Regional and District Level Estimates of Maternal Mortality for Nepal: Are they Different from the National Estimates in 2011?

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ABSTRACT

Introduction: Nepal won Millennium Development Goal Award on Maternal Health as the Maternal Mortality declined by 50% between 1996 and 2006 and by 80% between 1990 and 2010. However, maternal mortality in Nepal are estimated from Surveys using direct and indirect techniques amid the absence of robust vital registration system. Thus, maternal mortality estimates are not available at regional and district levels.

Methods: This paper estimated the regional and district level maternal mortality ratio for 2011 using multilevel regression model coefficients proposed by UN and World Bank for the first time in Nepal. Proportion of Maternal Deaths were estimated using Gross Domestic Product, General Fertility Rate and delivery by Skilled Birth Attendants. The maternal mortality ratio for five development regions and 75 districts were then estimated using the 2011 Census Reports.

Results: The maternal mortality ratio at 2011 was estimated as 155 deaths per 100,000 live births and was consistent with the previous values estimated between 1990 and 2010. Maternal mortality at Western and Central development regions were below while Eastern, Mid-Western and Far-Western Regions were above the national estimate. Twenty-two districts had it below while 53 had it above the national estimate. Kalikot and Kaski districts had highest and lowest maternal mortality ratio in 2011.

Conclusion: Maternal mortality declined in the country because of rapid fertility decline and increased contraceptive use and decreased anemia among pregnant women and obstetrics/abortion facilities in all districts of the country after legalization of abortion. Improvement in women's education, empowerment, wealth and living standard were also responsible for declining maternal mortality. Nepal now needs a robust vital registration system to "explain" the reasons of this decline and further devise and implement new plans, policies and programs to reduce it further at sub-national and local levels.

Key words: Maternal Mortality, Multilevel Regression, Development Region, Districts, Nepal

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INTRODUCTION

Maternal Mortality is included as one of the key indicators of Millennium Development Goals (MDGs) related to the improvement of maternal health. Reduction of maternal mortality ratio (MMR) by three quarters, between 1990 and 2015, is the crucial indicator for reaching the MGD Goal 5.[1]

Nepal is few countries in the world that is "on track" to reduce the maternal mortality.[2] The 2006 Nepal Demographic and Health Surveys (NDHS) revealed nearly 48% decline in MMR between 1996 and 2006[2] while 2009 Nepal Maternal Mortality and Morbidity Survey (NMMMS) found further decline at 229 maternal deaths per 100,000 live births.[3]

The 2009 NMMMS provided the MMR for eight districts included in the study whereas there exists estimate for Chitwan and Bara districts for 2005.[4] Since MMR for all the 75 districts and 5 development regions are not yet available, this study aims to estimate MMR for these districts and regions.

METHODS

In this study, MMR was calculated as the ratio of total deaths of women aged 15-49 years (D) and total live births in a year prior to the census (B) multiplied by proportion of maternal deaths (PM). The 2011 Household and Population Census reports of Nepal provided D and B for one year prior to the census. So, it was only required to estimate the PM in 2011 to complete the MMR calculation at sub-national level. As UN and World Bank have used the Multilevel Regression Model[1] to estimate the proportion of maternal deaths for each country and major region of the world, this study also used its estimates based to obtain the sub-national MMR for Nepal.

The UN and World Bank have used Gross Domestic Product (GDP) at 2005 Purchasing Power Parity (PPP\$), General Fertility Rate (GFR) and Delivery by Skilled Attendant at Birth (SAB) as three key variables along with country and regions as first and second level variables[1]. The fitted model was:

$$LN(PM) = \beta_0 + \beta_1*LN(GDP) + \beta_2*LN(GFR) + \beta_3*SAB + \alpha^c_{j[i]} + \alpha^k_{k[i]} + e$$

Where data were used for each observation (i) of country j, within region k. The UN and World Bank regression model used MMR estimations (data) from the 1996 NDHS, 2006 NDHS and 2008/2009 NMMMS for Nepal as they were most reliable and recent estimates available for Nepal.[1]

Thus, this study also used the regression coefficients of GDP (β_1=-0.217), GFR (β_2=1.272) and SAB (β_3=-0.652) along with multilevel coefficient estimate for Nepal (country effect: $\alpha^c_{j[i]}$ = -0.182) and the error term (e=0.28) obtained from the UN and World Bank estimates. [5,6] The model constant β_0 was 2.253. Since the UN and World Bank model included observed MMR between 0 and 1900, its estimates were sensitive as well as specific for the sub-national estimates of Nepal.

This study used 2011 Gross National Income (GNI) at 2005 PPP\$ for GDP.[7] The SBA data were extracted from the 2011/12 Annual Report (2067/68 BS).[8] GFR, on the other hand, were computed for each district using 2011 Population and Household Census Report[9]. All the calculations were done on Microsoft Excel 2013 while Map was created using Epi-Map program included in the Epi-Info 3.5.3 software.

Since the country effect (country specific regression coefficient) was used in all the sub-national level estimation, it was assumed that maternal mortality decline was same across the districts and regions. SBA data of 2011/12 fiscal year was used instead of taking average of three fiscal years i.e. 2010/11, 2011/12 and 2012/13. Further, GFR were calculated directly from the 2011 census report without any adjustments for underreporting of live births reported for 12 months prior to the 2011 census and/or smoothing of the child and female population structure for age heaping and/or digit preference. Deaths of women aged 15-49 (D) were also used directly from the census report without adjustments[10]. These were the main limitations of the MMR estimation in this study.

RESULTS

The MMR of Nepal was estimated as 155 for 2011. MMR for Eastern, Central, Western, Mid-Western and Far-Western regions were estimated as 167, 79, 149, 197 and 216 respectively for the same period. Central and Western regions had MMR below national level whereas Eastern, Mid-Western and Far-Western had above the national estimate. Central Region had lowest MMR whereas Far-Western Region had highest MMR.

Figure 1 represents the district-wise maternal mortality ratio where five districts (Kaski, Lalitpur, Kathmandu, Manang and Chitwan) had MMR below 100 and 7 districts (Kalikot, Dolpla, Taplejung, Bajura, Bajhang, Mugu and Jajarkot) had it above 300. Further, most of Far-Western, Mid-Western and Eastern hills and mountainous districts had MMR between 200 and 300. On the other hand, all the *Terai* districts had MMR between 100 and 200 except Chitwan and Kapilbastu districts which had it below 100 between 200 and 300 respectively.

The highest and lowest MMR were estimated as 478 and 66 for Kalikot and Kaski districts respectively. Table 1 revealed 5 districts with MMR between 50 and 100, 17 districts with MMR between 100 and 150, 21 districts with MMR between 150 and 200, 18 districts with MMR between 200 and 250, 7 districts with MMR between 250 and 300, 5 districts with MMR between 300 and 350 and 1 districts each with MMR between 400 and 450 and, 450 and 500 respectively. Twenty-two districts had MMR below national estimate whereas 53 districts had above it.

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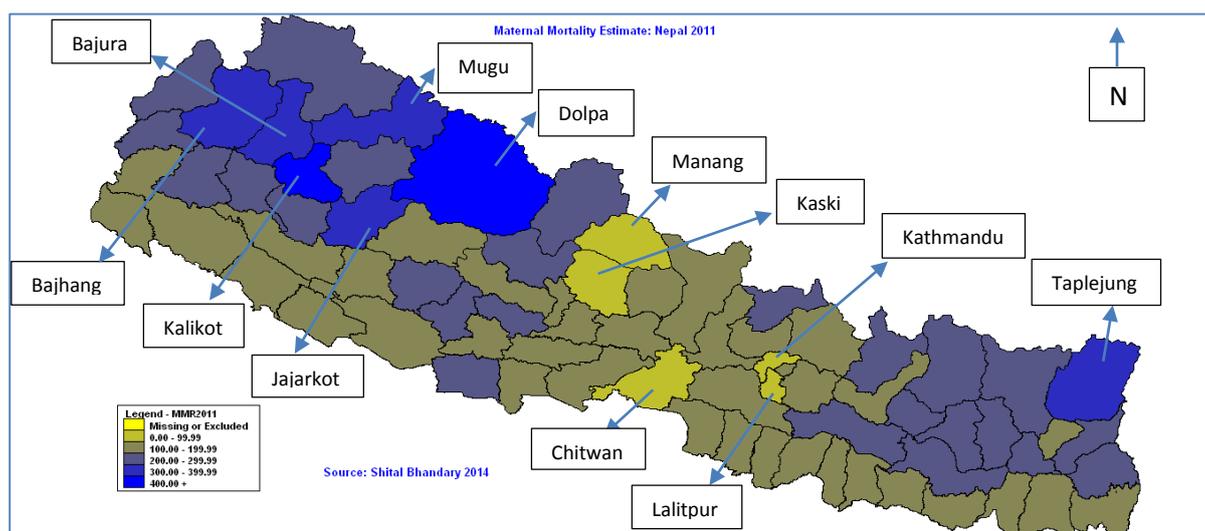eISSN: 2363-1168

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Figure 1: Maternal Mortality Ratio Estimates by Districts, Nepal: 2011

Table 1: Maternal Mortality Ratio Range and Estimates by Districts, Nepal: 2011

MMR Range	MMR Estimates
450-499	Kalikot (478)
400-449	Dolpa (412)
300-349	Mugu (344), Jajarkot (332), Bajura (320), Bajhang (317), Taplejung (314)
250-299	Jumla (295), Mustang (288), Bhojpur (283), Achham (283), Phython (282), Panchthar (265), Darchula (259)
200-249	Rolpa (248), Ilam (246), Humla (246), Solukhumbu (241), Baitadi (239), Khotang (236), Rasuwa (234), Udaypur (231), Dhankuta (227), Dailekh (226), Sindhuli (222), Doti (219), Myagdi (212), Kapilvastu (212), Gulmi (211), Okhaldhunga (210), Dolkha (206), Sankhuwasabha (204)
150-199	Rukum (199), Nuwakot (193), Dhading (192), Sindhupalchowk (191), Mahottari (190), Terhathum (189), Kailali (188), Baglung (186), Arghakhanchi (183), Nawalparasi (179), Makwanpur (179), Jhapa (178), Salyan (176), Ramechhap (175), Dadeldhura (170), Palpa (163), Dang (163), Bardiya (159), Kanchanpur (159), Surkhet (159), Sarlahi (156)
100-149	Kavre (148), Parbat (148), Parsa (138), Gorkha (136), Morang (135), Rautahat (135), Rupandehi (131), Syangja (130), Lamjung (126), Saptari (124), Bara (124), Banke (124), Tanahu (123), Sunsari (122), Siraha (112), Bhaktapur (107), Dhanusha (101),
50-99	Chitwan (98), Manang (87), Kathmandu (77), Lalitpur (69), Kaski (66)

DISCUSSION

Maternal mortality declined from 539 from 281 per 100,000 live births between 1996 and 2006 for Nepal. The 2012 UN and World Bank Estimate revealed that maternal mortality fell continuously in the country between 1990 and 2010: 770 in 1990, 550 in 1995, 360 in 2000, 250 in 2005 and 170 in 2010.[1] The present estimate is consistent with this trend as it found MMR as 155 for 2011. MMR also fell from 683-596 to 274-153 for Rupandehi, Kailali and Okhaldhunga districts between 1998 and 2008[11] and further to 130 and 189 from 274 and 263 for Rupandehi and Kailali districts between 2008 and 2011 respectively. Ironically, MMR estimate for Okhaldhunga district was found to be higher for 2011 (210) than in 2008 (153). It also fell from 140 to 98 for Chitwan district and from 329 to 125 for Bara district between 2005 and 2011.[4] These results indicates that maternal mortality fell across districts and regions between 1990 and 2011. However, maternal mortality was still found to be very high for Far-Western, Mid-Western and Eastern regions requiring immediate attentions from all the sectors.

The reasons for this unprecedented fall in maternal mortality at national and sub-national levels can be attributed to many plans, policies and programs implemented since mid-1990 i.e. after the reinstatement of multi-party democratic system in the country in 1990. For instance, Post-Abortion Care (PAC) service started as pilot project at Maternity Hospital in 1995 was gradually expanded to other urban referral centers and district hospitals to prevent the maternal deaths due to abortion complications as early as 1999. This was a direct result of the 1998 NMMMS that revealed a high demand for PAC and complications of abortion accounted for the highest caseload in obstetrics departments of the district hospitals.[12] Consequently, 1998 Reproductive Health Strategy focused on the avoidance of three delays: "seeking", "reaching" and "receiving" care to reduce the high maternal deaths in Nepal[13]. In addition, abortion was legalized in the country in 2002 for the first 12 weeks of pregnancy or up to 18 weeks in cases of rape, incest, fetal malformation or when the women's life is endangered. This in turn has resulted in safe, legal abortions with clear guidelines and trainings on essential midwifery skills for the paramedics and nursing personnel.

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As the abortion was made available in public service from 2004, 158,188 first trimester abortions were recorded between March 2004 and October 2007 through 176 Comprehensive Abortion Care (CAC) service centers of 71 districts and, more than 400,000 women from 75 districts had benefitted from this program till 2010.[14] These numbers clearly indicate that CAC service played a vital role in lowering maternal mortality at national /sub-national levels and were reflected in the current estimate too.

Government of Nepal also revised the National Safe Motherhood Plan (NSMP) 2002-2017 to reflect its commitment to the Millennium Development Goals (MDG). It introduced programs with particular emphasis on reaching the poor and marginalized population through Nepal Health Sector Program I (NHSP I) that was based on the Sector Wide Approach (SWAp) for providing basic and reproductive health to the underserved. This initiative gained further momentum when 2007 Interim Constitution of Nepal included the basic health services and specifically reproductive health as citizen's right. Moreover, the Support to Safe Motherhood Program (SSMP) within NSMP framework provided direct funding and technical assistance for infrastructure development and implementation of basic and comprehensive essential obstetric care (BEOC and CEOC), which in turn helped more than 400 health posts and 137 sub-health posts to offer 24-hour delivery service by expanding SBA training sites and advanced trainings.[13] These timely initiatives contributed a lot in reducing maternal mortality in the country.

Nepal also introduced Safe Delivery Incentive Program (SDIP) in 2005 to increase the delivery by SBAs at public health facilities where cash was provided to the women giving birth in public health facilities to help pay their transportation fees. The amount varied according to region, lower in *Terai* and higher in the Mountains. An incentive was also paid to the healthcare providers for each delivery attended, either at home or in the facility, to incentivise attendance.[13] Building on SDIP, the *Aama Surakchhya* (Mother Survival) Program was implemented in 2009 which abolished the fees for safe delivery at public health facilities and SDIP payment to women continued. Women also started receiving extra cash payment if they have done the recommended four Ante-Natal Care (ANC) check-ups, which in turn helped to increase the ANC rate and delivery by SBA in the country. These programs again helped in the reduction of maternal mortality at sub-national and local levels.

The increase in caesarean section rate, particularly in rural areas, helped to decrease the maternal mortality[13]. Establishment of blood bank at district and sub-district level facilities in 2008 and reduction of anemia prevalence among women of reproductive age helped to manage the maternal deaths arising particularly from ante-partum and post-partum hemorrhages. Furthermore, fertility declined significantly from 4.6 to 2.6 child per women between 1996 and 2011

whereas use of modern contraceptive methods increased from 26% to 44% in the same period. These two factors helped in the reduction of maternal mortality as less women were at risk of childbearing.

Recent study based on 1996, 2001, 2006 and 2011 NDHS found the role of governments in upgrading maternity services, and addressing the demand-side barrier as essential but improvement of educational status of women was found to be the main factor for the reduction of maternal mortality in Nepal.[15] Another study based on 2009 NMMMS found a negative correlation between Human Development Index (HDI) and MMR further suggesting that improvement on education, general health and wealth played important roles in the reduction of the maternal mortality.[16] This study also revealed that reduction in fertility and moderate/severe type of anemia and increment in the gender empowerment and age at first birth played vital roles on lowering maternal mortality in Nepal, which was also highlighted in other paper that suggested to deal with wider social problems to tackle the maternal health problems in Nepal.[17]

The main credit for maternal mortality reduction in Nepal goes to the 4,000 plus Skilled Birth Attendants (SBAs) that are certified in certain core midwifery skills and 52,000 plus Female Community Health Volunteers (FCHVs) working actively in the country. These SBAs provided their services even at the lowest static health facility located at rural/remote areas while FCHVs provided counselling to the pregnant mothers regularly at village level. As these FCHVs were constantly in touch with all the pregnant women of the village though the regular meetings of "mothers group", they helped the pregnant women and their family to deliver babies at nearby health facility having SBAs. FCHVs also distributed tablet "Misoprostal" to women's home to reduce the risk of excessive bleeding after home deliveries, which in turn, reduced the maternal deaths due to postpartum hemorrhage in the country.

The maternal mortality will continue to fall in Nepal if the present interventions are sustained but it will soon reach to a "point of inflexion" and further reduction will not be possible.

So, Nepal requires a lot of people with Midwifery skills to achieve the 60% deliveries by SBAs in 2015 and more beyond it. Moreover, it is also required to deploy more skilled SBAs in the rural/remote areas of the country and strengthen the referral system there to improve the transportation of women with medical complications.

Last not the least, it is urgently required to set up a robust data collection mechanism e.g. vital registration / sample registration system with verbal autopsy and periodic surveys to be able to "explain" the reasons behind maternal mortality reduction at local, district, regional and national level and further help to devise and execute new plans, policies and programs.

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CONCLUSION

Estimation of maternal mortality is found to be consistent with the MMR estimates from UN and World Bank estimates. Maternal mortality not only fell at national level but it also declined at sub-national levels.

Maternal mortality declined in the country because of rapid fertility decline and increased contraceptive use and decreased anemia among pregnant women and obstetrics/abortion facilities in all districts of the country after legalization of abortion. Improvement in women's education, empowerment, wealth and living standard were also responsible for declining maternal mortality.

Nepal now needs a robust vital / sample registration system to "explain" the reasons of this decline and further devise and implement new plans, policies and programs at national, sub-national and local levels to sustain this achievement beyond post MDG era.

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