Determinants of Antenatal Morbidity: A Multivariate Analysis

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Abstract

Objectives: The aim of this paper was to investigate the potential risk factors for developing complications and their magnitude during the antenatal period. Methodology: The data used in this paper came from a prospective survey in rural areas of Bangladesh conducted by the Bangladesh Institute of Research for Promotion of Essential and Reproductive Health and Technologies (BIRPERHT) between November 1992 and December 1993. The differential patterns were analyzed for respondents' selected characteristics, and multivariate analysis was performed employing logistic regression and proportional hazards models for life-threatening and high-risk complications during pregnancy. **Results:** For life-threatening complications during pregnancy, several factors emerged as potential risk factors, such as number of the pregnancy, age at marriage, duration of pregnancy, economic status and history of anemia prior to the index pregnancy. The last two covariates were associated only in the proportional hazards. Potential risk factors for high-risk complications during pregnancy were level of education, age at marriage, wanted pregnancy, duration of pregnancy and economic status.

Conclusions: Health planners and policy makers in developing countries are trying to facilitate health services at the doorsteps of rural people. Our findings will help them understand the magnitude and underlying determinants of maternal morbidities and help their health planning process to reduce both life-threatening and high-risk complications during the antenatal period. Early age at marriage needs to be prevented through encouragement of girls' education as well as through increased social awareness programs. An effective quick referral mechanism should be developed to provide emergency services to high risk-groups. Finally, the importance of additional food supplements needs to be promoted during antenatal care visits as well as through mass media in order to reach people living in remote areas of rural Bangladesh.

1. Introduction

Reducing maternal mortality is one of the major goals of several recent international conferences and has been included in the Millennium Development Goals. The estimated number of maternal deaths worldwide in 2000 was 529,000, and an overwhelming majority of those deaths take place in developing countries (WHO et al. 2004). Various studies have identified a relationship between maternal morbidity and mortality and socio-economic factors related to this morbidity (Fortney and Smith 1999; Jejeebhoy 1997; Okolocha et al. 1998). However, far less is known about the magnitude, dimension and determinants of maternal morbidity among women in developing countries such as Bangladesh (BRAC 1994). Rochat et al. (1981) reported that 26% of all pregnancy-related deaths were attributable to induced abortion. Several studies demonstrated that the most important causes of maternal death in rural Bangladesh were eclampsia, septic abortion, postpartum sepsis, obstructed labour, and antepartum and postpartum hemorrhage (Rochat et al. 1981; Khan et al. 1986; Koenig et al. 1988; Bhuiyan and Hussain 1995). It was observed that prior to death, 42% of the pregnancies were attended by traditional practitioners and 33% were not attended at all (Fauveau et al. 1989; Goodburn et al. 1995). In another study, Koblinisky et al. (1993) reported that the number of acute morbidities related to childbirth could be as many as 67 episodes for every maternal death in a country such as Bangladesh.

These results indicate that women do not receive adequate healthcare during pregnancy or delivery. Bhatia (1995) showed that in India, 18% of the women reported problems during the antenatal period and an equal proportion during delivery. In another study, conducted in South India, Bhatia and Cleland (1995) found that 33% of women reported at least one problem; the most common problems were weakness, anemia and lower abdominal pain. Bhatia (1993) also indicated that levels of maternal mortality in India were very high.

It is worth noting that maternal health is greatly affected by lack of adequate nutritional intake. Kulier et al. (1998) showed that nutritional interventions such as calcium supplementation during pregnancy reduce the risk of high blood pressure and pre-eclampsia. Similarly, iron and folate supplementation can reduce the incidence of low pre-delivery hemoglobin. Manual work and poor nutrition are certainly associated with the risk of prematurity and some of the medical complications of pregnancy. Incomes, type of housing, type of family, age at marriage, gainful employment and maternal education have a direct relationship with pregnancy and its outcome (Bhargava et al. 1991). It was also observed that women's health and well-being were most influenced by unwanted pregnancies and multiparities that led to greater harm than the occasional side effects of some of the contraceptives (Ray 1995).

The information on maternal morbidities at the community level in Bangladesh is scant. Several hospital-based or cross-sectional studies are available, and most of them focus on maternal mortality (Rochat et al. 1981; Khan et al. 1986; Fauveau et al. 1989; Chen et al. 1974; Obaidullah et al. 1981; Akhter et al. 1996). However, hospital-based studies are not representative samples of the community, because most rural pregnant women do not visit such facilities (Fortney and Smith 1999; Bhatia 1995). Cross-sectional surveys need very large samples to capture all the conditions as they vary during the gestation period. Prospective studies are an ideal approach in these situations, though very costly and time-consuming. In 1994, the Bangladesh Rural Advancement Committee

(BRAC), in collaboration with the London School of Hygiene and Tropical Medicine, undertook a prospective study on postpartum morbidity and its relationship to delivery practices. They identified that postpartum morbidities were very common in the community. So far, few prospective studies are available on maternal morbidity in different countries. Chakraborty et al. (2003a), using the multiple-decrement life table technique, reported the likelihood of high-risk disease conditions that women experience during the antenatal period for different age categories from the same data set. The objective here is to identify the selected background and demographic characteristics that influence life-threatening and high-risk complications during the antenatal period and the magnitude of antenatal morbidities, using the longitudinal data set on maternal morbidity from Bangladesh.

2. Methods

This paper is based on the data from the survey on Maternal Morbidity in Bangladesh, conducted by the Bangladesh Institute of Research for Promotion of Essential and Reproductive Health and Technologies (BIRPERHT). Data collection spanned the period November 1992 to December 1993. The study was conducted after securing necessary permission from the Institutional Ethics Committee known as the Human Subjects Committee of the BIRPERHT.

Sampling

A multi-stage random sampling was employed to collect data on maternal morbidity. One district from each of four divisions was selected in the first stage. In the second stage, one *thana (a thana is comprised of several unions, giving a population size of 0.2-0.25 million)* from each selected district was selected randomly. Finally, two unions (unions are comprised of several wards, which are small geographical areas comprised of villages in rural areas) from each selected *thana* constituted the study area. For the prospective study, 1020 pregnant women (pregnancy less than 6 months) were interviewed. Prospective subjects were followed up, on average once a month, through full-term pregnancy, delivery and until 90 days postpartum or 90 days after any other pregnancy outcome. Information on socio-economic, background, pregnancy-related care and practice, extent of morbidity during the index pregnancy, delivery, and postpartum period or abortion was collected. Of 1020 women, 993 had at least one antenatal follow-up and 1005 had information available on pregnancy termination. Finally, 1006 had at least one postpartum follow-up. Details regarding data collection, sampling and the questionnaire are presented in a published report (Akhter and Chowdhury 1996; Islam and Chowdhury 2006).

Outcome variables

In this study, all major types of morbidity during the antenatal period are taken into account as outcome variables of interest on the basis of the published literature (Chakraborty et al. 2002; Chakraborty et al. 2003a). Different morbidities were observed for each subject during the follow-up period: hemorrhage, fits/convulsion, edema, excessive vomiting, cough or fever for more than 3 days. We did not consider other morbidities due to their very high proportion. For our analysis, we considered two binary variables: (i) life-threatening complications (hemorrhage, fits and convulsion), and (ii) high-risk complications (edema, excessive vomiting, and cough/fever for more than 3 days). For this paper, we considered the first-time occurrence of any morbidity during antenatal visits.

Covariates

To identify potential risk factors, we considered the following variables: education (no education = 0, primary [1–5 years education] = 1, & secondary and above [6 years or more] = 2); economic status (low [if roof of the house is made of bamboo/straw] = 0, & high [if roof is made of C.I. sheet/cement/tally] = 1); gainful employment (no = 0, & yes = 1); special food for pregnancy (no = 0, & yes = 1); age at marriage (15 years or less = 0, & more than 15 years = 1); number of pregnancies excluding current one (no pregnancy = 0, 1–4 = 1, & 5+ = 2); pregnancy wanted (no = 0, & yes = 1); anemia before pregnancy (no = 0, & yes = 1) and STD before pregnancy (no = 0, & yes = 1).

The cut-off points for independent variables were chosen based on those suggested in the literature (Chakraborty et al. 2002; Chakraborty et al. 2003a, 2003b; Islam et al. 2006).

Limitations of the Study

The study was conducted about 15 years ago but was longitudinal in nature, which gives better insight about the morbidities that occur at phases of the antenatal period. The sample size does not permit analyzing data more efficiently for some of the variables due to small cell frequencies. The number of follow-ups is not equal for each respondent due to the variation in entry time in the survey, which complicates the analysis to some extent. Although this survey was old, it was very extensive in order to cover different aspects of maternal morbidities. Since data collection, the socio-economic status of people in rural areas has not improved substantially; hence the findings of the study still have important policy implications of scientific merit.

Table 1. Distribution of respondents by background characteristics (*N* = 993)

Characteristics	%	*n*
Education		
No education	54.8	544
Primary	28.4	282
Secondary and above	16.8	167
Economic status		
Low	79.9	793
High	20.1	200
Special food for pregnancy		
No	74.8	743
Yes	25.2	250
Age at marriage		
Less than or equal to 15 years	65.1	646
More than 15 years	34.9	347
Number of pregnancies		
No pregnancy	27.1	269
1–4	57.1	567
5+	15.8	157
Wanted pregnancy		
No	31.6	314
Yes	68.4	679
Anemia before pregnancy		
No	38.6	383
Yes	64.4	610

Note. Some of the *n*'s may not add to the total due to missing values.

3. Results

Table 1 shows the distribution of respondents' background characteristics. It is clear that a majority had no formal education (54.8%), while a little more than one quarter had primary education and about one sixth had secondary or higher. As expected, an overwhelming majority of the respondents (79.9%) reported low economic status and less than one third were employed (not shown). The majority were married before they were 16 years of age (65.1%), indicating that most rural women marry at a very young age and are exposed to a number of health risks due to early initiation of

childbearing. Most (74.8%) received no special food during pregnancy. The index pregnancy was the first for 27.1% of the women, while a majority (57%) had experienced 1–4 pregnancies and 15.8% reported having had 5 or more pregnancies prior to the index pregnancy. Among respondents, 68.4% had wanted the index pregnancy. History of previous complications showed that 64.4% had anemia before the pregnancy.

Table 2 displays the distribution of respondents by reported duration of pregnancy and level of complications – life threatening or high risk. It is surprising to note that a very high proportion of respondents reported these complications during the first trimester, but levels declined steadily in subsequent trimesters.

Table 2. Percent distribution of respondents for life-threatening and high-risk complications at different antenatal follow-ups

Follow-up Number	Morbidities									
	Life-Threatening Complications				High-Risk Complications				Total *N*	
	No		Yes		No		Yes			
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
1	804	24.1	188	38.0	562	22.7	430	31.9	992	25.9
2	786	23.6	131	26.5	631	25.4	286	21.2	917	24.0
3	687	20.6	84	17.0	532	21.4	239	17.8	771	20.1
4	549	16.5	45	9.1	405	16.3	189	14.0	594	15.5
5	340	10.2	30	6.1	231	9.3	139	10.3	370	9.7
6	135	4.1	13	2.6	99	4.0	49	3.6	148	3.9
7	31	0.9	3	0.6	21	0.8	13	1.0	34	0.9
8	0	0.0	1	0.2	0	0.0	1	0.1	1	0.0

Note. Some of the *n*'s may not add to the total due to missing values.

Table 3 shows the percentage of respondents with life-threatening and high-risk complications, by characteristic. As expected, the percentages of high-risk complications are much higher than those of life-threatening complications. There were few cases of fits or convulsion, but due to a higher number of excessive-bleeding cases (termed hemorrhage here), the percentage of life-threatening complications appears to be higher than expected. On Table 3, a significant negative association between level of education and prevalence of life-threatening complications is clearly evident, and although a similar pattern is observed for high-risk complications, it does not appear to be significant. It is quite surprising that economic status seems positively associated with high-risk complications. Special food for pregnant women seemed to have decreased the extent of life-threatening complications significantly. As expected, lower age at marriage is associated with higher prevalence of both life-threatening and high-risk complications. On the other hand, life-threatening complications are positively associated with number of pregnancies. If the pregnancy is desired, then it is likely that the prevalence of both types of complications would be reduced significantly. It is also observed that prior history of anemia increases the prevalence of life-threatening complications significantly.

Multivariate Analysis

To identify the net effects of the selected socio-economic, demographic and medical characteristics on antenatal complications, we employed both logistic regression and proportional hazard models. For each type of complication, one logistic and one proportional hazard model is used.

The occurrence of life-threatening complications is significantly associated with first-time pregnancy (no prior pregnancies) compared with 1–4 prior pregnancies (reference category), higher age at marriage, and duration of pregnancy (second trimester and third trimester compared to first trimester). All these associations indicate that prevalence of life-threatening complications decreases for respondents with no prior pregnancy compared with those with 1–4 prior pregnancies, age at marriage greater than 15 years compared with lower age, and duration of pregnancy to the second or third trimesters compared with the first (Table 4).

Table 3. Differential patterns of complications reported during antenatal period, by background characteristics (*N* = 993)

Characteristics	Prevalence of Complications		
	Life-Threatening Complications	High-Risk Complications	*n*
Education	**		
No education	28.86	63.05	544
Primary	21.63	62.76	282
Secondary and above	18.56	53.29	89
Economic status		*	
Low	24.46	59.65	793
High	27.50	68.00	200
Special food for pregnancy	*		
No	26.51	62.45	743
Yes	20.80	58.00	250
Age at marriage	**	**	
Less than or equal to 15 years	28.64	64.71	646
More than 15 years	18.44	55.04	347
Number of pregnancies	**		
No pregnancy	17.10	57.25	269
1–4	27.69	62.61	567
5+	29.30	63.69	157
Wanted pregnancy	**	**	
No	30.57	68.79	314
Yes	22.53	57.88	679
Anemia before pregnancy	**		
No	19.58	58.22	383
Yes	28.52	63.28	610

Notes. χ^2 was used to test association.
Some of the *n*'s may not add to the total due to missing values.
* Significant at 5% level. ** Significant at 1% level.

Similar findings are observed (Table 4) for high-risk complications. Their prevalence is observed to have negative associations with secondary or higher level of education compared with no education, age at marriage greater than 15 years compared with lower age, desired pregnancy, and pregnancy duration to the second and third trimesters compared with the first.

To consider the outcome variables as function of duration, we used the proportional hazards model for examining the relationships with selected covariates. We observed slight changes in results for both life-threatening and high-risk complications (Table 5). In the new model, based on duration of occurrence of life-threatening complications, age at marriage greater than 15 years is negatively associated as in the logistic regression model, but positively associated with economic status and history of anemia before the pregnancy. Similarly, for high-risk pregnancy complications, economic status is positively associated, while there is a negative association with wanted pregnancy.

Table 4. Logistic regression analysis for life-threatening complications (yes = 1) and high-risk complications (yes = 1)

Characteristics	Life-Threatening Complications				High-Risk Complications			
	Coefficient	OR	95% CI		Coefficient	OR	95% CI	
Education								
No education	0.000	1.00			0.000	1.00		
Primary	-0.435	0.65	0.404	-1.036	-0.207	0.81	0.544	-1.214
Secondary and above	-0.278	0.76	0.408	-1.403	-0.622*	0.54	0.323	-0.893
Number of previous pregnancies								
No pregnancy	-0.928**	0.40	0.238	-0.657	-0.303	0.74	0.487	-1.120
1–4 pregnancies	0.000	1.00			0.000	1.00		
5 or more pregnancies	-0.157	0.85	0.463	-1.578	-0.372	0.69	0.407	-1.169
Age at marriage (>15 years = 1)	-0.707**	0.49	0.315	-0.774	-0.430*	0.65	0.451	-0.937
Economic status (high = 1)	0.283	1.33	0.803	-2.194	0.354	1.42	0.907	-2.237
Anemia before pregnancy (yes = 1)	0.259	1.30	0.842	-1.993	0.165	1.18	0.823	-1.689
Wanted pregnancy (yes = 1)	-0.424	0.65	0.403	-1.063	-0.562**	0.57	0.376	-0.864
Special food for pregnancy (yes = 1)	-0.269	0.76	0.474	-1.233	0.002	1.00	0.672	-1.494
Duration of pregnancy								
1–3 months	0.000	1.00			0.000	1.00		
4–6 months	-1.385**	0.25	0.130	-0.482	-1.357**	0.26	0.125	-0.530
7 or more months	-5.081**	0.01	0.003	-0.013	-4.220**	0.01	0.007	-0.031
Constant	2.387**				3.597**			
Model Chi-square (p-value)	494.020 (0.000)				463.175 (0.000)			

OR = odds ratio. CI = confidence interval.
* Significant at 5% level. ** Significant at 1% level.

4. Conclusion

This paper examines the potential risk factors for developing complications during the antenatal period from a prospective study in rural areas of Bangladesh. For life-threatening complications during pregnancy, several factors emerged as potential risk factors, such as number of the pregnancy, age at marriage, duration of pregnancy, economic status and history of anemia prior to the index pregnancy. The last two covariates were observed to be associated only in the proportional hazards model. Similarly, potential risk factors for high-risk complications during pregnancy are level of education, age at marriage, wanted pregnancy, duration of pregnancy and economic status. In

general, the prevalence of different complications was very high and, in particular, the prevalence of life-threatening complications during pregnancy was relatively higher than those of a cross-sectional study in Bangladesh (Akhter and Chowdhury 1996). The high prevalence of these complications in rural Bangladesh indicates the poor safe-motherhood situation. High-risk conditions such as edema, fever for more than 3 days and excessive vomiting are also generally more prevalent among women in rural Bangladesh. However, there might be some over-reporting of the high-risk conditions during pregnancy.

Table 5. Cox regression analysis for life-threatening complications (yes = 1) and high-risk complications (yes = 1)

Characteristics	Life-Threatening Complications				High-Risk Complications			
	Coefficient	RR	95% CI		Coefficient	OR	95% CI	
Education								
No education	0.000	1.00			0.000	1.00		
Primary	-0.281	0.76	0.559	-1.021	0.016	1.02	0.845	-1.223
Secondary and above	-0.257	0.77	0.509	-1.174	-0.141	0.87	0.673	-1.120
Number of previous pregnancies								
No pregnancy	-0.300	0.74	0.524	-1.046	0.020	1.02	0.835	-1.246
1–4 pregnancies	0.000	1.00			0.000	1.00		
5 or more pregnancies	-0.124	0.88	0.618	-1.262	-0.124	0.88	0.694	-1.123
Age at marriage (>15 years = 1)	-0.396**	0.67	0.502	-0.903	-0.162	0.85	0.713	-1.015
Economic status (high = 1)	0.325*	1.38	1.015	-1.887	0.287**	1.33	1.092	-1.625
Anemia before pregnancy (yes = 1)	0.334*	1.40	1.056	-1.847	0.089	1.09	0.921	-1.298
Wanted pregnancy (yes = 1)	-0.255	0.78	0.585	-1.026	-0.264**	0.77	0.639	-0.923
Special food for pregnancy (yes = 1)	-0.175	0.84	1.056	-1.847	-0.075	0.93	0.765	-1.125
Model Chi-square (p-value)	35.490 (0.000)				21.972 (0.009)			

RR = risk ratio. CI = confidence interval.
* Significant at 5% level. ** Significant at 1% level.

We observed that past history of complications (anemia before pregnancy) is positively associated with complications during pregnancy, which was confirmed in other studies, as well (Bhatt 1995). The risk of developing complications increased during the first pregnancy, in an unwanted pregnancy, in women of lower age at marriage, with less education and in those who ate no special food during the antenatal period. Other studies found similar relationships in India (Bhargava et al. 1991; Ray 1995; Choolani and Ratnam 1995; Rao 1995). In rural Bangladesh, pregnant women do not have easy access to adequate antenatal care. In addition, there is an acute shortage of efficient healthcare facilities and providers. Hence, the problems accumulate, and in the absence of an effective referral system, they become more complex. Due to lack of awareness, women lack the nutritional intake necessary during pregnancy and thus suffer from avoidable causes of morbidity at a much higher rate than expected. Some important policy measures that emerged from the findings of the study are listed below.

Both life-threatening and high-risk complications during the antenatal period are associated with rural women's lower age at marriage. If marriage takes place at a very early age, childbearing also

starts at a relatively younger age, resulting in complications during the antenatal period. Early age at marriage needs to be prevented through encouraging girls' education as well as through increased social awareness programs. In fact, to encourage girls' primary and secondary education, the government introduced a nationwide stipend program for girls in secondary schools, and it has resulted in increased girls' enrolment (Raynor and Wesson 2006). As girls without much education tend to marry early, the increase in education could effectively increase their age at marriage, because these are positively associated.

First pregnancy always involves some risks, particularly if the pregnancy occurs at an early age. Antenatal services provided at the grassroots level need to emphasize the first pregnancy and follow-up visits during that pregnancy in order to identify both life-threatening and high-risk complications. In addition, an effective quick referral mechanism should be developed to provide emergency services to this high-risk group. In Bangladesh, there is a change from community-based outreach services to static clinics for service delivery of clinical and non-clinical needs, antenatal care, postnatal care, etc. Women with first pregnancies at a young age can be given special attention in order to provide them with necessary care, and a referral system can be developed to provide better healthcare facilities in emergencies.

A substantial proportion of unwanted pregnancies can be reduced by promoting family planning programs for the target group who want to either space births or end childbearing permanently. Bangladesh has a successful family planning program that can address unmet needs for pregnancies in the high-risk group, and this can reduce both life-threatening and high-risk complications significantly. The importance of food supplements needs to be promoted during visits for antenatal care as well as through mass media in order to reach people living in remote areas of rural Bangladesh.

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