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Maternal factors of low birth weight babies in an antenatal care hospital in Bangladesh

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Abstract: Low birth weight (LBW) has been considered as the strongest predictor of child morbidity and mortality. The goal of this study was to inspect the socio-demographics and nutritional status of mother and its impact on neonatal birth weight. A cross-sectional study was conducted among 85 mothers with third trimester's pregnancy period of age between 17 to 35 years in maternal health care centers at Chittagong, Bangladesh. Average age of mothers was 24 ± 04 years and age at marriage it was 18 ± 03 years. Height and MUAC of the respondents were 153 ± 5.37 cm and 25.53 ± 3.09 cm respectively. Half of participants suffered from anemia (Hb level < 11 g/dL). Average birth weight was 2759.7 ± 561.42 g. The preterm birth was 10.6% and about 22.35% babies delivered by C section. Twenty eight percent of offspring were born with low birth weight (LBW), among the LBW babies, 11.76 % were born at home and 16.47 % at hospital. Maternal height (AOR: 2.79; 95% CI: 1.02-8.44), Mid Upper Arm Circumference (MUAC) (AOR 2.73; 95% CI 1.03-8.01) and gestational age (AOR 8.92, 95% CI: 1.76-45.16) were significantly associated with LBW of babies after adjusting the education level of mothers. The proportion of LBW was not negligible which still national public health concern in Bangladesh. Proper nutrition and monitoring on gestational length might minimize small size babies.

Keywords: maternal factors; low birth weight; MUAC; preterm; Bangladesh

1. Introduction

Low birth weight (LBW) is typically the absolute most determinants of newborn child mortality (UNICEF, 2004). Low birth weight (LBW) defined as less than 2500 g at birth (WHO, 1992). In 2015, 20.5 million newborns, an estimated 14.6 per cent of all babies born globally that year, suffered from low birth weight (Christian *et al.*, 2013). About half of the world underweight kids have born in South Asia (UNICEF, 2004; WHO, 2014). LBW babies die mainly in first years of their life because of malnutrition (Walden *et al.*, 2007; Shahnawaz, 2014).

Bangladesh rapidly meets most of the millennium development goals, but malnutrition rate still remains unacceptably high (Rahman *et al.*, 2016). National survey 2003–2004 reported about 36% infants born with lower size in Bangladesh, where 29% frequencies found in urban areas (BBS, 2005; Azimul *et al.*, 2009). In National survey of 2015, the LBW rate was 22.6 percent (IPHN, 2017). Additionally, commonness of LBW is conflicting from 17% to 25.5% and inconclusive (Khan *et al.*, 2018; Yasmeen and Azim, 2011). Besides, its determinants change crosswise over assorted settings and need examination with in various conditions (Hosain *et al.*, 2006).

Previous research found that LBW is a multifactorial outcome (Karim *et al.*, 2016). Maternal age, education and family income have been related to with LBW (Fall *et al.*, 2015; Silvestrin *et al.*, 2013; Wasunna and

Mohammed, 2002). Mothers with low MUAC and pre pregnancy BMI are more likely to deliver small babies (Mohanty *et al.*, 2006). In addition, antenatal hypertension, anemia and poor weight gain during pregnancy expand the danger of LBW (Badshah *et al.*, 2008; Feresu *et al.*, 2004). Obstetrical components of parity and gestational age likewise unequivocally connected with low birth weight (Hinkle *et al.*, 2014; Voigt *et al.*, 2004). In spite of the fact, indicators could be change among various settings and financial conditions.

Chittagong is the second largest city in Bangladesh. Many people have moved from rural area to the city and lead lower class life in city slums. They mostly took antenatal care from those types of low-cost maternity clinics. National study 2011 expressed most noteworthy recurrence (23%) of low birth weight found at Chittagong division (Haque *et al.*, 2015). According to existing literature, only one hospital based study was conducted in this setting which used only MUAC as hypothesized predictors of birth size (Ahmed *et al.*, 2000). But, other possible determinants could be contributed to the detrimental outcome. Understanding on the prevalence of LBW and its potential risk factors would be the key for developing and designing interventions to reduce the events of LBW.

2. Materials and Methods

2.1. Study setting

We conducted this study to know the events of LBW and its associated factors among mothers came to antenatal care clinic. We have selected one representative community clinic that provides low-cost services for pregnant women and children and located at the center of Chittagong city corporation Chittagong districts, 265 km from capital Dhaka. The total population of Chittagong district was 8,440,000 of 2011 census data (BBS, 2011). National survey 2011 stated highest rates (23%) of poor birth size found at Chittagong division (Haque *et al.*, 2015). Pregnant women who came to the clinic for regular health checkup invited to participate in this study.

2.2. Procedures and participants

The study was conducted in accordance with the declaration of Helsinki, 1964. The study was approved and reviewed department of Statistics, University of Chittagong. Ethical clearance obtained from data collecting institution (Approval no.: 01: 01/09/2015). Right to withdraw from the study at any time, without any precondition was maintained. Trained investigators explained the study objectives to the women.

Of a total of 105 women contacted in third trimester pregnancy period, only 85 women agreed to participate and the rest of the women who refused to participate, 19.05% (N = 20) due to lack of time or lack of interest in participating in the study. Pregnant mothers were asked, and written consent was obtained from 85 mothers after discussing the purpose, concealment, assured that this research will not be harmful for them. Data were collected with a pre-tested structured questionnaire in room of clinic beside the checkup room. Technicians of clinic assisted to collect data and require average 10 minutes for each participant. Response rate of the study was 80.95%.

2.3. Study variables

We collected data on socio-demographic of pregnant women, gestational age, mother's age, mother's age at married, mother's education, maternal height, pre-pregnancy weight, family income, maternal parity, and nutritional parameters including mid-upper arm circumference (MUAC), body mass index (BMI), and hemoglobin (Hb). We hypothesized that maternal age, education and family income, MUAC, pre pregnancy BMI, anemia and poor weight gain during pregnancy, parity and gestational age could be associated with LBW (Fall *et al.*, 2015; Silvestrin *et al.*, 2013; Wasunna and Mohammed, 2002; Mohanty *et al.*, 2006; Badshah *et al.*, 2008; Feresu *et al.*, 2004; Hinkle *et al.*, 2014; Voigt *et al.*, 2004).

2.4. Anthropometric measurement

Height of women measured using portable Harpenden stadiometer (Holtain Ltd, London, UK) and categorized as <151 cm and \geq 151 cm according to Kitange (1994). Mid-upper arm circumference (MUAC) measured with Talc insertion tape and classified into \leq 24 cm and > 24 (WHO 1995). We denoted <2500 gm as low birth weight (LBW) and \geq 2500 gm or (2500-4200) gm as normal birth weight (WHO, 1992). According to Engle & Kominiarek (2008) gestational age categorized as preterm (< 37 weeks) and term birth (\geq 37 weeks). Data on maternal Hb concentration collected from lab report prescribed by doctors. We defined Hb level <11 g/dl as anemic and \geq 11 g/dl as normal or nonanemic (Shirima and Kinabo, 2005).

2.5. Statistical analysis

Frequency distributions, descriptive analysis (mean, standard deviation (SD), range) were calculated for all variables. Multiple linear regression model was used with step wise backward selection method. All assumptions (independence, homoscedasticity, normality and linearity) of final model were checked by graphically and formal test. We used studentized residuals test to detect any outlier in response variable. Leverage test was used to know any outlier in predictors. Bivariate analysis performed to check the association between birth weight and other covariates. Multiple logistic regression analysis conducted to measure the effect of covariates on birth weight. We checked the final model with Hosmer and Lemeshow goodness of fit test statistic. We used statistical software SAS 9.3 and R 2.14.0 and, considered 5% level of significance.

3. Results

3.1. Characteristics of mothers and prevalence of LBW

Average age of participants was 24 years (SD 4 years). Maximum mothers 44(41.1%) belonged to age between 21 to 25 years. Mean age of marriage was 18 years (SD 3 years). One half (51.4%) of the respondents get married at \leq 18 years old. Mean pre-pregnancy weight was 50.48 kg (SD 9.29 kg). Illiterate or primary educated mothers comprised 19 (22.35%) of participants. Only 14 (13.1%) of respondents were employed.

Average height of the participant was 153 cm (SD 5.37 cm) whereas 32.7% (95% CI: 23.9; 42.5) subjects were less than 151 cm. According to the MUAC measurement, the average MUAC was 25.53 cm (SD 3.09 cm) while 39.3% (95% CI: 30.0; 49.2) mothers' was wasting, and 60.7% was normal. Of the interviewed, 64 mothers gave the blood for Hb analysis. Half (51.6%; CI: 38.73; 64.25) of the them had the Hb level $<$ 11 g/dL.

Average birth weight was 2759.7 ± 561.42 g. The preterm birth was 10.6% (95% CI: 4.96; 19.15). About 22.35 % babies delivered by C section and 71.77% mothers admitted hospital for child-birth. Prevalence of LBW was 28.23% (95% CI: 19.0; 39.04). Among the LBW babies, 11.76 % were born at home and 16.47 % at hospital.

3.2. Multiple regression analysis

The final model of multiple regression analysis contained the parameters of age, education, parity and gestational age. Age, education and gestational age were positively associated with birth weight but contemporary parity was negatively associated with birth weight. In general, a unit change of age, education level and gestational age corresponding to increases 75.4 gm, 85.37 gm and 88.66 gm birth weight respectively (Table 1). On the contrary, if expect one more child then the probability of birth weight decreases 309.94 gm (Table 1). After fitting the model all assumptions of the regression model was checked (Figure 1) and the model satisfies the normality, equality of the variance or homoscedasticity, independence of the residual and linearity of the model by the Shapiro-Wilk test, Levene test, Durbin Watson test and lack of fit test respectively. No outlier was found regarding response variable and predictors.

Table 1. Parameter estimates of LBW using multiple regression model.

Parameters	Estimate	Standard Error	Pr > t
Intercept	-1073.1	1038.4	0.3046
Age of mother (in years)	75.3954	26.306	0.0053
Education	85.3657	39.5086	0.0338
Parity	-309.94	115.243	0.0087
Gestational age at birth (in week)	88.6578	22.738	0.0002

3.3. Univariate analysis of influencing factors of birth weight (BW)

We used chi-square test to examine the association between birth weight and other covariates (Table 2). When the cell frequency was less than 5, the Fisher Exact test was performed as alternative to chi-square test. A significant association ($P=0.014$) between birth weight and gestational age was observed. Marginal significant association found between birth weight and maternal height and MUAC.

Table 2. Association between birth weight and other covariates of mothers in an antenatal care clinic, Chittagong, Bangladesh (N=85).

Parameters	Birth Weight		Chi-square	P-value
	Low (< 2500 gm) N (%)	Normal (≥ 2500 gm) N (%)		
Age (in years)				
≤ 20	6 (7.06)	15 (17.65)		0.329 ^{FET}
21-25	14 (16.47)	26 (30.59)		
>25	4 (4.71)	20 (23.53)		
Age at marriage (in years)			0.678	0.410
≤ 18	11 (12.9)	34 (40)		
>18	13 (15.3)	27 (31.8)		
Education				0.526 ^{FET}
Illiterate	2 (2.35)	5 (5.88)		
Primary	3 (3.53)	9 (10.59)		
Secondary	16 (18.82)	31 (36.47)		
Higher secondary & above	3 (3.53)	16 (18.82)		
Employment status				0.788 ^{FET}
Employed	3 (3.53)	9 (10.59)		
Unemployed	21 (24.71)	52 (61.18)		
Height (cm)			3.616	0.057 ^{MS}
<151	10 (11.76)	13 (15.29)		
≥ 151	14 (16.47)	48 (56.47)		
Mid Upper Arm Circumference (MUAC)			3.888	0.049 ^{MS}
≤ 24	13 (15.29)	19 (22.35)		
> 24	11 (12.94)	42 (49.41)		
Hemoglobin (g/dL) (N=54)				0.105 ^{FET}
<11	4 (7.41)	26 (48.15)		
≥ 11	8 (14.81)	16 (29.63)		
Parity				0.8450 ^{FET}
Nulliparous	11 (12.94)	23 (27.06)		
Primiparous	10 (11.76)	30 (35.29)		
Multiparous	3 (3.53)	8 (9.41)		
Gestational age at birth				0.014 ^{*FET}
Preterm (< 37 w)	6 (7.06)	4 (4.71)		
Term (≥ 37 w)	18 (21.18)	57 (67.06)		

FET=Fisher Exact Test; MS=Marginally significant * Significant at P<0.05

3.4. Multiple logistic regression analysis of influencing factors of low birth weight

Parameter estimates from multiple logistic regression model was shown in Table 3. Maternal height, MUAC and gestational age were significantly associated with low birth weight of infants after adjusting the education. The probability of low birth weight was 2.79, 2.73, 8.92 times higher for the respondents of height < 151 cm, MUAC ≤24 cm and gestational age at birth < 37 weeks compared to height ≥ 151 cm, MUAC > 24 and gestational age at birth ≥ 37 weeks respectively. A Hosmer and Lemeshow test (P = 0.51) indicated that the model fit the data well. All the parameters of fitted model were significant tested by Likelihood ratio test by comparing null model and saturated model (Chi-square=14.36, P-value=0.006).

Table 3. Parameter estimates of low birth weight using multiple logistic regression model.

Parameters	Estimate	Standard Error	P-value	OR (95% CI)
Height of mother <151cm ^a	1.026	0.565	0.034	2.79 (1.02-8.44)
MUAC ≤24 cm ^b	1.004	0.549	0.027	2.73 (1.03-8.01)
Gestational age <37 w ^c	2.188	0.828	0.008	8.92 (1.76-45.16)
Education below secondary ^d	0.069	0.655	0.566	1.07 (0.30-3.87)

^a Height of ≥151 cm as reference or comparison group. ^b MUAC >24cm as reference or comparison group. ^c Gestational age ≥ 37 weeks as reference or comparison group. ^d Secondary and above as reference or comparison group.

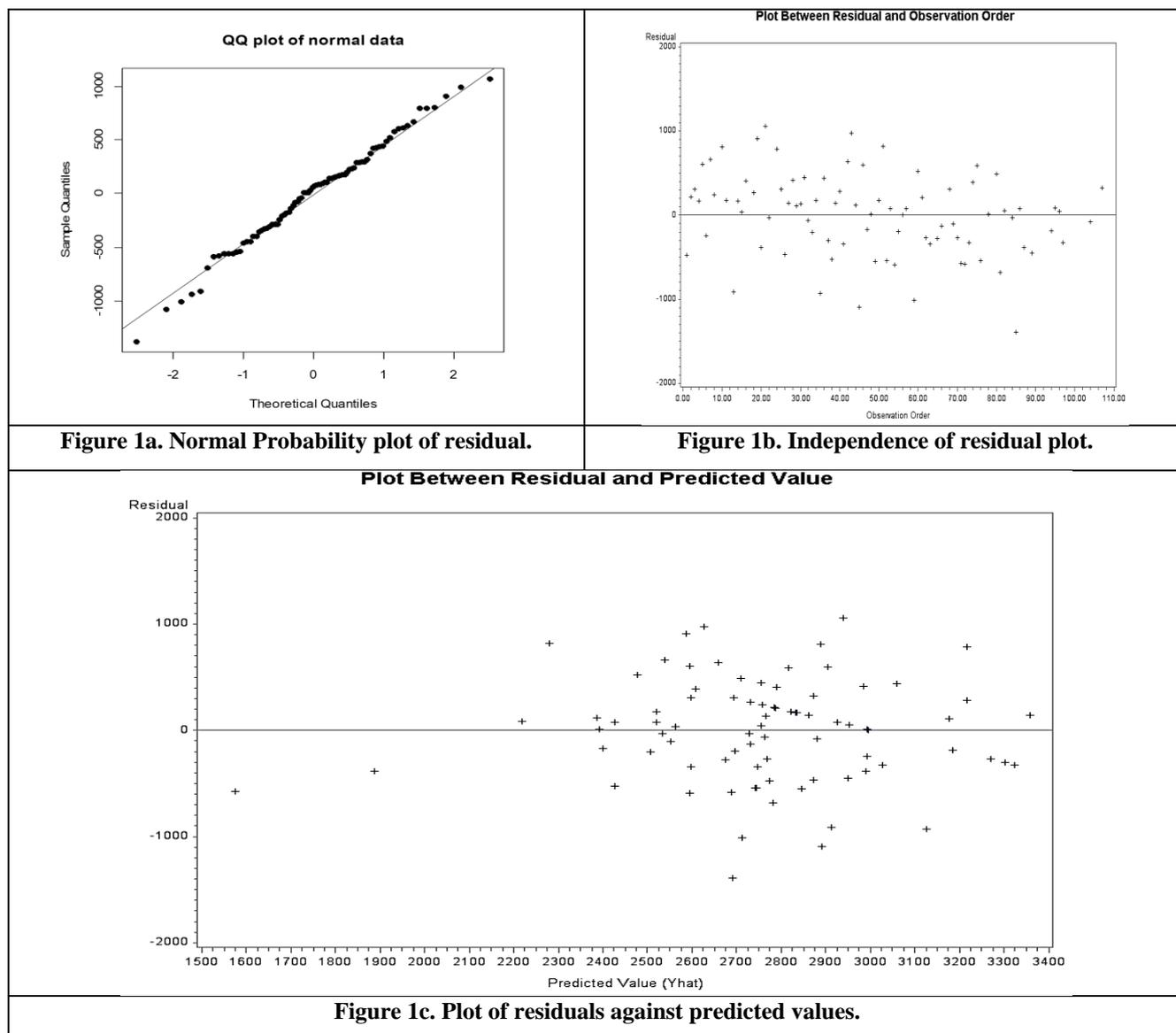


Figure 1. Normality, independence and homoscedasticity checked by using graphical method.

4. Discussion

This study explores the prevalence and determinants of LBW among low income city mothers. Findings showed that twenty eight percent of neonates were smaller in weight. Maternal height, gestational age and MUAC were associated with this birth outcome.

National survey 2011 found 23% LBW in the Chittagong District (Haque *et al.*, 2015). This study revealed slightly higher prevalence. It was similar 28.3% in demographic Surveillance of Ethiopia and 27% in Nepal (Assefa *et al.*, 2012; Sharma *et al.*, 2015). Our higher prevalence might be due to lower socio-economy of the participants. About half of our participants came from the family income below 10000 BD TK. Money is key to get access to facilities, food and services may lead mothers fit for child birth.

Recent reviews have suggested that mother’s nutritional status positively affected LBW (da Silva Lopes *et al.*, 2017). Present study shows that the risk of LBW was 2.73 times higher for MUAC \leq 24 cm than $>$ 24 cm. Sebayang *et al.* (2012) found that MUAC was closely associated with LBW among Indonesian babies. Similar result shown among the newborn in a maternity hospital of Zibabwe (Feresu *et al.*, 2015). Nutritional management of mother during pregnancy has a strong role to reduce the LBW (Ramakrishnan, 2004). Research in Bangladesh noted LBW as determinants of malnutrition of under-five children (Rahman *et al.*, 2016). Nutritional care on pregnant mother can lower LBW as well as malnutrition of under- five children in this area. Research in few Nordic countries has shown that maternal height was significantly associated with birth weight (Zhang *et al.*, 2015). We found 2.79 times higher LBW in the mothers height of \leq 151 cm then $>$ 151 cm in our investigation. Similar finding was observed in Sudanese newborn (Elshibly and Schmalisch, 2008). Although,

Veena *et al.* (2004) pointed out that infant size is influenced by paternal rather than maternal height while Voigt *et al.* (2004) stated that influence of paternal characteristics is negligible. Shorter women may have a small uterus size which may limiting fetal growth (Zhang *et al.* 2007) or height reflect a nutritional condition indirectly effect on fetal growth in uterus (Subramanian *et al.* 2009).

Investigation showed that Bangladesh is one of leading countries for small-for-gestational-age infants (Lee *et al.* 2013). We observed low birth weight was 8.92 times higher for Gestational age at birth ≤ 37 weeks than >37 weeks. Similarly gestational age considered as a significant contributor to birth weight in in the United States (Donahue, 2010). Elshibly and Schmalisch (2008) found that gestational age and LBW was significantly associated.

Several studies have reported increased risks of low birth weight (LBW) among offspring of adolescent mother (Chen *et al.*, 2007; Haldre *et al.*, 2007). We observed an association of maternal age with birth weight of infant. Another study of Britto *et al.* (2013) showed that age of less than 20 years was more likely to have LBW baby than ≥ 20 years. Another study was found that the birth weights are different with different age (Tabrizi and Saraswathi, 2012). In this study, more than half 55 (51.4%) of the respondents were married while as ≤ 18 y old. Many studies showed that children of young mother have an increased risk of low birth weight and preterm birth (Fall *et al.*, 2015).

Socio-economic variables have long been known to influence the outcome at birth (Elshibly and Schmalisch, 2008). We found a positive association of maternal education with LBW of child. In Bangladesh, maternal formal education led to decrease in child stunting (Semba *et al.*, 2008). Another study by Rahman *et al.* (2016) shown higher education of mother strongly associated with LBW of babies in a nationally represented survey in Bangladesh. Education acts as gate way for awareness leads mother to cope up the challenges of pregnancy resulting better outcome. Parity was negatively associated with birth weight in our study. Previous studies found lowest birth weights among infants of nulliparous women (Shah, 2010; Melve *et al.*, 2002; Pedersen *et al.*, 2007). Hinkle *et al.* (2014) noted that birth weight continued to increase minimally up to third parity. Our study was not free from limitations. This hospital based study may narrow its generalization. All participants were not educated might left some information bias.

5. Conclusions

Maternal height, MUAC and gestational age were major determinants of birth size. Improving and monitoring the nutritional status of women particularly pregnant women would lower the incident. Results of this study suggest future study to identify risk factors of pregnancy malnutrition and premature delivery. We expected our findings will help decision makers to design and implement policy to reduce incidence of LBW babies in similar settings of Bangladesh and other developing countries.

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Conflict of interest

None to declare.

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