.8	512.9	72	860	932
AFRO E	34.9	564.0	59	958	1,017
AMRO A	0.0	0.9	0	1	1
AMRO B	0.5	27.9	1	62	63
AMRO D	7.4	201.1	3	72	75
EMRO B	2.0	60.3	1	41	42
EMRO D	11.3	260.2	8	178	185
EURO A	0.0	0.4	0	1	1
EURO B1	0.0	13.3	0	11	11
EURO B2	0.4	8.9	0	2	2
EURO C	0.0	3.8	0	5	5
SEARO B	1.4	90.0	3	177	180
SEARO D	29.6	228.9	193	1,495	1,689
WPRO A	0.0	0.8	0	1	1
WPRO B1	0.7	25.8	4	170	175
WPRO B2	0.6	47.1	0	34	34
WPRO B3	2.9	139.5	0	5	5
World	11.5	135.7	345	4,073	4,418

Figure 8.1. Prevalence rates of severe postpartum anemia by age group, broad regions, 2000.



9. Conclusions

One of the main limitations in estimating the global burden of postpartum haemorrhage, as well as the other maternal conditions, is that epidemiological studies are currently using different definitions of the condition, rendering those studies difficult to compare. More efforts are needed to develop standard definitions that may allow comparability of their work.

These are Version 3 estimates for the GBD 2000. Apart from the uncertainty analysis, updating estimates to reflect revisions of mortality estimates and any new or revised epidemiological data or evidence, it is not intended to undertake any major addition revision of these estimates.

We welcome comments and criticisms of these draft estimates, and information on additional sources of data and evidence. Please contact Colin Mathers (Evidence and Information for Policy, WHO Geneva) on email mathersc@who.int.

Figure 8.2. Maternal haemorrhage YLD rates, broad regions, 1990 and 2000.

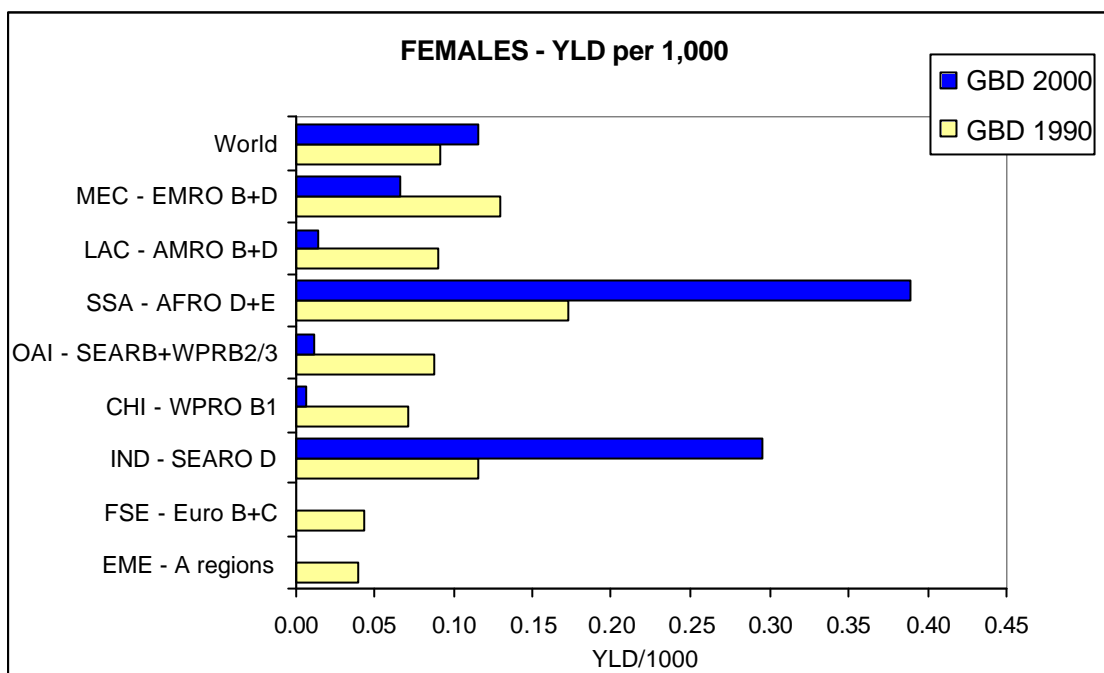
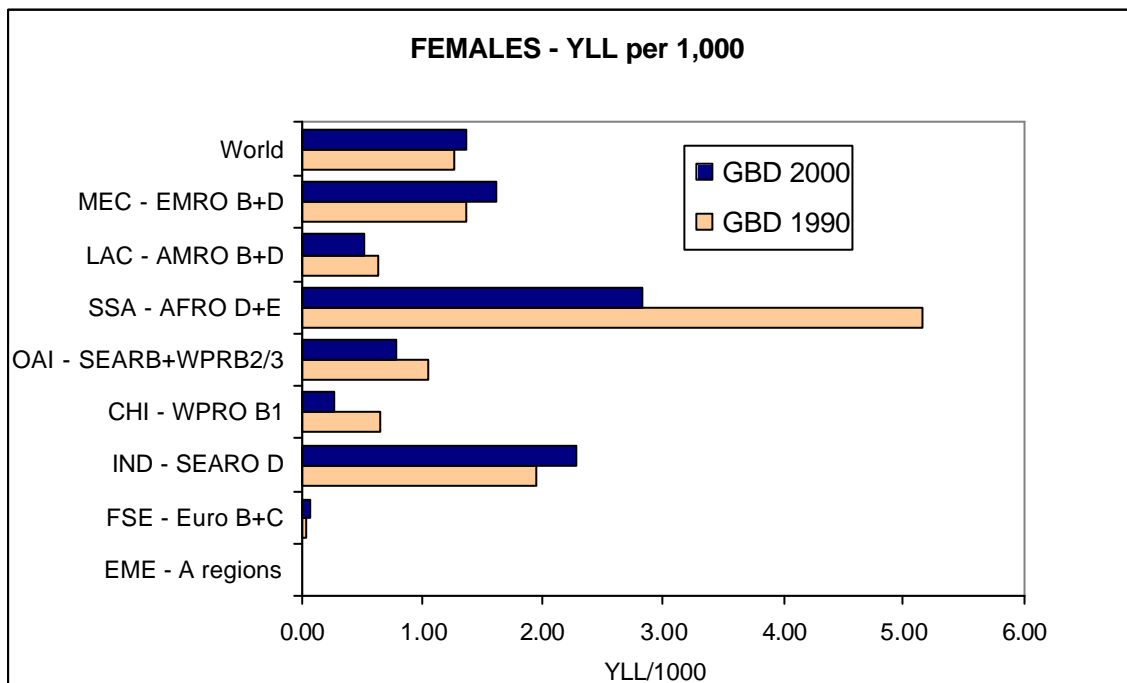


Figure 8.3. Maternal haemorrhage YLL rates, broad regions, 1990 and 2000.



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