

Long Abstract

The role of fertility in maternal mortality decline

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A United Nations interagency group (2010) estimated that global maternal deaths declined 34 percent from 546,000 in 1990 to 358,000 in 2008, while the maternal mortality ratio (MMR) declined from 400 to 260 per 100,000 live births. For this paper we propose to use the same database to examine the role of fertility in this reduction, and present detailed results for 172 countries.

Fertility may be hypothesized to affect the number of maternal deaths occurring in a period of time through several mechanisms. The most direct is by affecting the frequency at which women are exposed to the risk of a maternal death. Maternal deaths (MD) may be expressed as either the number of women at risk times the Maternal Mortality Rate (MMrate), or as births times the Maternal Mortality Ratio (MMR).

$$MD = W(15-49) * MMrate$$

$$MD = Births * MMR * 100,000$$

Births may in turn be expressed as women exposed times the General Fertility Rate (GFR) for the period in question:

$$MD = W(15-49) * GFR * MMR * 100,000$$

This last expression provides a convenient means of accounting for the role of fertility decline on maternal deaths. If we consider the two points in time that began and ended the UN estimates, 1990 and 2008, we can disaggregate the proportionate change in the number of maternal deaths into proportionate changes in each these three components:

$$MD(2008)/MD(1990) = W(2008)/W(1990) * GFR(2008)/GFR(1990) * MMratio(2008)/MMratio(1990)$$

The average annual rate of change in the number of maternal deaths may also be expressed as the sum of the average annual rates of change in each component:

$$\ln[MD(2008)/MD(1990)]/18 =$$

$$\ln[W(2008)/W(1990)]/18 + \ln[GFR(2008)/GFR(1990)]/18 + \ln[MMR(2008)/MMR(1990)]/18$$

Table 1 shows the results of these computations, for the 172 countries included in the UN study. This illustrates that the majority of countries experienced positive rates of growth in the number of

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reproductive age women and negative rates of change in GFR's , MMratios and the number of maternal deaths. For the proposed paper we will present a graphical summary of the information contained in Table 1.

The algebraic expressions relating changes in maternal deaths to changes in the population of women at risk, GFR's and MMratios also allow us to consider several alternative scenarios, which are summarized in Table 2. The first scenario is to estimate the number of maternal deaths in 2008 if there had been no change in each country's GFR or MMratio between 1990 and 2008, but the number of women did change as observed. This is equivalent to assuming that the number of maternal deaths grew at the same rate as women at risk in each country. This would give a worldwide total of 858,000 maternal deaths in 2008, which are 500,000 more than were estimated in the UN study. A second scenario is to consider what would have been the number of maternal deaths in each country in 2008 if numbers of women and GFR's had changed as observed in the UN database, but MMR's had not changed since 1990. This gives a worldwide total of 618,000 maternal deaths, which are 260,000 more than estimated in the UN study. This leads to the conclusion that changes in MMR's account for 52 percent ($260,000/500,000$) of the difference between the number of maternal deaths under a "no change in GFR and MMR" scenario and the number estimated by the UN for 2008, and changes in GFR's account for 48 percent of the difference.

It may be surprising to learn that almost half the change in maternal deaths between 1990 and 2008 can be attributed to changes in fertility. The worldwide annual number of births barely changed from 137 million in 1990 to 136 million in 2008, but there was considerable variation among countries. There are 83 countries in which the number of births increased between 1990 and 2008 and 89 in which it decreased. While the worldwide number of maternal deaths decreased between 1990 and 2008, the number of maternal deaths actually increased in 6 of the 89 countries where births decreased and in 27 of the 83 countries where births increased.

Proposed additional analyses:

1.) Comparison of general fertility rates in UN Study with other sources

The general fertility rates used in the UN study are based on the numbers of women and births in the population projections that were used. For selected countries with survey data we propose to compare the GFR estimates from surveys to the estimates implicit in the UN projections.

http://www.un.org/esa/population/publications/wpp2008/wpp2008_highlights.pdf

The UN study estimated maternal deaths by multiplying model-derived proportions of deaths classified as maternal (PMDF) by an estimate of all-cause deaths. This is divided by projected births to get MMR's. If the UN study over-estimated the number of births (and by implication the GFR) then the MMR was underestimated. This appears to have been the case for Guatemala where the UN estimated GFR at 0.157 and 0.136 in 2000 and 2008, but survey estimates in the country were 0.161 and 0.119 (see Table 3). One component of our analysis is, therefore, to systematically compare external estimates of general fertility rates from surveys such as the DHS with the estimates that were used in the UN study.

2.) Potential effect of fertility on maternal mortality ratios

As noted earlier above, fertility decline has a direct impact on maternal deaths by reducing the frequency with which women are exposed to risk of a maternal death (GFR). It may also affect it by reducing the maternal mortality ratio by changing the distribution of births by maternal age and parity. In order to assess the potential magnitude of an age effect on the overall MMR it is necessary to obtain estimates of the maternal mortality ratio by age, $MMR(a)$. The UN database contains the information needed to produce such estimates for selected countries.

The expression for the maternal mortality rate can be expressed as:

$$MMrate = GFR * MMratio$$

The same identity is true of age groups:

$$asmdr(a) = asfr(a) * MMR(a)$$

The age-specific maternal death rate ($asmdr$) can also be expressed as the age-specific death rate ($asdr$) times the proportion maternal:

$$asmdr(a) = asdr(a) * PMDF(a)$$

Combining the two expressions for $asmdr$ we obtain:

$$asfr(a) * MMR(a) = asdr(a) * PMDF(a)$$

$$MMR(a) = asdr(a) * PMDF(a) / asfr(a)$$

We propose to use surveys with direct sisterhood questions to estimate age-specific maternal mortality ratios based on this final expression. It is our understanding that surveys with direct sisterhood questions provide reasonable estimates of $PMDF(a)$, and estimates of $asfr(a)$ are readily obtainable from the birth histories of these same surveys. Our proposed analysis, which is exploratory in nature, would entail combining these survey-based estimates of $PMDF(a)$ and $asfr(a)$ with a range of values for $asdr(a)$ based on different model life tables indexed by levels of life expectancy for the countries where the surveys were conducted. The goal of this exercise is to identify regularities in the age pattern of $MMR(a)$, which can then be used to assess the extent to which fertility reduction may lower the MMR by changing the age distribution of births.

Reference:

Trends in Maternal Mortality: 1990 to 2008, Estimates developed by WHO, UNICEF, UNFPA and The World Bank. Geneva: World Health Organization, 2010.

Table 1. Summary information from the database of the UN study on Trends in Maternal Mortality: 1990 to 2008

Country	#Women			GFR		MMR		Maternal deaths		Annual rates of change: 1990-2008			
	1990	2008		1990	2008	1990	2008	1990	2008	Women	GFR	MMR	Maternal deaths
Afghanistan	2768098.8	5912448.2	0.2544	0.2149	1669.7	1391.2	11756.0	17677.2	0.042	-0.009	-0.010	0.023	
Albania	821093.4	837086.0	0.0942	0.0551	48.1	31.2	37.2	14.4	0.001	-0.030	-0.024	-0.053	
Algeria	5798527.8	9895136.6	0.1384	0.0721	249.2	118.2	1999.3	843.5	0.030	-0.036	-0.041	-0.048	
Angola	2367942.4	4219550.0	0.2395	0.1838	1039.9	613.6	5897.9	4757.8	0.032	-0.015	-0.029	-0.012	
Argentina	7687169.6	9973788.4	0.0909	0.0690	83.7	48.8	585.3	335.9	0.014	-0.015	-0.030	-0.031	
Armenia	894705.6	873096.4	0.0808	0.0538	51.4	28.7	37.2	13.5	-0.001	-0.023	-0.032	-0.056	
Australia	4496500.8	5162526.2	0.0564	0.0517	10.3	7.7	26.2	20.4	0.008	-0.005	-0.017	-0.014	
Austria	1954530.4	2045852.8	0.0453	0.0371	8.4	5.1	7.4	3.9	0.003	-0.011	-0.028	-0.036	
Azerbaijan	1850106.4	2589528.2	0.1041	0.0637	64.1	38.1	123.5	62.9	0.019	-0.027	-0.029	-0.038	
Bahamas	69922.4	94387.0	0.0868	0.0598	55.1	48.8	3.3	2.8	0.017	-0.021	-0.007	-0.011	
Bahrain	113230.4	199406.8	0.1245	0.0700	24.7	18.6	3.5	2.6	0.031	-0.032	-0.016	-0.016	
Bangladesh	26679851.2	43706696.8	0.1502	0.0787	870.6	337.4	34884.6	11606.3	0.027	-0.036	-0.053	-0.061	
Barbados	72882.4	68678.6	0.0549	0.0416	68.1	69.4	2.7	2.0	-0.003	-0.015	0.001	-0.018	
Belarus	2491356.0	2608891.0	0.0577	0.0368	26.3	24.9	37.9	23.9	0.003	-0.025	-0.003	-0.025	
Belgium	2435292.0	2460411.0	0.0488	0.0482	6.8	5.5	8.1	6.5	0.001	-0.001	-0.012	-0.013	
Belize	43229.0	78684.8	0.1611	0.0945	106.3	60.6	7.4	4.5	0.033	-0.030	-0.031	-0.028	
Benin	1075753.0	1985293.2	0.2048	0.1720	793.6	412.0	1748.1	1406.7	0.034	-0.010	-0.036	-0.012	
Bhutan	117767.6	174113.4	0.1714	0.0851	944.9	202.0	190.8	29.9	0.022	-0.039	-0.086	-0.103	
Bolivia (Plurinational State of)	1600612.0	2417920.2	0.1521	0.1087	512.0	180.6	1246.6	474.5	0.023	-0.019	-0.058	-0.054	
Bosnia and Herzegovina	1128855.8	1008518.0	0.0539	0.0341	18.0	9.1	11.0	3.1	-0.006	-0.025	-0.038	-0.070	
Botswana	317191.2	511587.2	0.1484	0.0923	82.5	192.3	38.9	90.8	0.027	-0.026	0.047	0.047	
Brazil	38896870.2	53206800.2	0.0933	0.0585	119.2	57.7	4323.8	1794.3	0.017	-0.026	-0.040	-0.049	
Brunei Darussalam	67617.2	115321.4	0.1060	0.0673	27.6	21.2	2.0	1.7	0.030	-0.025	-0.014	-0.010	
Bulgaria	2101091.2	1812843.0	0.0484	0.0399	22.3	18.7	22.7	13.5	-0.008	-0.011	-0.010	-0.029	
Burkina Faso	1995092.4	3534897.0	0.2113	0.2027	766.1	557.7	3230.2	3996.6	0.032	-0.002	-0.018	0.012	
Burundi	1324792.6	2093520.2	0.1964	0.1325	1174.9	975.0	3056.8	2704.1	0.025	-0.022	-0.010	-0.007	
Cambodia	2376314.2	3974930.0	0.1782	0.0909	691.2	292.6	2927.5	1057.6	0.029	-0.037	-0.048	-0.057	
Cameroon	2695973.6	4583882.8	0.1903	0.1532	683.9	602.3	3508.3	4231.1	0.029	-0.012	-0.007	0.010	
Canada	7469392.8	8227806.0	0.0521	0.0429	8.5	6.8	33.3	24.0	0.005	-0.011	-0.013	-0.018	
Cape Verde	78345.6	134907.6	0.1739	0.0895	225.1	94.0	30.7	11.3	0.030	-0.037	-0.049	-0.055	
Central African Republic	669364.6	1049591.0	0.1814	0.1467	878.8	851.6	1067.0	1311.6	0.025	-0.012	-0.002	0.011	
Chad	1341407.8	2455486.6	0.2166	0.2028	1256.1	1187.3	3650.2	5913.2	0.034	-0.004	-0.003	0.027	
Chile	3549506.2	4494570.4	0.0852	0.0559	50.8	27.7	153.6	69.6	0.013	-0.023	-0.034	-0.044	
China	304920159.8	364890203.0	0.0802	0.0497	111.5	38.0	27266.2	6898.0	0.010	-0.027	-0.060	-0.076	
Colombia	8705221.4	12288955.8	0.1039	0.0747	150.2	72.8	1358.6	667.9	0.019	-0.018	-0.040	-0.039	
Comoros	96766.2	169811.0	0.1679	0.1258	528.0	337.5	85.8	72.1	0.031	-0.016	-0.025	-0.010	
Congo	553217.8	874619.2	0.1688	0.1428	457.5	576.8	427.2	720.4	0.025	-0.009	0.013	0.029	

Costa Rica	774629.8	1229960.4	0.1067	0.0616	52.5	34.6	43.4	26.2	0.026	-0.031	-0.023	-0.028
Cote d'Ivoire	2672811.0	4785101.2	0.1952	0.1508	689.4	472.8	3596.0	3411.9	0.032	-0.014	-0.021	-0.003
Croatia	1099504.6	1044045.2	0.0490	0.0403	13.9	8.3	7.5	3.5	-0.003	-0.011	-0.028	-0.042
Cuba	2981331.0	2998521.2	0.0585	0.0394	73.9	44.3	128.8	52.3	0.000	-0.022	-0.028	-0.050
Cyprus	170114.6	227547.0	0.0748	0.0437	17.0	9.9	2.2	1.0	0.016	-0.030	-0.030	-0.043
Czech Republic	2576981.8	2518054.4	0.0490	0.0431	11.9	6.8	15.0	7.4	-0.001	-0.007	-0.031	-0.040
Democratic People's Republic of Korea	5519280.2	6386089.2	0.0755	0.0514	265.6	246.0	1106.9	807.3	0.008	-0.021	-0.004	-0.018
Democratic Republic of the Congo	8171220.8	14364759.6	0.2319	0.2010	899.7	665.6	17045.2	19216.7	0.031	-0.008	-0.017	0.007
Denmark	1306468.2	1232484.0	0.0480	0.0505	7.5	5.0	4.7	3.1	-0.003	0.003	-0.022	-0.023
Djibouti	130030.8	220957.0	0.1731	0.1095	373.3	301.6	84.1	73.0	0.029	-0.025	-0.012	-0.008
Dominican Republic	1834383.2	2601088.8	0.1203	0.0861	219.2	105.0	483.6	235.1	0.019	-0.019	-0.041	-0.040
Ecuador	2518195.0	3469425.2	0.1188	0.0810	228.0	135.8	682.1	381.8	0.018	-0.021	-0.029	-0.032
Egypt	13210318.4	21549498.4	0.1450	0.0934	217.6	81.6	4169.4	1640.9	0.027	-0.024	-0.055	-0.052
El Salvador	1295742.6	1662532.2	0.1303	0.0749	198.7	111.8	335.6	139.3	0.014	-0.031	-0.032	-0.049
Equatorial Guinea	95275.4	160288.4	0.1943	0.1564	1030.7	278.6	190.8	69.8	0.029	-0.012	-0.073	-0.056
Eritrea	716087.4	1247686.2	0.1742	0.1454	930.5	284.1	1160.8	515.2	0.031	-0.010	-0.066	-0.045
Estonia	379230.6	333803.0	0.0546	0.0475	31.6	20.7	6.5	3.3	-0.007	-0.008	-0.024	-0.038
Ethiopia	10986267.8	18726813.6	0.2121	0.1650	987.8	467.1	23020.7	14430.5	0.030	-0.014	-0.042	-0.026
Fiji	184625.8	213300.2	0.1131	0.0829	40.3	26.4	8.4	4.7	0.008	-0.017	-0.023	-0.033
Finland	1259939.6	1170635.8	0.0508	0.0504	7.2	5.0	4.6	3.0	-0.004	0.000	-0.019	-0.024
France	14159545.8	14253003.6	0.0529	0.0527	10.9	8.7	81.4	65.5	0.000	0.000	-0.012	-0.012
Gabon	209676.2	367524.2	0.1703	0.1076	263.7	257.3	94.2	101.8	0.031	-0.026	-0.001	0.004
Gambia	209621.8	394683.2	0.1884	0.1548	747.1	404.1	295.1	246.8	0.035	-0.011	-0.034	-0.010
Georgia	1344623.8	1155151.4	0.0661	0.0451	58.2	48.4	51.7	25.2	-0.008	-0.021	-0.010	-0.040
Germany	19444176.4	19062842.8	0.0433	0.0350	10.0	6.6	84.4	43.9	-0.001	-0.012	-0.023	-0.036
Ghana	3411209.4	5775467.2	0.1723	0.1309	628.9	350.0	3697.0	2645.5	0.029	-0.015	-0.033	-0.019
Greece	2439580.2	2659822.6	0.0430	0.0400	4.5	3.5	4.8	3.7	0.005	-0.004	-0.015	-0.014
Guatemala	1960759.8	3333100.2	0.1786	0.1357	223.1	85.2	781.3	385.4	0.029	-0.015	-0.053	-0.039
Guinea	1375487.6	2253499.6	0.2112	0.1740	1196.3	677.4	3475.6	2656.4	0.027	-0.011	-0.032	-0.015
Guinea-Bissau	244113.4	362236.0	0.1777	0.1793	1183.3	995.5	513.4	646.5	0.022	0.000	-0.010	0.013
Guyana	202745.6	192110.8	0.0925	0.0712	309.1	272.6	58.0	37.3	-0.003	-0.015	-0.007	-0.025
Haiti	1649125.4	2559151.8	0.1612	0.1067	669.5	302.0	1779.8	824.8	0.024	-0.023	-0.044	-0.043
Honduras	1105819.8	1865195.8	0.1703	0.1080	213.1	113.3	401.1	228.2	0.029	-0.025	-0.035	-0.031
Hungary	2543383.6	2407182.6	0.0485	0.0409	18.8	10.5	23.1	10.4	-0.003	-0.010	-0.032	-0.045
Iceland	65011.8	76869.8	0.0684	0.0600	7.6	5.1	0.3	0.2	0.009	-0.007	-0.022	-0.020
India	203705469.8	300068918.2	0.1340	0.0897	568.1	233.3	155033.2	62787.6	0.022	-0.022	-0.049	-0.050
Indonesia	45010678.0	62961806.0	0.1014	0.0670	622.8	236.7	28418.9	9982.4	0.019	-0.023	-0.054	-0.058
Iran (Islamic Republic of)	12380847.4	22052139.4	0.1533	0.0629	150.0	30.3	2848.3	420.8	0.032	-0.049	-0.089	-0.106
Iraq	4017285.2	7175091.2	0.1735	0.1315	92.9	74.8	647.6	705.6	0.032	-0.015	-0.012	0.005
Ireland	851517.0	1149981.2	0.0622	0.0598	5.5	3.9	2.9	2.7	0.017	-0.002	-0.019	-0.005
Israel	1109357.4	1677151.2	0.0914	0.0832	11.4	7.4	11.6	10.4	0.023	-0.005	-0.024	-0.006

Italy	14278606.0	13814351.4	0.0389	0.0394	6.5	4.8	35.8	26.2	-0.002	0.001	-0.016	-0.017
Jamaica	596111.6	721364.0	0.1032	0.0727	65.7	89.2	40.5	46.8	0.011	-0.019	0.017	0.008
Japan	31388442.2	27485270.0	0.0411	0.0376	9.9	7.7	127.5	79.8	-0.007	-0.005	-0.014	-0.026
Jordan	686444.6	1613854.0	0.1787	0.0969	113.8	59.1	139.7	92.5	0.047	-0.034	-0.036	-0.023
Kazakhstan	4141765.4	4386471.2	0.0894	0.0688	57.9	74.4	214.4	224.3	0.003	-0.015	0.014	0.002
Kenya	5096343.6	9360030.2	0.1941	0.1604	381.0	526.1	3767.9	7899.2	0.034	-0.011	0.018	0.041
Kuwait	475308.6	728309.0	0.0993	0.0706	10.4	7.3	4.9	3.8	0.024	-0.019	-0.019	-0.014
Kyrgyzstan	1032594.2	1495937.2	0.1318	0.0800	77.5	81.1	105.4	97.0	0.021	-0.028	0.003	-0.005
Lao People's Democratic Republic	953735.2	1579333.4	0.1825	0.1075	1184.2	575.7	2061.7	977.2	0.028	-0.029	-0.040	-0.041
Latvia	647330.4	576197.4	0.0547	0.0400	36.9	29.4	13.1	6.8	-0.006	-0.017	-0.013	-0.036
Lebanon	779061.0	1184198.2	0.1015	0.0558	51.5	25.8	40.7	17.1	0.023	-0.033	-0.038	-0.048
Lesotho	388442.4	529814.4	0.1503	0.1121	365.4	525.8	213.4	312.2	0.017	-0.016	0.020	0.021
Liberia	489782.2	898729.8	0.2016	0.1617	1142.2	986.0	1127.8	1433.0	0.034	-0.012	-0.008	0.013
Libyan Arab Jamahiriya	955583.4	1735064.0	0.1213	0.0843	104.7	64.0	121.3	93.7	0.033	-0.020	-0.027	-0.014
Lithuania	921625.2	849173.2	0.0588	0.0370	20.2	18.1	10.9	5.7	-0.005	-0.026	-0.006	-0.036
Luxembourg	96838.4	119659.0	0.0500	0.0456	11.9	7.4	0.6	0.4	0.012	-0.005	-0.026	-0.020
Madagascar	2565119.4	4512154.4	0.1987	0.1523	705.8	440.1	3597.7	3024.4	0.031	-0.015	-0.026	-0.010
Malawi	2147082.2	3327194.4	0.2118	0.1801	905.1	505.1	4116.1	3026.5	0.024	-0.009	-0.032	-0.017
Malaysia	4553491.6	7194437.2	0.1201	0.0765	55.6	31.1	304.3	171.3	0.025	-0.025	-0.032	-0.032
Maldives	46083.4	90486.8	0.1855	0.0633	511.9	37.0	43.8	2.1	0.037	-0.060	-0.146	-0.168
Mali	1995847.6	3078746.0	0.2025	0.1759	1203.8	825.0	4864.9	4468.2	0.024	-0.008	-0.021	-0.005
Malta	92089.6	97816.6	0.0586	0.0378	14.1	8.3	0.8	0.3	0.003	-0.024	-0.029	-0.050
Mauritania	455370.2	796022.6	0.1747	0.1354	778.0	545.5	618.9	588.1	0.031	-0.014	-0.020	-0.003
Mauritius	295832.4	349220.2	0.0730	0.0521	60.0	36.7	13.0	6.7	0.009	-0.019	-0.027	-0.037
Mexico	20847706.4	29897954.6	0.1126	0.0685	111.7	61.5	2621.7	1260.2	0.020	-0.028	-0.033	-0.041
Mongolia	521801.8	812189.4	0.1341	0.0609	125.7	65.2	88.0	32.3	0.025	-0.044	-0.036	-0.056
Montenegro	145713.4	156194.4	0.0442	0.0488	14.8	14.9	1.0	1.1	0.004	0.006	0.000	0.010
Morocco	6047150.0	9000445.6	0.1212	0.0717	273.9	112.0	2008.3	723.5	0.022	-0.029	-0.050	-0.057
Mozambique	3157811.2	5355644.0	0.1929	0.1636	1031.7	545.1	6283.1	4775.4	0.029	-0.009	-0.035	-0.015
Myanmar	10329785.2	14237794.4	0.1064	0.0715	418.4	239.6	4597.5	2440.9	0.018	-0.022	-0.031	-0.035
Namibia	336556.0	551636.0	0.1578	0.1065	183.9	178.3	97.7	104.7	0.027	-0.022	-0.002	0.004
Nepal	4394000.8	7414860.2	0.1680	0.0990	870.1	380.3	6422.4	2791.5	0.029	-0.029	-0.046	-0.046
Netherlands	3963174.8	3881712.8	0.0480	0.0478	10.1	8.4	19.3	15.6	-0.001	0.000	-0.010	-0.012
New Zealand	896743.6	1058063.0	0.0642	0.0550	15.9	10.8	9.2	6.3	0.009	-0.009	-0.022	-0.021
Nicaragua	932963.4	1506393.2	0.1644	0.0929	186.1	104.2	285.4	145.7	0.027	-0.032	-0.032	-0.037
Niger	1777176.2	3198817.8	0.2491	0.2465	1438.1	823.0	6365.7	6488.5	0.033	-0.001	-0.031	0.001
Nigeria	21694475.4	35626594.6	0.2067	0.1688	1101.4	835.5	49393.7	50258.2	0.028	-0.011	-0.015	0.001
Norway	1052918.8	1113184.0	0.0554	0.0521	8.1	6.0	4.7	3.5	0.003	-0.003	-0.017	-0.017
Oman	349540.2	659131.8	0.1995	0.0933	49.5	19.9	34.5	12.2	0.035	-0.042	-0.051	-0.058
Pakistan	25297869.8	43422094.0	0.1828	0.1229	494.0	258.7	22840.0	13801.0	0.030	-0.022	-0.036	-0.028
Panama	617294.2	890491.6	0.1022	0.0787	103.1	66.4	65.1	46.6	0.020	-0.014	-0.024	-0.019
Papua New Guinea	1006234.8	1640908.8	0.1516	0.1260	338.5	254.4	516.4	526.0	0.027	-0.010	-0.016	0.001

Paraguay	987382.8	1578194.8	0.1440	0.0974	132.2	95.1	187.9	146.1	0.026	-0.022	-0.018	-0.014
Peru	5373704.6	7656239.8	0.1210	0.0795	250.0	98.5	1625.1	599.0	0.020	-0.023	-0.052	-0.055
Philippines	15141599.2	23362644.0	0.1357	0.0956	179.4	93.8	3687.6	2093.7	0.024	-0.019	-0.036	-0.031
Poland	9410801.4	9675432.2	0.0590	0.0384	13.6	7.6	75.3	28.1	0.002	-0.024	-0.032	-0.055
Portugal	2502805.6	2594912.6	0.0462	0.0403	11.7	7.8	13.6	8.2	0.002	-0.008	-0.022	-0.028
Puerto Rico	933979.8	986145.4	0.0686	0.0528	29.2	18.4	18.7	9.6	0.003	-0.015	-0.026	-0.037
Qatar	81551.8	192579.6	0.1304	0.0777	15.4	8.4	1.6	1.2	0.048	-0.029	-0.034	-0.015
Republic of Korea	12253305.6	13144895.6	0.0549	0.0344	29.8	12.4	200.7	55.9	0.004	-0.026	-0.049	-0.071
Republic of Moldova	1104006.0	990761.2	0.0724	0.0453	45.0	39.7	35.9	17.8	-0.006	-0.026	-0.007	-0.039
Romania	5595427.0	5425752.4	0.0566	0.0393	63.7	38.3	201.8	81.6	-0.002	-0.020	-0.028	-0.050
Russian Federation	36172239.0	38162221.4	0.0551	0.0404	40.5	54.7	807.7	843.9	0.003	-0.017	0.017	0.002
Rwanda	1529381.4	2470394.2	0.1938	0.1631	1101.4	541.6	3264.3	2182.1	0.027	-0.010	-0.039	-0.022
Saudi Arabia	3306763.0	6184562.6	0.1720	0.0956	41.1	24.1	233.9	142.4	0.035	-0.033	-0.030	-0.028
Senegal	1646156.4	2974529.8	0.2029	0.1576	745.6	413.1	2490.1	1937.4	0.033	-0.014	-0.033	-0.014
Serbia	2311102.6	2383301.4	0.0619	0.0482	13.2	11.2	18.9	12.9	0.002	-0.014	-0.009	-0.021
Sierra Leone	988344.4	1391663.6	0.1699	0.1601	1294.2	969.3	2173.5	2159.5	0.019	-0.003	-0.016	0.000
Singapore	934979.6	1192868.4	0.0577	0.0314	14.7	8.0	7.9	3.0	0.014	-0.034	-0.034	-0.054
Slovakia	1319761.6	1422089.2	0.0598	0.0386	13.2	7.9	10.4	4.3	0.004	-0.024	-0.028	-0.049
Slovenia	485543.8	491414.2	0.0449	0.0395	13.7	7.4	3.0	1.4	0.001	-0.007	-0.034	-0.040
Solomon Islands	69664.4	124789.2	0.1790	0.1246	129.2	100.7	16.1	15.7	0.032	-0.020	-0.014	-0.002
Somalia	1529558.0	2061062.6	0.1932	0.1918	1079.5	1210.1	3189.3	4784.8	0.017	0.000	0.006	0.023
South Africa	9269157.6	13470477.0	0.1166	0.0811	229.4	413.5	2479.1	4516.1	0.021	-0.020	0.033	0.033
Spain	9671592.4	11158760.4	0.0408	0.0439	6.1	4.7	23.9	22.9	0.008	0.004	-0.014	-0.002
Sri Lanka	4512268.6	5348057.0	0.0799	0.0682	90.9	38.6	327.4	140.7	0.009	-0.009	-0.048	-0.047
Sudan	6204779.6	10087316.2	0.1803	0.1284	827.5	750.6	9257.4	9725.7	0.027	-0.019	-0.005	0.003
Suriname	103847.4	135559.6	0.0926	0.0722	122.3	100.4	11.8	9.8	0.015	-0.014	-0.011	-0.010
Swaziland	205942.8	297783.0	0.1784	0.1178	255.9	415.3	94.0	145.7	0.020	-0.023	0.027	0.024
Sweden	2044854.0	2080520.4	0.0564	0.0514	7.1	4.4	8.2	4.7	0.001	-0.005	-0.027	-0.031
Switzerland	1731971.6	1829763.6	0.0466	0.0397	8.7	5.6	7.1	4.1	0.003	-0.009	-0.025	-0.030
Syrian Arab Republic	2740570.0	5710546.4	0.1701	0.1029	117.7	46.2	548.4	271.6	0.041	-0.028	-0.052	-0.039
Tajikistan	1187351.8	1818033.6	0.1720	0.1062	115.8	64.3	236.4	124.2	0.024	-0.027	-0.033	-0.036
Thailand	15650081.8	18980715.6	0.0715	0.0514	50.0	48.0	559.7	468.4	0.011	-0.018	-0.002	-0.010
The former Yugoslav Republic of Macedonia	490991.6	524867.6	0.0670	0.0425	15.9	11.1	5.2	2.5	0.004	-0.025	-0.020	-0.041
Timor-Leste	188135.4	239240.2	0.1719	0.1835	649.0	367.1	209.9	161.1	0.013	0.004	-0.032	-0.015
Togo	873826.0	1594939.4	0.1891	0.1334	648.3	346.9	1071.3	738.3	0.033	-0.019	-0.035	-0.021
Trinidad and Tobago	318115.4	395774.8	0.0821	0.0499	83.0	51.8	21.7	10.2	0.012	-0.028	-0.026	-0.042
Tunisia	1986416.0	2927281.4	0.1120	0.0559	131.3	60.1	292.2	98.3	0.022	-0.039	-0.043	-0.061
Turkey	13921429.2	20327772.0	0.1039	0.0663	67.7	23.2	979.7	312.6	0.021	-0.025	-0.060	-0.063
Turkmenistan	879350.4	1435452.2	0.1444	0.0771	91.1	76.9	115.8	85.1	0.027	-0.035	-0.009	-0.017
Uganda	3853607.0	6821486.6	0.2279	0.2147	671.0	430.5	5892.8	6306.5	0.032	-0.003	-0.025	0.004
Ukraine	12383341.2	11979199.2	0.0543	0.0382	29.6	44.8	198.7	204.9	-0.002	-0.020	0.023	0.002

United Arab Emirates	338923.8	947524.4	0.1467	0.0661	27.6	10.4	13.7	6.5	0.057	-0.044	-0.054	-0.041
United Kingdom of Great Britain and Northern Ireland	14140260.6	14660929.2	0.0546	0.0506	11.5	9.4	89.0	70.0	0.002	-0.004	-0.011	-0.013
United Republic of Tanzania	5796551.0	9723892.6	0.1949	0.1820	875.8	790.2	9891.9	13982.2	0.029	-0.004	-0.006	0.019
United States of America	67085206.0	75690163.4	0.0603	0.0580	14.1	13.7	571.9	603.1	0.007	-0.002	-0.002	0.003
Uruguay	743093.2	810442.8	0.0764	0.0622	43.5	30.8	24.7	15.5	0.005	-0.011	-0.019	-0.026
Uzbekistan	4809273.6	7696082.0	0.1480	0.0720	46.2	33.0	328.5	182.7	0.026	-0.040	-0.019	-0.033
Venezuela (Bolivarian Republic of)	4950995.4	7466379.8	0.1139	0.0801	97.3	77.7	548.7	464.8	0.023	-0.020	-0.012	-0.009
Viet Nam	16469317.6	24705720.4	0.1254	0.0605	166.2	56.4	3432.0	842.6	0.023	-0.040	-0.060	-0.078
Yemen	2565843.8	5366606.0	0.2494	0.1574	537.8	207.6	3441.4	1753.9	0.041	-0.026	-0.053	-0.037
Zambia	1793768.0	2799377.6	0.1943	0.1935	394.9	470.9	1376.1	2551.4	0.025	0.000	0.010	0.034
Zimbabwe	2368742.6	3181328.8	0.1647	0.1189	391.3	789.0	1526.4	2983.9	0.016	-0.018	0.039	0.037
TOTAL	1,308,353,736	1,740,303,658					545,284	357,702				

Table 2: Comparisons of alternate scenarios on estimates of the number of worldwide maternal deaths in 2008

Scenario	1990	2008
No change in GFR or MMR	545,284	858,446
Just GFR change	545,284	617,869
Observed GFR & MMR change	545,284	357,702

Table 3: Comparison of data from the maternal mortality study published by the United Nations and two RAMOS investigations in Guatemala (LBMM-2000 y ENMM-2007).

Indicator	United Nations Study			RAMOS Investigations		
	2000	2008	Percent change	LBMM-2000	ENMM-2007	Percent change
Mortality rate (15-49)(1,000)	2.35	2.01	-14.5%	1.81	1.75	-3.3%
Proportion maternal (PMDf)	0.073	0.071	-2.7%	0.136	0.094	30.9%
General Fertility Rate (GFR)	0.157	0.136	-13.4%	0.161	0.119	26.1%
Maternal Mortality Ratio (100,000)	110	110	0.0%	153	139	-9.2%
Maternal Mortality Rate (1,000)	0.172	0.143	-16.9%	0.246	0.165	32.9%
Women, 15-49	2,628,750	3,333,100	26.8%	2,635,657	3,226,557	22.4%
Deaths to women, 15-49	6,181	6,708	8.5%	4,758	5,645	18.6%
Maternal deaths to women, 15-49	454	480	5.7%	649	531	-18.2%
Births	412,775	452,452	9.6%	424,676	382,420	-10.0%

¹ - Trends in Maternal Mortality:1990 to 2008: estimates developed by WHO, UNICEF, UNFPA and The World Bank, WHO, 2010.