

## Factors Affecting Postnatal Care in Bangladesh: Clustered Data Analysis

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### Abstract

The study aims to determine the factors affecting postnatal care in Bangladesh using the data extracted from Bangladesh Demographic and Health Survey (BDHS), 2014. For the purpose of regression analysis, mixed logistic regression model has been utilized to take into account the possible correlation among subjects within clusters. It is found that region, place of residence, mother's education, wealth index, access to media, birth order and antenatal care visits have significant association with postnatal care.

**Key Words:** Postnatal care, Mixed logistic regression, Intra-cluster correlation, Chi-square test, BDHS.

### I. Introduction

Postnatal period, spanning one hour after the delivery of the baby to the following six weeks (42 days)<sup>20</sup>, is one of the most vulnerable stage to illness for mothers and their children. Lack of proper care during this period is life-threatening for both the mother and the newborn babies. In order to prevent injuries, disabilities and also reduce maternal and child mortality to a great extent, it is important to focus on implementing health care services during this postnatal period. In developing countries like Bangladesh, almost 40% of women experience complications after delivery and an estimated 15% of these women encounter potentially life-threatening problems<sup>13</sup>. Thus, a proliferating attention has been given to maternal and child health globally to improve the adverse effect of maternal and child health outcomes.

Despite the international emphasis in the last few years on the need to address the primary health needs of pregnant women and children, involvement in reducing maternal mortality has been found slow in developing countries including Bangladesh. A study on antenatal and postnatal care among indigenous community in Bangladesh, conducted by Islam and Odaland<sup>8</sup>, found that the factors associated with antenatal care (ANC) and postnatal care were respondent's place of residence, education, age, distances to the service centers and exposures to any mass media. Khanal et al.<sup>11</sup> used the Nepal Demographic and Health Survey data and demonstrated that mothers who were from urban areas, rich families, educated, delivered birth in a health facility and had attended a four or more ANC visits were more likely to receive at least one postnatal care visits. On the other hand, mothers or their partners who are involved in agriculture occupation were less likely to receive postnatal care (PNC). Using the data from Pakistan, Agha and Carton<sup>1</sup> used logistic regression and found that age, education, autonomy, household wealth, proximity to health facility, access to mass media have a significant impact on using the health care services. Shariff and Singh<sup>15</sup> used the data collected by National Council of Applied Economic Research in India and found significant effect of education, wages, access to media, locally available health services on postnatal care (PNC) and child delivery services. In this paper, an attempt has been made to examine the factors affecting postnatal care in Bangladesh using the data

extracted from Bangladesh Demographic and Health Survey<sup>4</sup> (BDHS), 2014. The BDHS survey was conducted using a two stage stratified sampling where the first stage comprises with a number of enumeration areas (EA). As the EAs are the geographical areas composed of some common characteristics, these are considered as clusters. In the second stage, individuals have been collected from each cluster which results a possible correlation among responses within cluster. In order to take into account this correlation, inclusion of random effects of clusters in regression model while analyzing postnatal care is compulsory which would provide more accurate results than fixed effect model. Therefore, the study utilizes mixed logistic regression to investigate the determinants of postnatal care in Bangladesh that can effectively incorporate fixed effect covariates and handles the possible random effects as well. This paper is organized in four sections. In section II, data and methodology have been described. Results obtained from univariate analysis, bivariate analysis and regression model are given in section III. Finally, the paper concludes with a short discussion on the overall work in section IV.

### II. Data and Methodology

#### Data

This study uses Bangladesh Demographic and Health Survey (BDHS)<sup>4</sup>, 2014, in order to identify determinants of postnatal care. The survey is based on a two-stage stratified sample of households. 600 EAs were selected with probability proportional to the EA size in the first stage, with 207 Eas in urban areas and 393 in rural areas. A complete household listing operation was then carried out in all the selected EAs to provide a sampling frame for the second stage selection of the households. In the second stage of sampling, a systematic sampling of 30 households on average was selected per EA to provide statistically reliable estimate of key demographic and health variables for the country as a whole, for the urban and rural areas separately, and for each of the seven divisions. According to the design, 18,000 residential households were selected and of those households, BDHS finally interviewed successfully 17,842 ever married women aged 15-49 years on a complete history of their live births along with related socio-economic and demographic variables. In order to assess the potential determinants of postnatal care, information of 4487 highest

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ordered children was collected who were born preceding 3 years of the survey.

#### Variables

The postnatal period is the period beginning one hour after the delivery of the baby and continuing until six weeks<sup>20</sup>. In this study, the dependent variable, receiving postnatal care, is of binary type taking values 1, if respondent receives postnatal care, and 0, otherwise.

On the basis of literature reviews on postnatal care, the socio-economic and demographic factors have been considered in this paper are: region (Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Shylet), place of residence (Urban, Rural), mothers education (No education, Primary, Secondary and Higher), wealth index (Poor, Middle, Rich), access to media (Exposure, Non-exposure), aware of community clinic (Yes, No), membership of NGO (Yes, No), mothers age at first birth (Below 20 years, Above 20 years), birth order (1<sup>st</sup> birth, 2<sup>nd</sup> & 3<sup>rd</sup> birth, 4<sup>th</sup> and above), antenatal care visits (Visits<4, Visits ≥4), sex of child (Male, Female) and size of child at birth (Small, Average/Large).

#### Statistical Methods

The study scrutinizes both unadjusted and adjusted effects of the selected covariates on postnatal care visits. Chi-square test was used to determine the unadjusted association between postnatal care and selected socio-economic and demographic variables. To find out the adjusted effects of covariates on postnatal care visits, mixed logistic regression model has been used. Covariates that were found significant in Chi-square test, are only included in the regression model.

#### Mixed Logistic Regression Model

Generalized linear model (GLM) is a flexible generalization of ordinary regression model that allows response variables that have error distribution models other than normal distribution. The major limitation of GLM while dealing with clustered data is the correlation among subjects which violates the independence assumption. In this situation, generalized linear mixed model (GLMM) approach is a suitable extension of GLM that allows the possible correlation among subjects. In fact, GLMMs are the best tools for analyzing normal and non-normal data that incorporates both fixed effects and random effects of clusters.

Suppose there are  $n_i$  number of individuals in each of  $q$  clusters ( $i = 1, 2, \dots, q$ ). Let  $y_{ij}$  denote the  $j^{\text{th}}$  observation under  $i^{\text{th}}$  cluster ( $j = 1, 2, \dots, n_i$  &  $i = 1, 2, \dots, q$ ),  $x_{ij}$  be the  $(p \times 1)$  column vector of values of explanatory variables with fixed effect model parameter  $\beta = (\beta_1, \beta_2, \dots, \beta_p)'$ . Also, let  $u_i$  be the vector of random effect values of cluster  $i$ . The linear predictor for a GLMM is given by  $g(\mu_{ij}) = x'_{ij}\beta + u_i$ ; where  $\mu_{ij} = E(y_{ij} | x_{ij}, u_i)$  and  $u_i$  is assumed to

follow normal distribution<sup>2</sup>.

A general and flexible approach for analyzing binary clustered data under GLMM is referred to as mixed logistic regression model. For a given random effect  $u_i$ , responses within  $i^{\text{th}}$  cluster are assumed to be independent binary random variables. A mixed logistic regression model takes the binomial exponential family with the canonical link of the form<sup>19</sup>

$$g(\mu_{ij}) = \log\left(\frac{\mu_{ij}}{1 - \mu_{ij}}\right) = x'_{ij}\beta + u_i$$

$$\text{with } \mu_{ij} = E(y_{ij} | x_{ij}, u_i) = \frac{e^{x'_{ij}\beta + u_i}}{1 + e^{x'_{ij}\beta + u_i}}.$$

In this modeling technique, it is assumed that  $u_i \sim iidN(0, \sigma_u^2)$ . Under this set up, our interest is to estimate  $\beta$  and  $\sigma_u^2$ . Therefore, the unconditional likelihood function<sup>2</sup> can be written as

$$L(\beta, \sigma_u^2 | x_{ij}) = \int_{-\infty}^{\infty} \left[ \prod_{i=1}^q L_i(\beta, \sigma_u^2 | u_i) \right] g(u_i) du_i.$$

For the purpose of estimation and test, *lme4 package* under *R programming language* has been employed. The package also provides the estimate of intra-cluster correlation coefficient which quantifies the degree of correlation in the responses of individuals within the same cluster<sup>6</sup>.

### III. Results

#### Univariate analysis

It is observed that the sample consists of subjects of 17.6%, 11.8%, 19.2%, 11.8%, 12.2%, 12.3% and 15.1% from Dhaka, Barisal, Chittagong, Khulna, Rajshahi, Rangpur and Sylhet, respectively. Among the respondents of the selected sample, 32.3% are from urban areas, while most of them residing in rural areas (67.7%). Among all women, 13.5% have no education, 27.5% have primary education, 47.4% have their secondary education and only 11.6% completed their higher education. Most of the mothers are from rich families (41.0%) while 39.9% from poor and 19.1% from middle class family. A large number of mothers are found to be exposure of media (62.1%) whereas 37.9% are not. It is also found that 21.7% mothers are involved to NGO, while most of them are not (78.3%). Among all mothers, 30.2% are aware of community clinic, whereas 69.8% are not. More than half of the mothers (81.1%) gave their birth at age below twenty and 18.9% are above twenty at the time of their first birth. Among the children, 40.6% are the first babies of their mother, 45.4% are the second and third child and a fewer number of children are 4<sup>th</sup> and higher in order (13.9%). Most of the mothers (68.0%) received ANC visits at most three times, whereas 32.0% received at least four times. It is also observed in the sample that 51.6% live births occurred are male and 48.4% are female. In the case

of child's size at birth, 19.5% babies have been born as small while most of them are average/ large in size (80.5%).

Moreover, 65.7% mothers have received postnatal care and 34.3% have not.

**Table 1. Percentage distribution of postnatal care by selected covariates with Chi-square test p-values**

Variable	Postnatal Care		p-value
	No	Yes	
<b>Region</b>			< 0.001
Barisal	38.4	61.6	
Chittagong	33.0	67.0	
Dhaka	29.1	70.9	
Khulna	28.1	71.9	
Rajshahi	27.4	72.6	
Rangpur	35.6	64.4	
Sylhet	48.1	51.9	
<b>Place of residence</b>			< 0.001
Urban	21.0	79.0	
Rural	40.6	59.4	
<b>Mother's education</b>			< 0.001
No education	50.7	49.3	
Primary	42.0	58.0	
Secondary	30.8	69.2	
Higher	11.0	89.0	
<b>Wealth index</b>			< 0.001
Poor	50.2	49.8	
Middle	34.5	65.5	
Rich	18.7	81.3	
<b>Access to media</b>			< 0.001
Exposure	24.0	76.0	
Not exposure	51.2	48.8	
<b>Aware of community clinic</b>			0.005
Yes	37.3	62.7	
No	33.0	67.0	
<b>Involvement to NGO</b>			0.082
Involved	36.7	63.3	
Not involved	33.6	64.4	
<b>Mother's age at first birth (years)</b>			< 0.001
< 20	36.4	63.6	
20+	25.1	74.9	
<b>Birth order</b>			< 0.001
1 <sup>st</sup>	28.9	71.9	
2 <sup>nd</sup> -3 <sup>rd</sup>	36.0	64.0	
4 <sup>th</sup> +	46.7	53.3	
<b>Antenatal care visits</b>			< 0.001
0-3	41.5	58.5	
4+	19.0	81.0	
<b>Sex of child</b>			0.890
Male	34.2	65.8	
Female	34.4	65.6	
<b>Child size at birth</b>			< 0.001
Small	39.4	60.6	
Average/ Large	33.0	67.0	

#### *Bivariate analysis*

In order to assess whether a specific covariate is significantly associated with postnatal care visits, Pearson Chi-square test have been employed. The results are given in Table 1.

From Table 1, it is found that region is significantly associated with postnatal care visits. The percentage of receiving postnatal care (PNC) is highest in Rajshahi and lowest in Sylhet division. Moreover, percentage of having

PNC in urban area is higher compared to rural area which signifies that mothers of urban area are concerned more than mothers of rural area. Mothers with higher education receive highest percentage of postnatal care. On the other hand mothers with no education have the lowest percentage of receiving postnatal care. Large differences have been found among the categories of wealth index. From Table 1 it is observed that mothers from rich family receive higher postnatal care than mothers belonged to middle class and poor family. It is also observed that mothers with access to media like reading newspaper, listening radio, watching TV have higher percentage of receiving postnatal care than those who do not have such access. Moreover, it can be seen that mothers who are aware of community clinic have lower percentage of receiving postnatal care compared to the mothers who are not aware of community clinic. NGO membership has a reverse relationship with having PNC. It is observed that mothers who are affiliated with NGO receive lower percentage of PNC than those who are not. From Table 1 it is observed that mothers aged above 20 receive higher percentage of PNC than mothers aged below 20. Moreover, mothers receive postnatal care for their first child more than for their later one. In the case of Antenatal care, it is observed that mothers who have at least four antenatal care visits receive higher postnatal care than mothers with at most three antenatal care visits. Table 1 also confirms that the percentage of having PNC is almost same for male and female child. Moreover, child born with average/ large size receives higher postnatal care than child born with small size. From Table 1, this is clear that except sex of child, all covariates were found to have significant unadjusted association with postnatal care.

#### *Mixed Logistic Regression Model*

To examine the potential determinants of postnatal care, mixed logistic regression model has been used. The results obtained from the GLMM applied to the postnatal care data are presented in the Table 2. The Table contains the estimated regression coefficients, corresponding standard errors along with p-values and odds ratios. Variance component and correlation obtained from the model have also been displayed in Table 2.

From Table 2 it can be observed that mothers from Sylhet division have 42.7% lower odds of having postnatal care visits compared to mothers from Dhaka (p-value=.035). For other six divisions, the odds remain same. Place of residence has been found significant factor related to having postnatal care (PNC) (p-value<0.001). Mothers from rural area have 47.5% lower odds of having PNC compared to mothers from urban area. Mother's education plays a vital role on having PNC visits. From the Table 2 it can be seen that mothers with secondary and higher education have respectively 39.5% (p-value=0.019) and 217.9% (p-value<0.001) higher odds of having PNC visits compared to mothers with no education. But there is no significant difference of receiving PNC between illiterate and primary educated mothers. Wealth index is also an important determinant for having PNC visits. Mothers from poor family have 25% lower odds of having PNC (p-value=0.016) compared to mothers belong to middle class family. However, mothers from rich family have 52.6% higher odds of having PNC (p-value= 0.001) compared to mothers from middle class family. Moreover mothers who are exposed to media have 46.7% higher odds of having postnatal care compared to mothers who are not exposed to media (p-value< 0.001).

**Table 2. Regression coefficients with standard errors, p-values and odds ratios obtained from mixed logistic regression for postnatal care in Bangladesh**

Variable	Coefficient	SE of coefficient	p-value	OR
<b>Region</b>				
Barisal	-0.062	0.274	0.819	0.939
Chittagong	0.017	0.248	0.942	1.018
Dhaka(RC)	-	-	-	-
Khulna	0.172	0.265	0.514	1.188
Rajshahi	0.268	0.263	0.307	1.308
Rangpur	-0.154	0.260	0.553	0.857
Sylhet	-0.555	0.263	<b>0.035</b>	0.573
<b>Place of residence</b>				
Urban(RC)	-	-	-	-
Rural	-0.642	0.168	<b>&lt;0.001</b>	0.525
<b>Mother's education</b>				
No education(RC)	-	-	-	-
Primary	0.191	0.136	0.161	1.210
Secondary	0.333	0.142	<b>0.019</b>	1.395
Higher	1.156	0.224	<b>&lt;0.001</b>	3.197
<b>Wealth index</b>				
Poor	-0.287	0.119	<b>0.016</b>	0.750

Middle(RC)	-	-	-	-
Rich	0.422	0.129	<b>0.001</b>	1.526
<b>Access to media</b>				
Exposure	0.383	0.104	<b>&lt;0.001</b>	1.467
Non exposure(RC)	-	-	-	-
<b>Aware of community clinic</b>				
Yes	0.073	0.104	0.483	1.076
No(RC)	-	-	-	-
<b>Membership of NGO</b>				
Involved	-0.050	0.104	0.630	0.950
Not involved(RC)	-	-	-	-
<b>Mother's age at first birth (years)</b>				
<20(RC)	-	-	-	-
20+	0.100	0.120	0.405	1.105
<b>Birth order</b>				
1 <sup>st</sup> (RC)	-	-	-	-
2 <sup>nd</sup> -3 <sup>rd</sup>	-0.231	0.092	<b>0.012</b>	0.793
4 <sup>th</sup> +	-0.331	0.137	<b>0.016</b>	0.718
<b>Antenatal care visits</b>				
0-3(RC)	-	-	-	-
At least 4	0.791	0.104	<b>&lt;0.001</b>	2.206
<b>Size of child at birth</b>				
Small(RC)	-	-	-	-
Average /large	0.127	0.103	0.218	1.135
<b>Variance</b>	1.841			
<b>Correlation</b>	0.3591			

RC= Reference Category

Birth order is an important determinant for having postnatal care. It is observed from Table 2 that for babies with order 2<sup>nd</sup> or 3<sup>rd</sup> have 20.7% (p-value=0.012) lower odds of having PNC compared to first child. Moreover, there is a 28.2% lower odds of receiving PNC for the babies of order 4<sup>th</sup> or above compared to the first child. In the case of antenatal care (ANC) visits, it has been observed that mothers who received at least four ANC visits are 2.206 times likely to have PNC compared to the mothers who received at most three ANC visits. In addition, no significant differences have been observed between the categories of awareness of community clinic, membership of NGO, mother's age at first marriage and size of child at birth.

From the Table 2, it can be seen that the cluster variance is 1.841 which is noticeable. The intra-cluster correlation is 0.3591 which signifies that 35.9% of the total variation in postnatal care is due to variation between clusters.

#### IV. Conclusion

The World Health Organization (WHO) describes the postnatal period as the most critical and yet most neglected phase in the lives of mothers and babies. Lack of care in this time period may result in death or disabilities of newborns. The study emphasized this issue and aimed to determine the potential factors those are responsible for receiving postnatal care visits. The analysis has been done using BDHS<sup>4</sup> data, 2014. As BDHS used a two staged stratified sampling technique for collecting data where the first stage

enumeration areas are clusters, application of any fixed effect model would provide misleading results. Therefore, to get more accurate and precised estimates, the mixed logistic regression has been utilized for analyzing the PNC data to take into account the random effects of clusters as well as other fixed effects.

The study reveals that mothers from Sylhet division are significantly less likely to have postnatal care compared to mothers from Dhaka. All other divisions are equally likely to receive PNC. Moreover agreeing the previous finding<sup>11</sup>, the study also found that mothers residing in rural area are less likely to receive postnatal care than mothers residing in urban area. This is because rural areas have less access to public healthcare services, such as roads, transports etc. It has been observed from this study that mothers with secondary and higher education are more likely to receive postnatal care compared to the mothers with no education. Some previous studies have also shown such finding between mother's education and postnatal care<sup>3,11</sup>. This is expected because education fosters new values and attitudes that are favorable to the use of modern health care which leads to increase the chances of women desiring skilled care and empowers them to access such cares. This study also reveals that the likelihood of receiving postnatal care increases with the increase of economic status of a family and this finding is similar to some previous works<sup>5,16</sup>. This is because it is expected that wealthier families are more likely to spend a higher proportion of their earnings on

healthcare compared to poor households. Access to media has been proved to have a very strong significant association with postnatal care visits. The finding signifies that mothers with access to media are more likely to receive postnatal care compared to mothers with no such accesses. This is expected because media augments the awareness among people including women on health and other matters.

In the case of birth order, it has been observed that for the 2<sup>nd</sup> -3<sup>rd</sup> child and for the 4<sup>th</sup> and above child, mothers are significantly less likely to receive postnatal care compared to the first child. This may be due to the fact that women for their babies with higher birth order may have developed knowledge and self-confidence regarding child and maternal health. Previous studies have shown that women are more likely to use maternal health care services at the time of their first baby than babies of higher orders because of perceived risk associated with first pregnancy<sup>7,17</sup>. One of the encouraging finding of this study is that mothers who attended at least four ANC visits are significantly more likely to receive postnatal care compared to mothers with less than four ANC visits. Previous studies exert positive association between ANC and postnatal care<sup>10,11,14</sup>. This may be due to fact that women with more ANC visits show a higher satisfaction with the care quality and hence more likely to use health care services for delivery and healthcare issues. However, the study shows an insignificant association between child size at birth and postnatal care which is contradictory to the previous work conducted by Titaley et al.<sup>18</sup>.

To improve maternal and child health outcomes to a great extent, it is important to emphasize on educating women. It is equally important to ensure health care services available to all geographical and economical accesses. Promotion of health related programs in rural areas targeting lower educated women are vital to increase awareness among mothers about the importance of postnatal care services. Women should be encouraged to read newspaper and also access to electronic media should be made easily available to them. Moreover, complete ANC visits (visits  $\geq 4$ ) for mothers should be pursued as much as possible. However, government should take necessary prompt actions to implement new strategies that can increase awareness among women regarding child and maternal health care to elevate the adverse consequences of avoiding postnatal care.

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