Socio-Demographic and Health Factors Affecting Maternal Mortality in Rural Bangladesh

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Abstract:

The present study examines the impact of non-biological factors such as age, birth-order, education, smoking, anaemia, and tetanus vaccination on maternal mortality using data on maternal deaths collected by Gonoshayastha Kendra (GK) from 592 villages of Bangladesh. The analysis of data reveals that further reduction in maternal mortality is possible in rural Bangladesh through vigorous campaigns against smoking, preventing births to women with four or more children, delaying first time childbearing, prevention and treatment of anaemia, and promoting full doses of tetanus vaccination for pregnant women.

1.0 Introduction

Bangladesh has made significant strides towards achieving the Millennium Development Goals (MDGs), which was formally endorsed in 2000 by 189 member countries of the UN. However, the country's scorecard on maternal health goal falls short of expectation. According to the MDG target, Bangladesh is expected to reduce maternal mortality ratio (MMR) from around 574 maternal deaths due to pregnancy and childbirth-related complications per 100,000 live births in 1990 to 143 by 2015. Despite some progress, only 44 percent of this target was achieved by 2000. An additional 56 percent has to be reduced to achieve MDG target in less than a decade. MMR was estimated to be around 320 per 100,000 live births during 1998-2000 (National Institute of Population Research and Training, et al 2003). An estimated 14,000 Bangladeshi women die from pregnancy and childbirth-related complications per year (UNFPA 2006).

Many of these deaths are related to demographic, social and nutritional conditions, health practices and habits. The paper is an attempt to identify some proximate determinants of maternal deaths, since identification of such factors may lead to a selection of interventions amenable to policy prescriptions for reduction of these deaths from non-biological/ non-medical factors and contribute significantly to achieving the MDG on maternal health.

2.0 Factors Affecting Maternal Mortality

Maternal deaths are examined in relation to demographic factors, socio-economic conditions, nutritional status and health habits and practices. Demographic situations are determined in terms of maternal age and gravidity. Gravidity in this study refers to the number of pregnancies experienced by a woman prior to the death event examined in this study. Socio-economic Status (SES) of a household in this study is determined on the basis of various qualitative and quantitative socio-economic, demographic and health indicators such as occupation of head of the household, dietary intake (calories and protein consumption) of household members, household ownership of land for cultivation and homestead, and domestic animals, fruit trees and household assets, materials used in the construction of roof, wall and floor of the house, accessibility of household to safe drinking water, sanitation, and consumer durables, and proximity of household to the nearest road, to name a few. On the basis of these considerations a village level GK health worker (based upon his or her visits to the household) classifies a household into one of the following five categories: *destitute, very poor, poor, middle class and rich.* However, no quantifiable data has been collected to objectively verify these criteria. In this analysis, socio-economic status of a household is re-grouped into just two categories: (a) poor by merging destitute; very poor and poor; and (b) well off by merging middle class and rich. This re-classification is done keeping in view the small number of cases of maternal deaths and its distribution across socio-economic status (SES). Mother's education was also considered as a proximate determinant of maternal mortality.

3.0 Data and Reliability of Data

The study will be based on a panel data set, in which several cohorts of women were followed from the time of their conception until the outcome of their pregnancies (until 42 days after the delivery). It is extremely rare in the developing country setting to have such unique data set. The panel data consists of those who had conceived and delivered between 15 April 2002 and 14 April 2005. Field level health workers of Gonoshasthaya Kendra (GK) collected the data from 592 villages as part of routine surveillance. GK is one of the largest

service providers in the health sector outside of the Government of Bangladesh. It serves over one million populations in 592 villages geographically spread across the country in 15 districts.

How reliable is the data on maternal mortality collected by GK? Data on maternal mortality is suspect even in developed countries such as Netherlands and the United States. As high as 25% of maternal deaths were not reported in these countries (Smith JC et al 1980, Schuitemaker N et al 1997). Maternal deaths constitute about 25% of deaths among women of reproductive age in developing countries (Royston, E and Armstrong, S 1989), compared to only 14 percent in the GK programme areas. The possibility of under-reporting of maternal deaths cannot be completely ruled out in the GK programme areas, particularly those abortion related deaths, which take place in the early stage of pregnancy. Usually, it takes about 3-months well into pregnancy before a GK worker identifies this. However, every effort was made to minimize this omission. GK health workers meticulously collect all vital events in the GK programme areas; including maternal deaths under close supervision and monitoring of their supervisors and village level Health Committee. All pregnant women are registered and followed for antenatal and post-natal care services by health workers. Moreover, GK local level health workers organize follow-up meetings at the house of the deceased pregnant woman, and discuss with the family members, including the funeral attendees, the possible reason(s) for the death and how this could have been prevented. GK supervisors regularly check with local priests about funeral ceremonies and count new grave(s). Under this watertight follow-up system, it is very unlikely that a maternal death would be missed out of reporting, unless it is purposively or inadvertently done, which is unacceptable unless proven otherwise. An independent evaluation of quality of population data, including maternal death, routinely collected by GK in its programme villages through its field level health workers, was conducted in 10% or 60 of its programme villages by GK Research and Evaluation Division by employing a new batch of interviewers and supervisors in May 2006. Data on maternal deaths collected by this new set of interviewers matched the corresponding data reported by health workers during April 2005-May 2006 in the same 60 villages (Gonoshastha Kendra 2007).This further confirms the reliability of the data on maternal deaths collected by GK.

4.0 Adult Female Mortality

Table 1 presents adult female and maternal deaths in the programme villages of Gonoshayastha Kendra (GK) during 15 April 2002-14 April 2005. There were

616 adult female deaths, yielding an adult female death rate of 0.90 per thousand women in the reproductive ages 15-49 years. Of 616 adult female deaths, 86 or 14 percent of adult female deaths were identified as maternity related, that is, occurring during pregnancy or within 42 days of the pregnancy ending. The comparable figure at the national level was around 35 percent during the 1980s (Ginneken, J.Van, et al 1998), indicating a downward trend in adult female mortality rate over the years. There were 48,362 pregnancy terminations and 46,320 live births, resulting in a maternal mortality ratio of 1.78, per 1000 reported pregnancy termination or 1.86 per 1,000 live births during 2002-05.

Table 1

Distribution of birth, adult female and maternal deaths during the period 15 April 2002 - 14 April 2005.

Group	Population	Deaths	Death rate (per 1000)
Females aged 15-49	684328*	616	0.90
Females with pregnancy termination	48362	86	1.78
Live births	46320	86	1.86

**Refers to total number of women in the reproductive ages (15-49 years) during 2002-05*

Most of the maternal deaths (81.4%) were attributed to direct obstetric causes, particularly post-partum haemorrhage and eclampsia, accounting for 95% of all direct causes (Chauhury, RH and Zafrullah, C 2008). The remaining causes were attributed to factors indirectly related to pregnancy such as age, gravity, socio-economic status, education, smoking, anaemia and tetanus vaccination. This paper examines the gross and net effect of these socio-demographic and health factors on maternal mortality.

5.0 Socio-demographic and Health Factors Affecting Maternal Mortality

Seven hypotheses are posited for verification in this study.

(i) The higher the chances of pregnancy among younger and older women, the higher the risk of their death due to maternal/childbirth related complications.

(ii) The higher the chances of pregnancy among women with many children (4 or more) and women experiencing first time childbearing, the higher

the risk of their death due to maternal/childbirth related complications, compared to those with 2-3 children.

(iii) The higher the socio-economic status of a pregnant woman, the lower the chances of her death due to maternal/childbirth related complications.

(iv) The higher the level of education of a pregnant woman, the lower the chances of her death due to maternal/childbirth related complications.

(v) The higher the level of anaemia of a pregnant woman, the higher the chances of her death due to maternal/childbirth related complications.

(vi) The greater the frequency of smoking by a pregnant woman, the higher the chances of her death due to maternal/childbirth related complications.

(vii) The higher the chances a pregnant woman has been vaccinated against tetanus, the lower the chances of her death due to maternal/childbirth related complications.

The justifications for postulating each of these hypotheses are elaborated in sub-sections 5.1-5.7.

The effect of socio-demographic factors on MMR is examined at bi-variate and multi-variate levels. At the bi-variate level simple two-way relationships are examined between MMR and socio-demographic variables and the findings are presented in Table 2. At the multi-variate level, net effect of a socio-demographic variable (independent variable) on MMR (dependent variable) is examined by taking into account the effect of other socio-demographic and health-related variables (i.e. age, gravidity, socio-economic status, education, smoking, anaemia and tetanus), using a logistic regression specification:

$$\ln\left(\frac{p}{1-p}\right) = \vec{X}\vec{\beta} + \varepsilon \qquad (1)$$

Where:

p is the relative frequency of MMR in the i^{th} sample
X is a vector of independent variables (age, gravidity, socio-economic status, anaemia, tetanus, and smoking status)
β is the corresponding vector of coefficients
ε is the stochastic disturbance term

Equation (1) is estimated using the Generalized Least Square (GLS) estimator.

Regression results are presented in Table 3, in which the coefficients are expressed as deviations from the omitted category.

5.1 Demographic Factors:

5.1.1 Maternal Mortality and Age

One would expect to find a U-shaped relationship between age and maternal mortality (MMR), in which MMR is expected to be very high among high-risk very young and older child bearers. Data in Table 2 in general tend to support this hypothesized relationship, particularly at older ages. The risk is relatively higher among mothers under 30. Thereafter, the risk of maternal mortality increases sharply and reaches its highest at age 40 and above. However, when the net effect of age on MMR is examined by taking allowance of the correlations of other independent variables (gravidity, mother's education, smoking status, tetanus vaccination, socio-economic status, and anaemia) with age and dependant variable (MMR), the relationship turns weak and statistically insignificant (See regression results in Table 3). As expected, the regression results show that younger, middle-aged and older women aged 15-19, 30-39 and 40 and above have higher chances of maternal mortality, compared to women aged 20-29. The chances of death of adolescent (15-19 years), middle-aged (30-39 years) and older mothers (40 years and above) are 1.11, 1.10 and 1.82 times higher, compared to women aged 20-29. But the differences are not statistically significant (see Table 3).

5.1.2 Maternal Mortality and Gravidity

Gravidity in this study refers to the number of pregnancies experienced by a woman prior to the birth and death event examined in this study. All pregnancies are at risk. However, the risk is unusually high among women experiencing first time childbearing and women with many pregnancies. Data in Table 2 confirm the expected association between gravidity and risk of maternal mortality. MMR is relatively higher among women experiencing their first childbearing episodes, compared to women with 1-2 previous pregnancies. The rate falls sharply for women with 1-2 previous pregnancies. Thereafter, it rises very high, reaching its highest among women with 3 or more gravidities. This U-shaped relationship between gravidity and MMR still holds, even when allowance is made of the relationship of gravidity with other independent variables and maternal mortality (see regression results in Table 3). Regression result shows that chances of death of mothers with no previous pregnancies and 3 or more previous pregnancies prior to the current pregnancy are 2.29 and 2.25 times higher, compared to mothers with 1-2 previous pregnancies. These differences are statistically significant (see Table 3).

5.2 Social Factors

5.2.1 Socio-economic Status (SES) and Maternal Mortality

Socio-economic Status (SES) of a household in this study is determined on the basis of various qualitative and quantitative socio-economic, demographic and health indicators (for details, see section 2). SES of a household is likely to be inversely associated with MMR because mothers of well-off households are expected to be more aware of life threatening risks of pregnancies than mothers of poor households. The former is also more likely to access and utilize antenatal and post-natal care services than the latter because of their greater awareness and affordability. This is also indirectly supported by data in Table 2, which shows higher MMR for women of poor SES background, compared to women of well-off SES background. However, this relationship is not statistically significant (i.e., chances of death of mothers with higher SES are not significantly different from mothers with poor SES background) when allowance is made for other factors, which are related to both SES and MMR (see Table 3).

5.2.2 Maternal Education and Maternal Mortality

One would expect to find an inverse relationship between the education of the mother and maternal mortality. An educated pregnant woman is more likely to be aware of the complications of pregnancies and their consequences on life. Therefore, she is expected to better manage her pregnancy in terms of seeking and utilizing antenatal and postnatal care services than her counterpart who has little or no formal education. Utilization of medical advice and services is also likely to be higher among mothers with formal education than their counterparts with no formal education as the former is likely to read and follow medical instructions more carefully than the latter. One would therefore expect to find an inverse relationship between education and maternal mortality. The higher the level of education, the lower the level of maternal mortality. Data in Table 2 show an unexpected relationship between maternal mortality and her level of education, in which maternal mortality shows a positive relationship with education. The picture, however, reverses when allowance is made for other variables (see regression results in Table 3), which are related to mother's education and maternal mortality. The net effect of maternal education shows an inverse relationship with maternal death. Mothers with no formal education are 1.24 times more likely to die due to pregnancy and childbirth-related complications, compared to mothers who have some education. But the difference is not statistically significant.

5.3 Health Factors

5.3.1 Tetanus and Maternal Mortality

Tetanus is a life-threatening disease, for which there is a little or no treatment. However, this can be prevented through tetanus vaccination. A pregnant mother is more vulnerable to this deadly disease, particularly when delivery takes place in poor sanitary conditions as in many developing countries, including Bangladesh. It is a common practice in Bangladesh, particularly in rural areas, to cut the umbilical cord using non-sanitary (unclean) steel blade or blade made of bamboo and paste a mixture of ashes and cow dung on the cord. These unhygienic practices expose a pregnant woman to higher risk of tetanus infection. Moreover, home, which still remains the place of delivery for the absolute majority of women, particularly rural women, is mostly in a state of poor sanitary conditions. This may also expose a rural pregnant woman to tetanus infection during postpartum period. Data in table 2 confirm a considerably higher MMR for pregnant women who were not vaccinated against tetanus, compared to those who were vaccinated. This finding still holds even when allowance is made for other variables, which are related to tetanus vaccination as well as MMR (see regression table 3). Regression result shows significantly lower chances of MMR among women who were vaccinated, compared to those who were not vaccinated. Mothers who were vaccinated are 0.18 times less likely to die, compared to mothers who were vaccinated.

5.3.2 Anaemia and Maternal Mortality

Very often women become anaemic during pregnancy due to increase in demand for iron and other vitamins. The mother must increase her production of red blood cells to meet the needs of the foetus and the placenta. Foetal iron metabolism is completely dependent on maternal iron diet i.e. iron transport from the placenta. In order to have enough red blood cells for the foetus, the body starts to produce more red blood cells and plasma. It has been estimated that the blood volume increases approximately 50 percent during pregnancy, although the plasma amount is disproportionately greater. This causes dilution of the blood, making haemoglobin concentration fall, reaching its lowest between 25 and 30 weeks unless treated with iron supplementation. Fall in haemoglobin level below normal level may expose a pregnant woman to higher risk of death. Anaemia status of a pregnant woman in GK programme villages is determined by visual examination of eyes with Sahli's Haemoglobinometer during ANC visit by health workers and is categorized into: (1) normal to very mild, and (2) moderate to severe. Data in Table 2 confirm this connection between haemoglobin level and maternal mortality, in which women with moderate to severe anaemia have considerably higher MMR, compared to women with normal to mild anaemia. The

bi-variate relationship observed between anaemia level and maternal mortality still holds, even when allowance is made for other variables which have bearing on both independent (anaemia) and dependent (MMR) variables, as the result of regression analysis shows (see Table 3). Pregnant women with moderate to severe anaemia are 35.45 times more likely to die, compared to pregnant women with normal to mild anaemia. And this difference is found to be statistically significant.

5.3.3 Smoking and Maternal Mortality

Smoking is injurious to health and is strongly associated with many life-threatening diseases such as cancer and various coronary diseases. Smoking may increase blood pressure and can expose a pregnant woman to higher risk of death by further aggravating pregnancy-induced hypertension. Coma and convulsions associated with pregnancy-induced hypertension take a large toll of maternal deaths in Bangladesh (National Institute of Population Research and Training, et al 2003). One would, therefore, expect to find higher MMR among mothers who smoke than those who do not smoke. This is also borne out by data both at bi-variate and multi-variate levels. Data in Table 2, which examine the two-way relationship between smoking and MMR show that women who smoke have considerably higher MMR, compared to women who do not smoke. This two-way relationship between MMR and smoking still holds even when allowance is made of other independent variables, which are related to both MMR and smoking (See Table 3). Pregnant women who smoke are 14.17 times more likely to die, compared to women who do not smoke and this difference is found to be highly significant.

Table 2

Reproductive and Biosocial Factors Affecting Maternal Mortality Ratio

	Variable	Maternal Mortality Ratio
Age of Mother	15-19	145.2
	20-29	143.2
	30-39	333.3
	40+	589.9
	Total	**186**
Gravidity (Number of previous pregnancies)	0	175.2
	1-2	98.8
	3-4	351.9
	5-8	458.2
	Total	**186**
Socio-economic status	Very poor	280.7
	Poor	200.6
	Well-off	110.9
	Total	**186**
Vaccination (TT)	Vaccinated	144.4
	Not vaccinated	150.3
	Total	**186**
Status of Smoking	Yes	306
	No	126.3
	Total	**186**
Maternal education	No education	183
	Some education	192
	Total	**186**
Anaemia	Normal to very mild	124
	Moderate to severe	243
	Total	**186**

Table 3

Logistic Binary Regression Model of Determinants of Maternal Mortality (Chances of Survival of Pregnant Women)

Independent Variable	Regression Coefficient	Significance Level
Age of mother		
20-29	-	-
15-19	1.11	0.80
30-39	1.10	0.52
40+	1.82	0.17
Gravidity (Previous pregnancies)		
1-2	-	-
0	2.29	0.009
3 and over	2.25	0.009
Mother's education		
Some education	-	-
No education	1.24	0.410
Smoking Status		
Not Smoking	-	-
Smoking	14.17	.000
Immunization against tetanus toxoid		
Not Immunized	-	-
Immunized	-.184	.000
Economic Status		
Very Poor & Poor	-	-
Well-off	-0.82	0.578
Anaemia (haemoglobin) Level		
Normal to very mild	-	-
Moderate to severe	35.45	0.000

6.0 Policy Lessons

The findings clearly point out to the need for preventing smoking, discouraging births to women with four or more children, delaying births to primigravidas, treatment of aneamia, and promotion of full doses of tetanus vaccination for pregnant women. These factors will help to significantly reduce maternal mortality.

Prevention of smoking will require, among other things, an all-out campaign against smoking using electronic and print media, mobilizing support of national and local leaders, including community and religious leaders to speak against smoking in public fora, and imposing heavy duties/taxes on tobacco products. Consideration should also be made to include lessons on adverse health consequences of smoking in school curricula.

Prevention of births to women with 4 or more children and delaying births to primigravidas (i.e. first time pregnant women), particularly the former still remains a major challenge to reduction of maternal mortality in rural Bangladesh. Among currently pregnant women, about 41 percent are with 4 or more children and 17 percent are primigravidas (National Institute of Population Research and Training, et al 2005). A massive information, education and communication campaign is needed to raise awareness among all concerned, particularly husbands, mother-in-laws and married women of the adverse consequences of pregnancy on the lives of women with multiple children and among first time pregnant women. Mothers with 4 or more children should be encouraged to accept terminal methods of family planning to stop having babies, while married women without previous pregnancies should be encouraged to accept temporary methods to delay pregnancies beyond age 19. The use of terminal methods in Bangladesh is low (female sterilization-5.0%, male sterilization- 0.7%) and also declining in recent years (National Institute of Population Research and Training, et al 2007). The unmet need for family planning, defined as fecund women who are currently married and who say either that they do not want any more children or that they want to wait two or more years before having another child, but are not using contraception, is also very high (19.8%) among currently married adolescent women (National Institute of Population Research and Training, et al 2007). Government should promote and ensure availability of terminal methods to high parity women and temporary methods of contraceptives to younger women. NGOs can also play a leading role in this respect. Consideration should also be given to include lessons on adverse health consequences of pregnancy for women with high parity and first time pregnant women into formal and non-formal school curricula.

Reduction of anemia is another major challenge to reduction of maternal mortality. Fifty-nine percent of pregnant and lactating women are anaemic in rural Bangladesh (Dhaka University 1998). In most cases, anaemia is a consequence of malnutrition, i.e., inadequacy of required nutrients in the diet or inability to properly absorb the food a person consumes. The nutrient

deficiencies, which are directly related to anaemia are iron, vitamin, riboflavin, folic and other micro-nutrients. The prevention and treatment of anaemia will call for providing iron-folic-acid tablets to anaemic pregnant women. Consideration should be given to fortification of community-consumed food as a means of improving the micro-nutrient intake of iron and foliates among pregnant and lactating women. There is a need to promote nutrition education among family members, particularly a need for additional nutrients and a balanced diet for a pregnant woman. In Bangladesh a woman generally is the last family member to eat after feeding every one else in the family. In many poor households with constrained food consumption to begin with, very little is left over to eat by the time it is the mother's time to eat. Family members should be educated to discontinue this practice by allowing pregnant women to rather eat first. In the long-run, it is necessary to improve the nutrition of the girl child by promoting her value.

Considerable progress has been made with regard to tetanus vaccination coverage of pregnant women in Bangladesh. Four out of five currently pregnant women are reported to have received tetanus vaccination for the last pregnancy (National Institute of Population Research and Training, et al 2003). The coverage of tetanus vaccination, however, needs to be further improved in order to bring about a significant reduction in maternal mortality. This can be achieved, to a great extent, by meeting the unmet need for tetanus vaccination of the rural population, particularly the poorer section of the population who fall far behind the national average in receiving antenatal care. Targeted care to poor mothers must be made through external efforts by all concerned to motivate and encourage them to use maternal health services.

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