# Evaluating maternal mortality ratios of Nepal with 2003 Nepal world health survey estimates

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# ABSTRACT

**Introduction:** Maternal mortality is an important indicator for women's health. It is estimated as pregnancy related maternal mortality ratio (PRMR) in Nepal Demographic and Health Surveys (NDHS). However, 2011 National Population and Household Census (NPHC) gave a very high estimate of this indicator and challenged the 1996 and 2006 NDHS estimates. This warrants the evaluation of these estimates using another reliable source and this study aims to fill that gap.

**Method:** The 2003 Nepal World Health Survey (WHS) data files were used to get PRMR for 1995-2002. SPSS syntax was used to create sibling history to compute PRMR for the country. Standard error was computed to get 95% confidence interval (CI) and compare it with NDHS and NPHC estimates.

**Result:** Data quality of sibling history was found to be reliable for getting maternal mortality estimates as age and age at death data was good. Adjusted PRMR of 285 was obtained for 1996-2002 with 95% CI of 161-391. This CI overlapped for 2006 NDHS estimate but it did not overlap the 1996 NDHS and 2011 NPHC estimates.

**Conclusion:** PRMR from 2003 Nepal WHS were found to be consistent with 1996 and 2006 NDHS as per reported confidence intervals but it was not consistent with the 2011 NPHC estimate. As NPHC used indirect method due to poor data quality of observed deaths and live births, it cannot be considered as a reliable estimate of PRMR. Thus, it is recommended to use surveillance based methods to get valid and reliable estimate of PRMR and MMR for Nepal.

Key words: Maternal Mortality, World Health Survey, Demographic and Health Survey, Census, Nepal

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#### INTRODUCTION

Maternal mortality is an important indicator for women's health<sup>1</sup>. It can be calculated directly from the vital registration system if it is complete and data quality is excellent for observed deaths as well as live births. It is computed from direct and indirect methods using nationally representative surveys when reliable data is not available.<sup>2</sup> Thus, direct sisterhood method was used to compute maternal mortality ratio (MMR) for 1996 and 2006 Nepal Demographic and Health Surveys (NDHS) and 2011 National Population and Housing Census (NPHC).

Even though it was reported as MMR in NDHS and NPHC, it was pregnancy-related mortality ratio (PRMR) as it was based on the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of cause. The 2016 NDHS started reporting correct estimate of MMR as it is based on the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.<sup>3</sup>

Thus, this study aims to evaluate PRMR estimates of Nepal with estimate of 2003 Nepal World Health Survey (WHS).

# METHOD

The 2003 Nepal WHS datasets were used to compute PRMR of Nepal using user-written code/syntax in IBM SPSS 20.0 software. Sibling history file, that is, siblings of all the surveyed women of 15-57 years, was created using women data file of 2003 Nepal WHS. This data was further used to compute total, non-maternal and maternal deaths and, women-years of exposure of sisters to get age-specific pregnancy related maternal mortality rates using women aged 15-49 years only.

#### Table 1: Completeness of information on siblings, 2003 Nepal WHS

	Sisters		Brothers		All siblings	
	Number	Percent	Number	Percent	Number	Percent
All siblings	22773	100.00	22791	100.00	45564	100
Living	18433	80.97	18030	79.11	36463	80.03
Dead	4340	19.06	4761	20.89	9101	19.97
Living siblings	18433	100.00	18030	100.00	36463	100.00
Age reported	18358	99.59	17964	99.63	36222	99.61
Age missing	75	0.41	66	0.37	141	0.39
Dead siblings	4340	100.00	4761	100.00	9101	100.00
YSD reported	4182	96.38	4602	96.66	8784	96.52
YSD missing	158	3.78	159	3.46	317	3.61
Dead siblings	4340	100.00	4761	100.00	9101	100.00
AD reported	3994	92.03	4352	94.41	8346	91.70
AD missing	346	8.66	409	9.40	755	9.05

These maternal mortality rates were further adjusted using adjustment factors, proportion of women in each age group, using the household member data file to make it comparable with the NDHS estimates of Nepal. Birth history data was then used to compute age-specific fertility rates (ASFRs), total fertility rate (TFR) and general fertility rate (GFR) seven years prior to the survey.

The PRMR was computed as ratio of total maternal mortality rate and GFR of 15-49 years. Its confidence interval was computed using standard error of mean (SEM) of the quinquennial adjusted maternal mortality rates. The SEM was calculated using simple random sampling approach.

So, confidence interval of PRMR for this study is not strictly comparable with the NDHS PRMR confidence interval as they were based on the Jackknife repeated sampling method of survey clusters<sup>4</sup> instead of simple random sampling method of adjusted maternal mortality rates used here.

#### RESULT

Sibling history revealed that there were 45564 siblings: 22733 female (49.98%) and 22791 male (50.02%) siblings of women aged 15-57 years. Among the siblings, 4 out 5 were alive and 1 out of 5 was dead. Only 0.40 percent of age was missing among the living siblings whereas around 3.6 percent of years since death (YSD) data of dead siblings were missing. Yet, around 9 percent of age at death (AD) data of the dead siblings was missing.

Further, there were 3933 women of reproductive age group in the survey and they reported 15344 sisters. Percentage distribution of women and sisters by quinquennial age groups were found to be different (Table 2). Among the 15344 sisters, around 93% (14276) were alive whereas nearly 6% (927) died due to non-maternal reasons

and about 1% (141) died of maternal causes for all the years prior to the survey.

#### Table 2: Distribution of Women and Sisters with Status, 2003 Nepal WHS

Age	Women	Percent of women	Sisters	Percent of sisters	Status of sisters:			
					Alive	Non-maternal deaths	Maternal deaths	
15 - 19	294	7.48%	1628	10.61%	1407	200	21	
20 - 24	769	19.55%	2673	17.42%	2427	203	43	
25 - 29	719	18.28%	2648	17.26%	2506	112	30	
30 - 34	672	17.09%	2684	17.49%	2554	110	20	
35 - 39	634	16.12%	2347	15.30%	2224	107	16	
40 - 44	498	12.66%	1980	12.90%	1850	122	8	
45 - 49	347	8.82%	1384	9.02%	1308	73	3	
Total	3933	100.00%	15344	100.00%	14276	927	141	

# Table 3: Fertility Rate Estimates for Seven Years before the Survey, 2003 Nepal WHS

Age at birth	Total births	Total Exposure	ASFR
15-19	806	5042	160
20-24	1261	5410	233
25-29	762	4858	157
30-34	423	4413	96
35-39	200	3658	55
40-44	66	2567	26
45-49	1	1915	1
TFR			3.6
GFR			126

# Table 4: Maternal Mortality Estimates for Seven Years before the Survey, 2003 Nepal WHS

Sister's Age Group	Non-Maternal Deaths	Maternal Deaths	Total Deaths	Total Exposure	MM Rate per 1000	Proportion Maternal	Adjustment Factors	Adjusted MM Rate
15-19	17	3	20	15678	0.191	0.1500	0.074752	0.014
20-24	28	8	36	18004	0.444	0.2222	0.195525	0.087
25-29	19	8	27	17884	0.447	0.2963	0.182812	0.082
30-34	17	5	22	16294	0.307	0.2273	0.170862	0.052
35-39	19	5	24	13546	0.369	0.2083	0.161200	0.060
40-44	30	4	34	10007	0.400	0.1176	0.126621	0.051
45-59	28	1	29	6212	0.161	0.0345	0.088228	0.014
Total	158	34	192	97625	0.348	0.1771		0.360
PRMR					276			285

Table 3 showed that Age-specific fertility rate (ASFR) was highest for age 20-24 (233 births per 1000 women in this age group) followed by women of 15-19 and 25-29 years. The total fertility rate (TFR) and general fertility rate (GFR) for 1995-2002 period was obtained as 3.6 birth per woman and 126 births per thousand women aged 15-49 years respectively.

There were 192 deaths (158 non-maternal and 34 maternal deaths) and 97625 women-years of exposure seven years prior to the survey among sisters. It gave 0.348

(192/97625\*1000) pregnancy related maternal mortality rate per 1000 women-years of exposure. The unadjusted pregnancy related maternal mortality rate was highest for age 20-24 years followed by 25-29 and 40-44 years.

After using adjustment factor in each quinquennial age groups and adding these age-specific mortality rates, the pregnancy related maternal mortality rate increased to 0.360 per 1000 women-years of exposure. The age-adjusted pregnancy related maternal mortality rate also revealed the similar pattern like the unadjusted pregnancy related maternal mortality rates (Table 4).

The unadjusted PRMR was computed as 276 (0.348/0.126\*100) whereas adjusted PRMR was 285 (0.360/0.126\*100) maternal deaths per 100,000 live births in Nepal during 1996-2002 period. Standard error of adjusted PRMR was computed as 0.06, which produced 95% confidence interval of 161-391 for this rate.

## DISCUSSION

Sibling history showed that age of the siblings was available for nearly all the living siblings whereas age at death was not available for around 9 percent of dead siblings. However, data on years since death was available for the nearly 96.4% of the siblings and it was enough to get reliable estimate of PRMR for 2003 Nepal WHS. These values were similar to the data reported in the 2016 NDHS report; however, age at death was reported more in the NDHS surveys than Nepal WHS.<sup>4</sup>

The GFR and TFR values were in-between the reported values of these indicators for the 2001 and 2006 NDHS surveys, even though longer reference period of 7 years was used in this study compared to the shorter reference period of 3 years used in NDHS.<sup>4</sup> The ASFRs were slightly different than the NDHS estimates due to the longer reference period used to get correct estimation of PRMR.

The adjusted PRMR was found to be consistent with the finding of 2006 NDHS survey as confidence interval overlapped.<sup>4</sup> It also revealed that PRMR reduced significantly between 1996 and 2003 as PRMR confidence interval did not overlap between these surveys. This indicates that maternal health initiatives started from mid-1990s started to show their effects on early-2000s in Nepal.<sup>4,5,6,7</sup>

The 2011 National Population and Household Census (NPHC), for the first time estimated PRMR from the sampled households at national level and reported it as 480 per 100000 live births (CI:404-557).<sup>6</sup> The main advantage of this estimate was the large sample size of maternal deaths whereas main limitation was data quality of reported deaths and live births. This NPHC estimate of PRMR did not match with the NDHS and Nepal WHS estimates showing decreasing PRMR in the country. This has also happened elsewhere as PRMR estimates did not match.<sup>8</sup>

Maternal Mortality Estimation Inter-Agency (MMEIA) group revised the PRMR estimates for 1996 NDHS, 2006 NDHS and 2011 NPHC as 703, 397 and 559 respectively.<sup>9</sup> Their estimate of MMR for 1995, 2000 and 2005 based on these revised PRMR values were 660, 548 and 444 respectively using regression model with GDP per capita (PPP at 2011 International USD\$), GFR and Skilled Attendance at Birth as independent variables. These values did not match with the 1996 and 2006 NDHS and, 2003 Nepal WHS PRMR estimates as they were calibrated on the 2011 NPHC estimate of PRMR, which was very high and computed using indirect techniques. Thus, PRMR estimate of 2011 NPHC is questionable as reported data quality on age-sex structure, observed deaths and observed live births were found to be poor<sup>6</sup>.

The MMEIA report estimated the PRMR for 2010 and 2015 as 349 and 258 respectively, which was close to the 2016 NDHS PRMR estimate of 259<sup>4,9</sup>. However, confidence interval (176-425) of 2015 MMEIA estimate was different than the confidence interval 2016 NDHS estimate (134-345). Recent PRMR estimate of Nepal for 2017 from the MMEIA groups was 186, which seems to be plausible as it was further calibrated using 2016 NDHS estimate rather than unreliable 2011 NPHC value.<sup>10</sup>

The main limitation of this study is that it used simple random sampling for getting standard error (SE) and confidence interval. Further, it is based on the 34 maternal deaths, which provided large SE of 48 (0.06/0.126\*100) for PRMR like other nationally representative surveys using direct sisterhood method. This SE is around 19% of the PRMR giving margin of error of around 38% and comparable with other study<sup>11</sup>. Thus, it is recommended to get robust national estimation of PRMR/MMR through studies with one-year surveillance approach such as Nepal Maternal Mortality and Morbidity Study<sup>12</sup> and Bangladesh Maternal Mortality and Health Care Study<sup>13</sup>.

## CONCLUSION

The 2003 Nepal WHS showed good data quality for sibling history and thus the PRMR estimates are valid as well as reliable as it was based on the direct sisterhood methods. The PRMR estimate of 285 based on adjusted age-specific maternal mortality rate is consistent with 1996 and 2006 NDHS estimates. This indicates that maternal mortality improved in the country in the 1995-2002 period, which can be attributed to the various maternal health related plans, policies and programs implemented at that time in the country. The PRMR from 2011 Census of Nepal is not reliable and it is recommended to use surveillance based approach to get correct estimate of PRMR and MMR until vital registration system becomes complete and useful in terms of data quality in Nepal.

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