

Utilization of Antenatal Care, Skilled Birth Assistant and Institutional Delivery in Bangladesh

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(Received: 30 May 2017 ; Accepted : 31 October 2017)

Abstract

Maternal mortality is an important phenomenon to assess the overall health status of a society. To reduce maternal mortality the worldwide recognized vital three factors are: antenatal care, presence of skilled birth assistance and selection of place of delivery. This study made an initiative to identify potential risk factors which can influence the three factors employing the Bangladesh Demographic and Health Survey (BDHS), 2014 data. The parameters are estimated using Poisson count model and Logistic regression model. The estimation results indicate that mother's education level, place of residence, mother's age at birth, wealth index, husband's education level, media exposure and region are significant factors for antenatal care visits. The significant factors for skilled birth assistance are mother's education level, place of residence, wealth index, media exposure and husband's education level where as place of residence, mother's education level, wealth index, media exposure and husband's education level are significant factors for selection of place of delivery. These results may help the policy makers to develop policies that may facilitate the reduction of maternal mortality in Bangladesh.

Keywords: Antenatal care, Skilledbirth assistance, Place of delivery, Poisson count model, Logistic regression model.

I. Introduction

The degree of socio-economic development of a country is reflected by its maternal mortality rate (MMR). Every year many mothers die because of pregnancy related complications as they do not have proper consciousness about the care of pregnancy period. Besides many are dying at the time of delivery because of their reluctance of giving institutionalized delivery provided with necessary medical facilities. According to the world health statistics¹, MMR per 100,000 live births was estimated at 216 globally in the year 2015. Most of these deaths occur in the developing countries¹. Thus as a developing country, maternal mortality deserves a high attention from the government as well as from the researchers of Bangladesh. When a woman dies in the process of giving birth of a child, her child and survival of any other children are endangered seriously and the whole family becomes vulnerable. Children are less chance to be immunized without mothers and are more chance to be malnourished. Besides infants without mothers are more likely to die i.e., the unexpected maternal mortality causes child mortality which has another ominous impact on the society. That is why for the welfare of the overall health condition including child mortality any developing countries like Bangladesh should start from reducing maternal mortality.

Maternal deaths are mainly classified as direct and indirect obstetrical deaths. Direct obstetrical deaths occur due to obstetric complications of maternity. They are generally one of the five major reasons: hemorrhage, eclampsia, sepsis, complications of obstructive labor and insecure miscarriage². Indirect obstetrical deaths occur due to diseases that were existed in the pastor from diseases occurring during the period of pregnancy (but without direct obstetrical causes). The most important indirect causes are malnutrition, anaemia, malaria, hepatitis, heart diseases, tuberculosis or HIV². Existing literatures³⁻¹² suggest that antenatal care (ANC), presence of skilled birth assistance (SBA) and selection of place of delivery (PoD) have direct association with direct obstetric maternal deaths. Hossain *et al.*³, Islam *et al.*⁵, Kabir *et al.*⁹ and Akanda¹¹ highlighted the relationship with ANC and some socio-demographic and

health related factors. Goodburn *et al.*¹² mentioned that trained birth attendants are more likely to practice hygienic delivery than those that are untrained and the probability of using a trained birth attendant at the time of delivery depends on respondent's type of residence, education, age at birth, susceptibility to media and husband's education. Akanda¹⁰ showed that women of wealthy income quintile, mother's education, place of residence, wanted pregnancy, and those whose health information was accessed through television, delivered their children in appropriate healthcare organizations. But this study attempts to find out the potential factors of ANC, SBA and PoD simultaneously. The currently available updated data are applied for that purpose.

II. Data and Methods

The nationally representative secondary data extracted from Bangladesh Demographic and Health Survey (BDHS), 2014 are used for this study which was conducted by National Institute of Population Research and Training (NIPORT), of the ministry of Health and Family Welfare, Bangladesh¹³. Mitra and Associates, a research firm in Dhaka from Bangladesh implemented the survey. Technical support was given by Macro International Inc. in Calverton, Maryland, USA; through the MEASURE DHS program. Financial support for the survey was provided by the U.S. Agency for International Development (USAID). For conducting the survey, Bangladesh was stratified into 20 strata where each stratum is made up of enumeration areas (EAs). It followed a two-stage stratified random sampling procedure. At the first stage, the survey randomly selected 600 EAs (among them 393 in rural areas and 207 in urban areas) with probability proportional to the enumeration area size. In second stage of sampling, a systematic random sample of 30 households was selected on average from each enumeration area. Finally, from the selected households information of the interviews of 17,863 ever-married women aged 12 to 49 years was collected. The BDHS, 2014 includes their socioeconomic, bio-demographic, and maternal and child health related information.

Three response variables are considered to describe the current situation of maternal health care³⁻¹²: number of

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antenatal care visits by a mother, whether a mother received safe health care from a skilled birth attendant (yes, no), what is the place of delivery (hospital/other, home). The number of observations is 7181 for this study. In the BDHS, 2014 data ANC is given as count data (0,1,2, ...). For the presence of SBA, it is considered whether women received the assistance from doctor, nurse, family welfare visitor (FWV), family welfare assistant (FWA), medical assistant/sub-assistant and health assistant (HA), community skill birth attendant (CSBA). If at least one of the above skilled persons present sat the time of delivery then SBA is ‘yes’ otherwise ‘no’. In case of place of delivery there are two categories- ‘yes’ for the women who give birth provided with health facilities from hospitals or other institutions, and ‘no’ for the women who give birth in home. To investigate the demographic and socio-economic impact on the antenatal care visit, skill birth assistance during delivery and place of delivery, a total of ten independent variables^{3,5,11-12,14-16} are considered: place of residence (urban, rural), religion (other, Islam), mother’s age at birth (<20, 20-30, 30+), mother’s education (no education, primary, secondary, higher), wealth index (poor, middle, rich), NGO membership (yes, no), media exposure (yes, no), husband’s education (no education, primary, secondary, higher), decision on respondent’s health care (others, respondent alone, husband and respondent (both), husband alone), region (Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet). It is noted that information on NGO membership of mother and exposure to media are indirectly collected in BDHS, 2014 survey. The variable NGO membership of mother is created if a respondent of the survey belongs to any one of the NGOs like BRAC, ASHA, Grameen Bank, BRDB, Proshika etc. As media exposure have impact on maternal issue by using the information of listening to radio/watching television, reading newspapers or magazine, the variable exposure to media is created.

Poisson count model

To find out the adjusted effects of selected covariates on ANC visits Poisson count model is fitted for the counted data of the number of ANC visits. Under the Poisson model, the response variable Y has a Poisson distribution. Suppose that there are *n* independent responses $Y_1, \dots, Y_i, \dots, Y_n$ with mean number of response μ_i . Then, the response variable Y_i has probability mass function (pmf) of the form

$$f(y_i, \mu_i) = \frac{e^{-\mu_i} \mu_i^{y_i}}{y_i!}; y_i = 0, 1, 2, \dots \dots \dots$$

Poisson count model is a member of generalized linear model (GLM) where log-link function is used as a link function¹⁷⁻¹⁸. That is, it models the log of mean of response with the linear predictor $\eta_i = x_i' \beta$ as follows:

$$\ln(\mu_i) = x_i' \beta = \eta_i \dots \dots \dots \dots \dots \dots \dots \dots \dots (i)$$

The regression model given in (i) is a Poisson count model where $x_i = (x_{i1}, \dots, x_{ij}, \dots, x_{ip})'$ be the *p* × 1 vector of covariates and $\beta = (\beta_1, \dots, \beta_j, \dots, \beta_p)'$ be the *p* × 1 vector

of regression coefficients linked with response.

Logistic regression model

The other two response variables are SBA and PoD which have binary categories. It is assumed in logistic regression model that response variable should be binary in nature. Hence the logistic regression model is used for the purpose of modeling SBA and PoD. Suppose that there are *n* independent responses $Y_1, \dots, Y_i, \dots, Y_n$ with probability of success π_i and the probability mass function (pmf) of y_i is

$$f(y_i) = \pi_i^{y_i} (1 - \pi_i)^{1-y_i}; y_i = 0, 1; 0 < \pi_i < 1.$$

Then the mean response is $E(y_i) = \pi_i$. In logistic regression model, logit link function¹⁸ is used to make a bridge between mean response π_i and the linear predictor $\eta_i = x_i' \beta$ as follows:

$$\ln\left(\frac{\pi_i}{1-\pi_i}\right) = \eta_i = x_i' \beta. \text{ Or, } \pi_i = \frac{e^{x_i' \beta}}{1+e^{x_i' \beta}} \dots \dots \dots (ii)$$

The regression model given in equation (ii) is a logistic regression model where $x_i = (x_{i1}, \dots, x_{ij}, \dots, x_{ip})'$ is the *p* × 1 vector of covariates linked with response and $\beta = (\beta_1, \dots, \beta_j, \dots, \beta_p)'$ be the corresponding vector of regression parameters.

III. Results and Discussion

The data analyses are conducted into three distinct categories (i) Univariate analysis, (ii) Bivariate analysis and (iii) Multivariate analysis. The results are presented below:

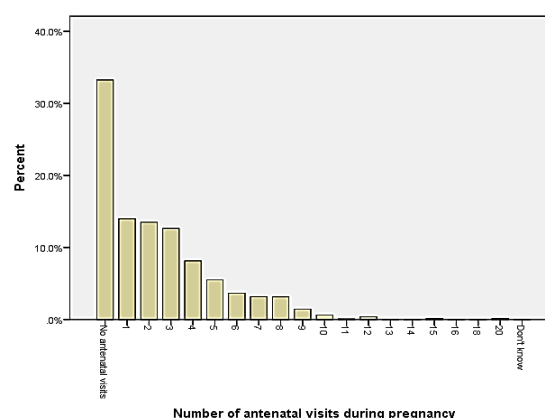
Univariate analysis

The percentage distribution of the covariates used in this study is shown in Table 1. It is observed that more than half of the women (68.4%) are from rural area while 31.6% are from urban area. About 90% of them are Muslims and the rest are non-Muslims. 58.1% mothers gave birth their first child within age groups 20-30, while 29.2% were in age below 20 and 12.7% were in age above 30. Among all women about 18% have no education, 29.8% have primary education, 43.5% have secondary education and 8.6% have higher education. Besides 39.9% mothers are from poor family and 19.2% are from middle class family whereas 40.9% are from rich family. It is observed that the highest numbers of observations are from Chittagong division (19%) and the lowest from Rajshahi division (13%). Among all mothers 25.9% belong to NGO membership where 74.1% do not. On the other hand 65.5% mothers have media exposure and 34.5% do not have. About 26.6% husbands have no education, 29.1% have primary education, 30.1% have secondary education, while only 14.2% husbands have higher education. A large number of women (50.5%) take decision on their health care with the collaboration of their husband and only 11.6% take decision alone but 31.2% women should entirely depend on their husband’s decision.

Table 1. Summary statistics of the covariates associated with ANC, SBA and PoD

Variables	Category	Freq.	Percentage (%)	95% CI	p-value of ANOVA test for ANC	p-value of χ^2 test for SBA	p-value of χ^2 test for PoD
Place of residence	Urban	2272	31.6	(30.52,32.68)	0.001	0.001	0.001
	Rural	4909	68.4	(67.32,69.48)			
Religion	Others	714	9.90	(9.21,10.59)	0.241	0.156	0.080
	Islam	6467	90.1	(89.41,90.79)			
Mother's age at 1 st birth	Age <20	2095	29.2	(28.15,30.25)	0.047	0.020	0.028
	Age 20-30	4172	58.1	(56.96,59.24)			
	Age 30+	914	12.7	(11.93,13.47)			
Mother's education	No edu.	1296	18.0	(17.11,18.88)	0.001	0.001	0.003
	Primary	2140	29.8	(28.74,30.85)			
	Secondary	3126	43.5	(42.35,44.65)			
	Higher	619	8.60	(7.95,9.25)			
Wealth index	Poor	2865	39.9	(38.77,41.03)	0.004	0.039	0.001
	Middle	1381	19.2	(18.29,20.11)			
	Rich	2935	40.9	(39.76,42.04)			
Belong to NGO	No	5319	74.1	(73.09,75.11)	0.034	0.001	0.046
	Yes	1862	25.9	(24.89,26.91)			
Media Exposure	No	2474	34.5	(33.40,35.60)	0.003	0.001	0.001
	Yes	4707	65.5	(64.40,66.60)			
Husband's education	No edu	1912	26.6	(25.58,27.62)	0.017	0.035	0.001
	Primary	2089	29.1	(28.05,30.15)			
	Secondary	2154	30.1	(29.04,31.16)			
	Higher	1022	14.2	(13.39,15.00)			
Decision on respondent's health care	Others	488	6.80	(6.21,7.38)	0.024	0.046	0.002
	Resp. alone	831	11.6	(10.85,12.34)			
	Both	3625	50.5	(49.34,51.65)			
	Husb. alone	2237	31.2	(30.12,32.27)			
Region	Barisal	838	11.7	(10.96,12.44)	0.056	0.083	0.074
	Chitt.	1361	19.0	(18.09,19.91)			
	Dhaka	1208	16.8	(15.94,17.66)			
	Khulna	859	12.0	(11.24,12.75)			
	Rajshahi	936	13.0	(12.22,13.77)			
	Rangpur	942	13.1	(12.31,13.88)			
	Sylhet	1094	14.4	(13.58,15.21)			

In the case of response variables, the percentage of number of ANC visits during pregnancy period is given in Figure 1. For SBA about 37% mothers got skilled birth assistance at the time of their delivery but about 63% did not get. However, approximately 80% women gave birth at home without the health facilities if needed while only about 20% gave birth at hospital or other institution where various health facilities are available.

**Fig 1.** Percentage distribution of the number of ANC visits of women

Bivariate analysis

An attempt has been made to find out the unadjusted association between selected covariates and ANC visits, SBA, PoD simultaneously. The results are given in Table 1. ANOVA test is applied to determine whether the average number of ANC visits is significantly associated with a specific covariate. On the other hand chi-square test is applied to find out whether a particular covariate is significantly associated with SBA or PoD. It is observed that for all covariates the average number of ANC visits differ significantly at 5% level of significance between the categories of the covariates except the covariate religion and region. The results of unadjusted association for SBA and PoD are almost similar. There is a significant association between a specific covariate and SBA or PoD for all covariates except religion and region.

*Multivariate analysis**Results of Poisson count regression model*

The parameter estimation results of Poisson count model are presented in Table 2. It is found that the mean number of ANC visits for women from urban area is 1.357 times higher than the rural area. The outcome is appropriate in Bangladesh as the sources of taking ANC are lower in rural areas than the urban areas. The mean number of ANC visits for the primary, secondary and higher educated mothers are 1.35, 1.773 and 2.286 times more than the non-educated mothers respectively. The mean number of ANC visits during pregnancy period is 1.147 and 1.515 times higher for the middle and rich mothers respectively in reference of poor mothers. In case of media exposure, the mean number of ANC visits is 1.224 times higher for the mothers who are exposed to media than the mothers who are not. Thus exposure to media can play a vital role in the regard of increasing ANC visits. The mean ANC visits for the women with primary, secondary and higher educated husbands are 1.086, 1.184 and 1.370 times higher respectively than the women with non-educated husbands. Hence ANC visits depend on husband's education level.

Table 2. Estimates of regression parameter ($\hat{\beta}$), Exp ($\hat{\beta}$), Standard errors and p-value obtained using Poisson count model for ANC visits

Variables	Categories	$\hat{\beta}$	S.E($\hat{\beta}$)	Exp($\hat{\beta}$)	p-value
Place of residence	Rural (Ref.)				
	Urban	0.278	0.017	1.357	0.001
Religion	Others (Ref.)				
	Islam	-0.148	0.023	0.862	0.050
Mother's age at birth	Age < 20 (Ref.)				
	Age 20-30	-0.021	0.017	0.979	0.330
	Age 30+	0.002	0.028	1.002	0.090
Mother's education level	No education (Ref.)				
	Primary	0.300	0.032	1.350	0.010
	Secondary	0.573	0.033	1.773	0.002
	Higher	0.827	0.040	2.286	0.001
Wealth index	Poor (Ref.)				
	Middle	0.137	0.026	1.147	0.007
	Rich	0.416	0.025	1.515	0.000
NGO membership	No (Ref.)				
	Yes	-0.020	0.019	0.980	0.281
Media exposure	No (Ref.)				
	Yes	0.202	0.022	1.224	0.005
Husband education level	No education (Ref.)				
	Primary	0.083	0.026	1.086	0.002
	Secondary	0.169	0.027	1.184	0.001
	Higher	0.315	0.033	1.370	0.001
Decision on respondent's health care	Others (Ref.)				
	Respondent alone	0.014	0.037	1.014	0.711
	Both	0.032	0.031	1.032	0.309
	Husband alone	-0.027	0.033	0.973	0.410
Region	Barisal (Ref.)				
	Chittagong	-0.206	0.029	0.814	0.004
	Dhaka	-0.051	0.029	0.951	0.083
	Khulna	0.019	0.030	1.019	0.531
	Rajshahi	-0.036	0.031	0.965	0.253
	Rangpur	0.260	0.029	1.297	0.013
	Syhet	0.176	0.032	0.839	0.007

Results of Logistic regression model

To find out the adjusted effect of selected covariates on SBA and PoD logistic regression model is used. Table 3 represents the results of logistic regression model on skilled birth assistance (SBA). It is observed that urban women are 3.149 times more likely to have SBA at the time of delivery than the rural women. Primary, secondary and higher educated mothers are 1.32, 2.171 and 6.212 times more likely to take SBA during delivery than those of non-educated mothers respectively. The women who are belonging to rich and middle class family are 1.289 and 2.29 times more likely to take SBA than the poor women

respectively. Women who are exposed to media have 1.473 times more probability to receive SBA than the women who are not exposed to media. Women with primary, secondary and higher educated husbands are 1.153, 1.586 and 2.633 times more probable to receive SBA than those who have non-educated husbands respectively.

The results of logistic regression model for place of delivery (PoD) are represented in Table 4. From Table 4 it is found that urban women are 1.894 times more likely to give birth at hospital or other places provided with health facilities than that of rural women.

Table 3. Estimates of regression parameter ($\hat{\beta}$), Exp ($\hat{\beta}$), Standard errors and p-values in logistic regression model for SBA

Variables	Categories	$\hat{\beta}$	S.E($\hat{\beta}$)	Exp($\hat{\beta}$)	p-value
Place of residence	Rural (Ref.)				
	Urban	1.147	0.065	3.149	0.004
Religion	Others (Ref.)				
	Islam	-0.627	0.094	0.534	0.050
Mother's age at birth	Age < 20 (Ref.)				
	Age 20-30	-0.029	0.067	0.972	0.666
	Age 30+	0.088	0.110	1.091	0.425
Mother's education level	No education (Ref.)				
	Primary	0.278	0.110	1.320	0.012
	Secondary	0.775	0.112	2.171	0.004
	Higher	1.826	0.163	6.212	0.034
Wealth index	Poor (Ref.)				
	Middle	0.254	0.089	1.289	0.005
	Rich	0.829	0.086	2.290	0.044
NGO membership	No (Ref.)				
	Yes	-0.046	0.071	0.955	0.519
Media exposure	No (Ref.)				
	Yes	0.388	0.077	1.473	0.001
Husband's education level	No education (Ref.)				
	Primary	0.142	0.092	1.153	0.123
	Secondary	0.461	0.095	1.586	0.035
	Higher	0.968	0.123	2.633	0.007
Decision on respondent's health care	Others (Ref.)				
	Respondent alone	-0.024	0.138	0.977	0.863
	Both	-0.137	0.116	0.872	0.238
	Husband alone	-0.096	0.120	0.908	0.424
Region	Barisal (Ref.)				
	Chittagong	-0.116	0.113	0.890	0.302
	Dhaka	-0.081	0.117	0.923	0.490
	Khulna	0.624	0.119	1.866	0.008
	Rajshahi	0.205	0.121	1.228	0.090
	Rangpur	0.178	0.122	1.195	0.143
	Syhet	0.012	0.122	1.012	0.920

The mothers with primary, secondary and higher education are 1.415, 2.226 and 5.712 times more likely to receive health facilities from hospital/other places at the time of delivery respectively than those who are non-educated. The women who are belonging to rich and middle class are 1.315 and 2.365 times more chance to give birth at hospital or clinic than those who are poor respectively. Women who are exposed to media have 1.444 times more chance to give birth at a place provided with health facility than the women

who are not exposed to media. There is no significant difference about choosing the delivery place for the women with non-educated and primary educated husbands. But the women with secondary and higher educated husbands are 1.501 and 2.291 times more likely to give birth at any institution provided with necessary medical facilities than that of the women whose husbands do not have any education respectively.

Table 4. Estimates of regression parameter ($\hat{\beta}$), Exp ($\hat{\beta}$), Standard errors and p-values in logistic regression model for PoD

Variables	Categories	$\hat{\beta}$	S.E($\hat{\beta}$)	Exp($\hat{\beta}$)	p-value
Place of residence	Rural (Ref.)				
	Urban	0.640	0.066	1.894	0.022
Religion	Others (Ref.)				
	Islam	-0.557	0.095	0.573	0.340
Mother's age at birth	Age < 20 (Ref.)				
	Age 20-30	0.032	0.069	1.032	0.645
	Age 30+	0.113	0.113	1.120	0.315
Mother's education level	No education (Ref.)				
	Primary	0.347	0.117	1.415	0.003
	Secondary	0.800	0.119	2.226	0.000
	Higher	1.743	0.162	5.712	0.000
Wealth index	Poor (Ref.)				
	Middle	0.274	0.094	1.315	0.004
	Rich	0.861	0.090	2.365	0.001
NGO membership	No (Ref.)				
	Yes	-0.134	0.073	0.875	0.068
Media exposure	No (Ref.)				
	Yes	0.367	0.081	1.444	0.044
Husband's education level	No education (Ref.)				
	Primary	0.120	0.097	1.128	0.214
	Secondary	0.406	0.099	1.501	0.038
	Higher	0.872	0.125	2.391	0.049
Decision on respondent's health care	Others (Ref.)				
	Respondent alone	-0.056	0.141	0.946	0.691
	Both	-0.076	0.119	0.927	0.521
	Husband alone	-1.18	0.123	0.889	0.339
Region	Barisal (Ref.)				
	Chittagong	-0.163	0.118	0.849	0.166
	Dhaka	0.119	0.120	1.126	0.322
	Khulna	0.764	0.122	2.147	0.030
	Rajshahi	0.393	0.125	1.481	0.002
	Rangpur	0.357	0.126	1.429	0.004
	Syhet	0.074	0.127	1.077	0.560

IV. Conclusion

Reduction of maternal mortality deserves immense importance both domestically and internationally. If maternal mortality is unexpectedly large particularly in impoverished communities like Bangladesh, then there arises so many crises. For instance, if the government of Bangladesh can be able to reduce maternal mortality then the child mortality rate will also be controlled and the socio-economic conditions of Bangladesh will also increase. That is why it is needed to ensure proper health care for the mothers and to reduce maternal mortality to be a prosperous country through proper antenatal care (ANC), skilled birth assistance, selection of institutional delivery provided with health facilities. Thus, the policy makers should consider these three factors meticulously. In this paper the significant factors of ANC, SBA and PoD are identified which can play an important role to increase ANC visits, to improve the percentage of taking skilled birth attendant and to increase the number of institutionalized delivery.

Some recommendations can be suggested according to the findings of the analysis:

- i) Necessary maternal health care facilities should be provided in rural areas such that the number of ANC visits, SBA, PoD provided with health facilities can be increased in rural areas.
- ii) Government should take necessary steps to increase the level of education of male and female as education is one of the most important factors to reduce maternal mortality.
- iii) The government should provide some social security and medical support for the poor people of the society since the poor people cannot afford medical and other health related supports easily.
- iv) Reading newspaper/magazine, or listening radio, or watching television should be increased as women being exposure with media have higher number of ANC visits, higher taking of SBA during pregnancy than non-exposure women.

- v) Necessary steps should be taken to increase consciousness about the importance of ANC visits during pregnancy, SBA and PoD at the delivery time and also to provide logistics supports at Chittagong, Khulna, Rangpur, and Sylhet divisions in Bangladesh to increase ANC visits, SBA and institutional delivery.

Acknowledgement

We are greatly indebted to the Department of Statistics, University of Dhaka for its logistics support. We are thankful to the National Institute of Population Research and Training (NIPORT) authorities, Bangladesh for allowing us to use BDHS, 2014.

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