

Understanding Global Trends in Maternal Mortality

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ABSTRACT

A recent report by WHO, UNICEF, UNFPA, and the World Bank describing trends in maternal mortality suggested that the number of maternal deaths declined worldwide from approximately 546,000 deaths in 1990 to 358,000 in 2008, a 34% decline over this period. Similarly, it was estimated the maternal mortality ratio (MMR) for the world as a whole declined by 34% over this period, falling from 400 to 260 (maternal deaths per 100,000 live births). Although the annual rate of decline in the global MMR (2.3%) fell short of the level needed to meet the targeted three-quarters reductions of the UN's Millennium Development Goals (MDG 5), this estimated rate of reduction is much faster than had been thought previously. In this paper, we describe briefly the data and methods used to develop the new estimates and offer a more detailed analysis of the estimated trends on a global and regional level.

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Introduction

Recently, the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA) and the World Bank released a report describing trends in maternal mortality over the period 1990-2008. This set of estimates, developed using a new method of estimation, indicates that the total number of maternal deaths has declined worldwide from approximately 546,000 deaths in 1990 to 358,000 in 2008. This represents a 34% decline over this period. Similarly, the global maternal mortality ratio (MMR), the ratio of maternal deaths to live births, declined by 34% from 1990 to 2008 falling from 400 to 260. Annually, the global MMR declined at a rate of 2.3%, below the 5.5% annual rate of decline needed to attain the fifth Millennium Development Goal of a 75% reduction in the MMR between 1990 and 2015.¹

In this paper, we take advantage of the wealth of information contained in both the estimates as well as the database used to generate the estimates to better understand the trends described in the report. First, we offer a short description of the data and methods used to construct the new estimates. Then, we proceed to describe how the pace of reduction in maternal mortality varies by region giving particular consideration to how changes in the total number of maternal deaths are dependent upon both direct changes in the risk of maternal mortality (as measured by the MMR) as well as changes in fertility levels. We also investigate the role of HIV/AIDS in producing differential trends in maternal mortality by region.

Data and Methods

A full description of the data and methods utilized to generate the estimates is provided in the interagency report and in an accompanying technical report, which are both available for download

(http://www.who.int/entity/reproductivehealth/publications/monitoring/MMR_technical_report.pdf).² A brief explanation is as follows:

- For countries whose death registration met certain criteria for quality, the death registration data were used directly in the analysis to derive the MMR.
- For countries lacking complete and reliable death registration systems, the core of our estimation strategy was a hierarchical/multilevel model with three main covariates (gross domestic product per capita (GDP), the general fertility rate (GFR), and the proportion of deliveries with a skilled attendant at birth (SAB)) plus random effects for countries and regions. The model was used to generate estimates both for those few countries with no available

¹ WHO/UNICEF/UNFPA/World Bank. *Trends in maternal mortality: 1990 to 2008. Estimates developed by WHO, UNICEF, UNFPA, and the World Bank.* Geneva, World Health Organization, 2010.

² John Wilmoth, Sarah Zureick, Nobuko Mizoguchi, Mie Inoue, and Mikkel Oestergaard. "Levels and Trends of Maternal Mortality in the World: The Development of New Estimates by the United Nations (Technical Report)." September 2010.

data on maternal mortality, and for those many countries where data on maternal mortality refer to a limited number of time intervals over the period from 1990 to 2008.

- Data on maternal mortality were drawn from a variety of sources including vital registration, sisterhood surveys, household surveys, surveillance systems, reproductive-age mortality studies, and censuses. Most data points on maternal mortality used as inputs to our estimation process consisted of the observed proportion classified as “maternal” among all deaths occurring to females aged 15-49 (PMDF). Data were adjusted to account for incomplete reporting and/or misclassification of maternal deaths. Additionally, adjustments were made to the input data so that the PMDF used in the regression model excluded AIDS-related maternal deaths.
- Using a non-AIDS PMDF, or $PMDF^{na}$, as the dependent variable with an offset of $\log(1 - a)$, where a is the proportion of AIDS deaths among all deaths of women aged 15-49 in the population, we estimated a multilevel regression model with random effects for both country and region. Thus, assuming that observation i refers to country j located in region k , the regression model was as follows:

$$\log(PMDF_i^{na}) = \beta_0 + \beta_1 \log(GDP_i) + \beta_2 \log(GFR_i) + \beta_3 SAB_i + \alpha_{j[i]}^C + \alpha_{k[i]}^R + \log(1 - a_i) + \varepsilon_i$$

Predicted values of this regression equation were computed for 5-year intervals centered around 1990, 1995, 2000, 2005, and 2008 for each country, and these were taken as estimates of the non-AIDS PMDF.

Results

Regional Trends in Maternal Mortality

The new estimates suggest that the total number of maternal deaths observed annually declined from 546,000 to 358,000 between 1990 and 2008 (Table 1). At the regional level, declines in the total number of maternal deaths during this time period were observed for all regions except Sub-Saharan Africa and Oceania. Whereas the estimated annual number of maternal deaths increased slightly in Sub-Saharan Africa from 199,000 to 204,000, a profound decline in the total number of maternal deaths across Asia (315,000 to 139,000) drove global trends.

When the annual rate of decline in maternal deaths is broken down into the annual rate of decline in births and the annual rate of decline in the MMR, the decline in the total number of maternal deaths at the global level is attributable entirely to a decline in the MMR, as the global trend in births was almost flat from 1990 to 2008 (Figure 1)³. The relationship amongst these quantities at the global level is driven by the relationship observed in the developing regions, since almost all maternal

³ Note that the annual rates of decline of births, MMR, and maternal deaths are related by the following equation: Annual rate of decline in births + Annual rate of decline in MMR = Annual rate of decline in maternal deaths,

deaths globally (99% in 2008) occurred in developing regions. In developed regions as well as in countries of the Commonwealth of Independent States (CIS), both declines in the MMR and declines in fertility played a role in the decline in maternal deaths.

Figure 2 offers a closer look at how trends in the MMR and in numbers of births have influenced trends in maternal deaths in developing regions. For the two regions that experienced an increase in the total number of maternal deaths over this period, Sub-Saharan Africa and Oceania, declines in the MMR were not rapid enough to counterbalance the effect of increasing numbers of births. In the other three developing regions considered here, Northern Africa, Asia, and Latin America and the Caribbean, annual declines in the MMR were relatively more rapid and the trend in births at least slightly downward.

Trends in HIV/AIDS related maternal deaths

The relative stagnation of the decline in maternal deaths observed for Sub-Saharan Africa can also be attributed to a rise in the number of maternal deaths that were associated with HIV/AIDS. The MMR observed for Sub-Saharan Africa in 2008 was 640. Excluding maternal deaths due to HIV/AIDS, however, this figure would be reduced to 580. Figure 3 reveals that when AIDS-related maternal deaths are excluded, a decline in the number of maternal deaths is observed for Sub-Saharan Africa over the period of 1990-2008.

Table 1
Estimates of the maternal mortality ratio (MMR, maternal deaths per 100,000 live births) and of the number of maternal deaths, United Nations MDG regions, 1990 and 2008

Region	1990		2008	
	MMR	Maternal deaths	MMR	Maternal deaths
World	400	546000	260	358000
Developed regions	16	2000	14	1700
Commonwealth of Independent States	68	3200	40	1500
Developing regions	450	540000	290	355000
<i>Africa</i>	<i>780</i>	<i>208000</i>	<i>590</i>	<i>207000</i>
Northern Africa	230	8600	92	3400
Sub-Saharan Africa	870	199000	640	204000
<i>Asia</i>	<i>390</i>	<i>315000</i>	<i>190</i>	<i>139000</i>
Eastern Asia	110	29000	41	7800
South Asia	590	234000	280	109000
South-Eastern Asia	380	46000	160	18000
Western Asia	140	6100	68	3300
<i>Latin America and the Caribbean</i>	<i>140</i>	<i>17000</i>	<i>85</i>	<i>9200</i>
<i>Oceania</i>	<i>290</i>	<i>540</i>	<i>230</i>	<i>550</i>

Figure 1
Annual rate of decline (in percent) for MMR, births, and maternal deaths, 1990-2008: Global overview

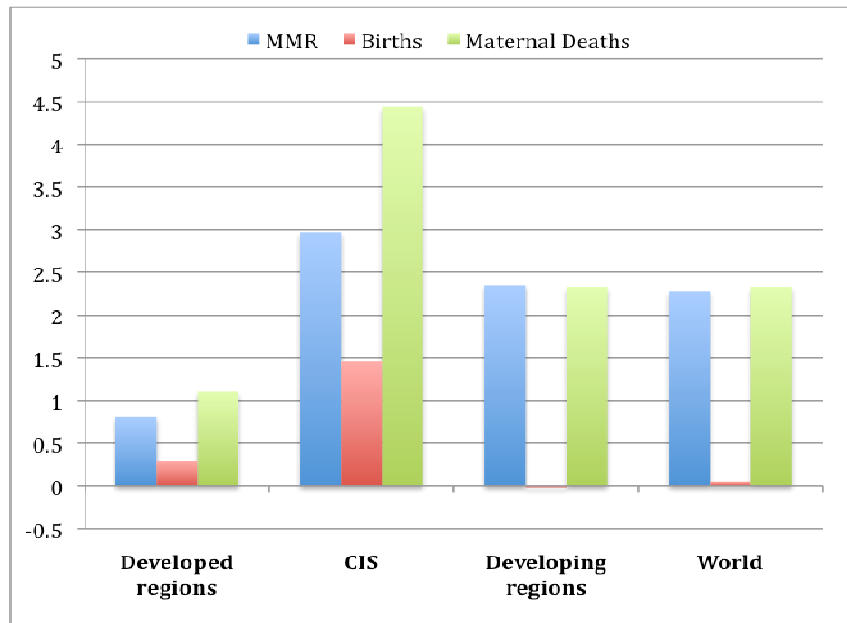


Figure 2
Annual rate of decline (in percent) for MMR, births, and maternal deaths, 1990-2008: Developing regions only

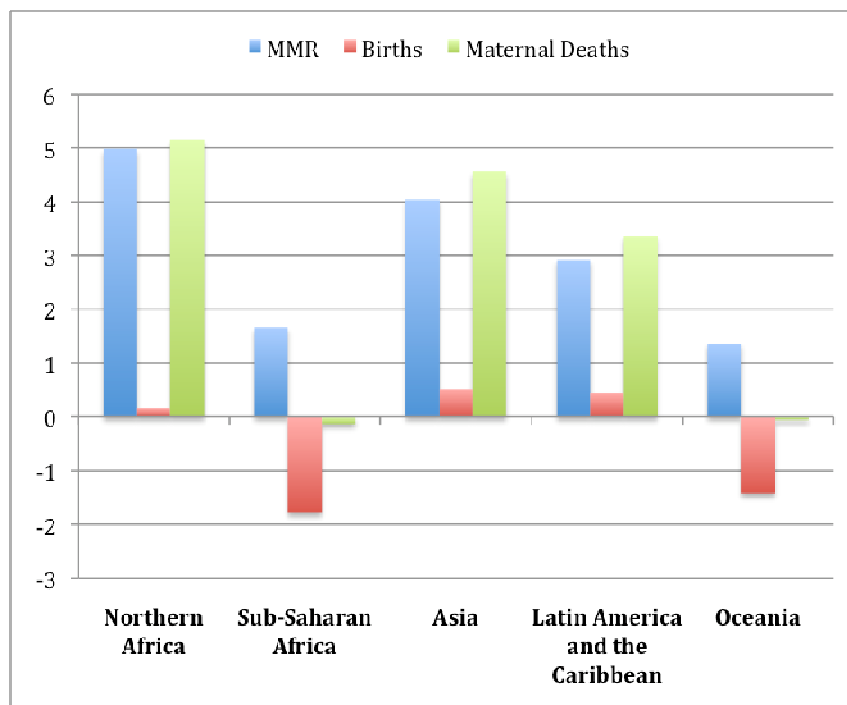


Figure 3
Trends in numbers of maternal deaths
(both in total and excluding AIDS-related maternal deaths),
Sub-Saharan Africa, 1990-2008

