Mal J Nutr 22(2): 257 - 265, 2016

Maternal Factors are Important Predictors of Low Birth Weight: Evidence from Bangladesh Demographic & Health Survey-2011

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ABSTRACT

Introduction: Low birth weight (LBW) children are vulnerable to infections and malnutrition leading to poor physical, mental and social development. The aim of this study was to investigate the prevalence and factors associated with LBW among Bangladeshi children. **Methods:** Secondary data were extracted from 8,364 married and currently non-pregnant Bangladeshi women having at least one child (age ≤5 years) from the Bangladesh Demographic and Health Survey 2011 (BDHS, 2011). **Results:** Overall prevalence of LBW was 17.6%. Younger mothers (age ≤20 years) were more likely (OR= 0.812) to deliver LBW infants than those between 21 and 29 years. Uneducated mothers had a higher chance (OR=0.552) of having LBW infants than mothers with higher education. Female infants were more likely (OR= 1.292) to be born LBW than males ($p<0.01$). Mothers from poor families, who did not attend ante-natal visits during pregnancy, and did not receive tetanus injections during pregnancy were more likely to deliver LBW infants. Underweight mothers had a higher probability than normal (OR= 0.880) and overweight (OR= 0.802) mothers to deliver LBW infants. **Conclusion:** The prevalence of LBW children in Bangladesh remains high. Mothers' education, socio-economic status and nutritional status are important predictors of delivering LBW infants. Reducing the prevalence of LBW should continue to be a health priority of government and non-government organisations.

Key words: Bangladesh, low birth weight, maternal education, nutritional status, socio-economic status

INTRODUCTION

Birth weight of children less than 2.50 kg is considered as low birth weight (LBW), and it is an important determinant of childhood morbidity. LBW is positively associated with mortality risk during the first year of life (Aluvaala *et al.*, 2015). Moreover, increased risk of infection, poor academic performance, problem behaviour and learning difficulties during childhood are strongly associated with LBW (Dunin-Wasowicz *et al*., 2000). The rates of LBW in children are highest in Asian and African countries followed by Latin America and Caribbean countries; while Oceania and Europe have the lowest rates (Neggers & Crowe, 2013). The prevalence of LBW children is 16% worldwide, and 28%

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of them are in South Asia, with 22% in Bangladesh (UNICEF, 2015). Reducing the prevalence of LBW can play a vital role in decreasing child mortality, which is one of the important concerns of the Millennium Development Goals (MDGs). Bangladesh, as one of the signatories of the MDGs, has achieved considerable progress in child mortality by 2014 (MDG, Bangladesh Progress Report, 2015).

Many factors are associated with LBW of children. These include maternal age, poor maternal nutritional status, gestational age, interval between pregnancies, parents' educational status, parity, violence during pregnancy, lack of antenatal care and socio-economic status (Ohlsson & Shah, 2008; Hossain *et al*., 2006). In Bangladesh, researchers have established a relationship between LBW children and mother's nutrition, teenage pregnancy, poor antenatal care, mother's education (Khatun & Rahman, 2008) and maternal age (Klemn *et al*., 2013). Evidence highlighting determinants of LBW in children have been discussed above, but most of the studies were conducted in specific settings i.e., community or rural based (Klemn *et al*., 2013; Shannon *et al*., 2008; Sharma & Kader, 2013). The study populations in most of the studies were relatively small and major determinants of LBW across a country may not have been taken into account in some of these studies.

As children are considered and treated as the future builders and developers of a particular country, special attention should be paid to children's health due to their unique role in the future of the nation. So it is important to investigate the relationship between the LBW in children and its relationship to parents' education, parity, parents' wealth index, parents' occupation, types of toilet at home, gender, number of injections before pregnancy, ante-natal visit during pregnancy, place of delivery, and nutritional status of mother, in order to ensure remedial measures are undertaken. Therefore, we designed this study to determine the prevalence of LBW among Bangladeshi children and assess the association between LBW and parents' socio-economic and demographic factors.

METHODS

The study sample consisted of 8,364 married, currently non-pregnant Bangladeshi women having at least one child (age ≤5 years). The cross-sectional data was taken from the Bangladesh Demographic and Health Survey (BDHS 2011). The BDHS 2011, which was carried out from 8 July to 27 December 2011, collected socio-economic, demographic, anthropometric, health and lifestyle information from 17,842 ever-married (age, 15 to 49 years) Bangladeshi women. The survey design, survey instruments, measuring system, quality control and ethics statement with subject consent have been reported elsewhere (NIPROT, 2013). The survey was conducted under the authority of the National Institute of Population Research and Training (NIPORT) of the Ministry of Health and Family Welfare, Bangladesh. After removing outliers, cases with missing data, excluding women having no children, women having children but age >5 years and currently pregnant women, the data set was reduced to 8,364 for the analysis in the current study.

Sampling

The sample for the BDHS 2011 was nationally representative and covered the entire population residing in non-institutional dwelling units in Bangladesh. Two-stage stratified sampling was used for selecting households. In the first stage, 600 enumeration areas (EAs) (207 from urban and 393 from rural) were randomly selected. In the second stage, a systematic sample of 30 households was selected from each EA. The selected EAs provided a statistically reliable estimate of key demographic and health variables for the country as a whole and for urban and rural

areas separately and for each of the seven divisions (NIPORT, 2013).

Measurement of variables

Outcome variable

The outcome variable for this study was child (age ≤ 5 years) birth weight which was divided into two categories; (i) low birth weight, defined as very small or smaller than average size (coded, 1); (ii) normal weight defined as average or above (coded, 0). Children whose birth weight was less than 2.5 kilograms were considered as LBW (NIPORT, 2013). Since most births (71.0%) in Bangladesh occur at home, where children often are not weighed at birth, data on birth weight were available for only a few children (NIPORT, 2013). In BDHS 2011, mother's perception was considered for their baby's weight; mothers were asked; what was the birth weight of her baby? Mother's report of a child being "very small" or "smaller than average", even though subjective, was considered a useful proxy for LBW (NIPORT, 2013).

Independent variables

The explanatory variables are listed below with their categories shown within parenthesis: mother's age (≤ 20 years: 1, 21-29 years: 2, 30-49 years: 3,) parents' education level (uneducated: 0, primary: 1, secondary: 2, higher: 3), wealth index (poor: 1, middle: 2, rich: 3); father's occupation (agriculture: 1, service and business: 2; worker: 3); mother's occupation (housewife: 1, others: 2); status of toilet (hygienic: 1, unhygienic: 2), religion (Islam: 1, other: 2); gender of child (male: 1, female: 2); place of delivery (home: 1, hospital/clinic: 2); parity (1: 1, 2: 2, 3: 3, ≥4: 4); injection before pregnancy (no injection: 0, 1-3: 2, ≥4: 3); antenatal visit during pregnancy (no visit: 1, yes: 2); nutritional status of mother (underweight: 1, normal weight: 2, over weight and obese: 3). Nutritional status was measured by body mass index (BMI) with underweight being BMI ≤18.5 kg/m^2; normal weight 18.5<BMI<25 kg/m^2; overweight 25≤BMI<30 kg/m^2; and obese being BMI ≥30 kg/m^2 (Hossain *et al.,* 2012).

Statistical Analysis

Chi-square (χ^2)-test was performed in this study to examine the association between LBW of children and other selected variables. Significant associated variables were considered as independent factors for multiple logistic regression model. This model was used to find the effects of parents' socio-economic demographics on LBW of children. Statistical analyses were carried out using SPSS software (version IBM 19). Statistical significance was accepted at $p<0.05$.

RESULTS

Socio-economic and demographic characteristics of the survey participants

A total of 8,364 Bangladeshi currently non-pregnant married women aged 15 to 49 having at least one child (age ≤5 years) were analysed in the present study. The prevalence of LBW babies in Bangladesh is 17.6% (Table 1). Comparing the prevalence of LBW by mother's age, the rate of LBW babies was much higher (19.8%) among younger mothers (age≤20 years), with the association being statistically significant ($p<0.01$). Uneducated parents were found to have more LBW babies than educated parents, and the association between level of parents' education and child birth weight was significant ($p<0.01$) for both father and mother. Poor families had a higher prevalence of LBW children (19.6%) compared to middle (17.2%) and rich families (15.7%) with the association between child birth weight and parents' wealth index being significant ($p<0.01$). Families living in households with unhygienic toilets had a higher prevalence of LBW children compared to families living in households with hygienic toilets, with the association between the two factors being statistically significant

(p<0.01). The prevalence of LBW among female (19.5%) was much higher than male children (15.8%) with the association between LBW and the gender of children being significant (p<0.01). Women who delivered at home were more likely to have LBW babies(18.3%) than woman who delivered at hospital/clinic (15.7%), with the association between these two factors being significant (p<0.01). The prevalence of LBW babies was much higher among mothers who had 4 or more children (19.6%) compared to mothers with three (16.9%) and two children (16.5%), with the association between parity and child birth weight being significant (p<0.05). Mothers who did not get tetanus injection before pregnancy were more likely to give birth to LBW children (24.6%) compared with mothers who took injection, with the association between taking injections before pregnancy and child birth weight being significant (p<0.01). Mothers who did not make antenatal visits during pregnancy had more LBW children compared to mothers who visited with the association between birth weight of children and antenatal visits during pregnancy being significant (p<0.01). In terms of nutritional status of mothers, we found that the prevalence of LBW children was much higher among underweight mothers (19.8%) compared to normal weight (17.1%) and overweight mothers (14.9%), with the association between mothers' nutritional status and child birth weight being significant (p<0.01) (Table 1).

Effect of parent's socio-economic and demographic factors on child low birth weight

Only the associated factors were considered as independent variables for the multiple logistic regression model. The model showed that younger mothers (age ≤20 years) were more likely to have LBW babies than older mothers (21≤age≤29 years) (OR=0.812, 95% CI: 0.704-0.937; p<0.05). Mothers with no education had a greater chance of having LBW babies compared to mothers with higher education (OR=0.552, 95% CI: 0.334-0.914; p<0.05). Children born in poor families were more likely to be LBW than children born in middle-class (OR = 0.870, 95% CI, 0.744-1.017; p<0.05) and rich families (OR = 0.806, 95% CI, 0.706-0.921; p<0.01). Female children were more likely to be LBW than male (OR=1.292, 95% CI: 1.154-1.447; p<0.01). Mothers who did not make antenatal visits during pregnancy period were more likely to have LBW babies than their counterparts (OR=0.826, 95% CI: 0.680-1.004; p<0.05). Mothers who did not take any tetanus injection during the pregnancy were more likely to have LBW babies than mothers who took the injection (OR=0.743, 95% CI: 0.565-0.979; p<0.05). Underweight mothers were more likely to have LBW babies than normal weight mothers (OR=0.880, 95% CI: 0.774-1.000; p<0.05) and overweight mothers (OR=0.802, 95% CI: 0.649-0.991; p<0.05) (Table 2).

DISCUSSION

This study suggests that 17.6% LBW children were born during the study period. This is slightly lower compared to the study by UNICEF which reported a LBW prevalence of 22% in Bangladesh, 28% in India, 18% in Nepal, 32% in Pakistan, 17% in Sri Lanka and 22% in the Maldives (UNICEF, 2015). So, it can be said that the prevalence of LBW in Bangladesh is better than in India, Nepal, Pakistan or Maldives.

This study demonstrated that younger mothers (age≤20 years) delivered more infants with LBW than older (age>30 years) and middle-aged (age 21-29 age) mothers. Thus the maternal age of 21-29 years was found to be the most suitable age group for giving birth to normal weight babies. The finding of the present study is in agreement with studies such as those carried out in Japan (Terada *et al*. 2013), India (Aras, 2013), British Columbia (Lisonkova *et al*., 2010), and Bangladesh (Khatun & Rahman, 2008).

Table 1. Background characteristics of the respondents

Characteristics	*Covariate* %	*Children birth weight* *Normal (82.4%)*	*Low (17.6%)*	χ^2 *value*	*p-values*
Mother age (in years)	Age ≤ 20 (20.4)	1370(80.2)	339(19.8)	12.030	0.002
	Age 21-29 (56.4)	3948(83.6)	773(16.4)		
	Age 30-49 (23.2)	1575(81.4)	359(18.6)		
Mother's educational status	Uneducated (19.2)	1278(79.5)	330(20.5)	30.757	0.001
	Primary (30.3)	2063(81.4)	471(18.6)		
	Secondary (42.6)	2968(83.3)	595(16.7)		
	Higher (7.9)	584(88.6)	75(11.4)		
Father's educational status	Uneducated (28.0)	1881(80.3)	461(19.7)	25.883	0.001
	Primary (29.3)	1999(81.6)	450(18.4)		
	Secondary (29.3)	2034(83.1)	415(16.9)		
	Higher (13.4)	979(87.1)	145(12.9)		
Wealth index	Poor (41.5)	2793(80.4)	680(19.6)	16.019	0.001
	Middle (19.1)	1320(82.8)	274(17.2)		
	Rich (39.4)	2780(84.3)	517 (15.7)		
Father's occupation	Agriculture (17.6)	1210(82.3)	260(17.7)	4.785	0.091
	Service & business (30.3)	2123(83.7)	412(16.3)		
	Worker (52.1)	3560(81.7)	799(18.3)		
Mother's occupation	Housewife (83.6)	610(82.3)	131(17.7)	1.805	0.179
	Other (16.4)	126(86.9)	19(13.1)		
Status of toilet	Hygienic (50.1)	3502(83.6))	685(16.4)	8.710	0.003
	Unhygienic (49.9)	3391(81.2)	1471(18.8)		
Religion	Islam (90.2)	6229(82.6)	131417.4)	1.481	0.224
	Others (9.8)	664(80.9)	157(19.1)		
Gender of child	Male (51.6)	3633(84.2)	681(15.8)	19.948	0.001
	Female (48.4)	3260(80.5)	790(19.5)		
Place of delivery	Home (72.4)	4949(81.7)	1109(18.3)	7.839	0.005
	Hospital/clinic (27.6)	1944(84.3)	362(15.7)		
Parity (In number)	1 (28.3)	1945(82.2)	422(17.8)	7.916	0.048
	2 (31.9)	2225(83.5)	439(16.5)		
	3 (19.0)	1322(83.1)	268(16.9)		
	≥4 (20.8)	1401(80.4)	342(19.6)		
Injection before pregnancy	No injection (10.0)	282(75.4)	92(24.6)	16.730	0.001
	1-3 (30.7)	929(80.6)	223(19.4)		
	≥4 (59.3)	1863(83.7)	363(16.3)		
Antenatal visit during pregnancy	No visit (27.7)	1840(79.6)	473(20.4)	18.072	0.001
	Yes (72.4)	5053(83.5)	998(16.5)		
Nutritional status of mother	Underweight (<18.5) (27.5)	1845(80.2)	456(19.8)	12.719	0.002
	Normal weight (18.5<BMI<24.9) (60.0)	4161(82.9)	860(17.1)		
	Overweight and obese (BMI≥25.0) (12.5)	887(85.1)	155(14.9)		
Total		6893(82.4)	1471(17.6)		

Table 2. Determinants of low birth weight in Bangladesh

Independent variable	*Coefficient (β)*	*SE of (β)*	*Odds Ratio (OR)*	*p- values*	*95% CI of OR*
Mother's age (in years)					
Age ≤20®			1.00	0.007	
Age 21-29	-0.208	0.073	0.812	0.004	0.704-0.937
Age 30-49	-0.053	0.085	0.948	0.534	0.802-1.121
Mother's educational status					
Uneducated ®			1.00	0.055	
Primary	-0.018	0.129	0.982	0.891	0.763-1.266
Secondary	-0.255	0.150	0.775	0.089	0.577-1.040
Higher	-0.594	0.257	0.552	0.021	0.334-0.914
Father's educational status					
Uneducated ®			1.00	0.467	
Primary	-0.150	0.117	0.860	0.199	0.684-1.082
Secondary	-0.100	0.131	0.905	0.445	0.700-1.170
Higher	-0.255	0.191	0.775	0.181	0.533-1.126
Wealth index					
Poor®			1.00	0.005	
Middle	-0.140	0.080	0.870	0.040	0.744-1.017
Rich	-0.215	0.068	0.806	0.001	0.706-0.921
Gender of child					
Male ®			1.00		
Female	0.257	0.058	1.292	0.001	1.154-1.447
Status of toilet					
Hygienic ®			1.00		
Unhygienic	0.119	0.092	1.126	0.195	0.941-1.347
Place of delivery					
Home ®			1.00		
Hospital	0.129	0.109	1.137	0.237	0.919-1.408
Parity					
1®			1.00	0.388	
2	-0.160	0.116	0.852	0.166	0.679-1.069
3	-0.190	0.133	0.827	0.155	0.637-1.074
≥4	-0.061	0.135	0.941	0.652	0.723-1.225
Injection before pregnancy					
No tetanus injection®			1.00	0.069	
1-3	-0.152	0.146	0.859	0.297	0.645-1.143
≥4	-0.297	0.140	0.743	0.035	0.565-0.979
Antenatal visit during pregnancy					
No visit ®			1.00		
Yes	-0.191	0.099	0.826	0.049	0.680-1.004
Nutritional status of mother					
Underweight®			1.00	0.062	
Normal weight	-0.128	0.066	0.880	0.049	0.774-1.000
Overweight	-0.221	0.108	0.802	0.041	0.649-0.991

Parent's education is an important factor for giving birth to normal weight babies, and in this study it was found that uneducated parents were more likely to have LBW babies. This finding was in agreement with previous studies **(**Fan, 2015); Kader & Perera, 2014; Muthayya, 2009; Khatun & Rahman, 2008; Astone, Misra & Lynch, 2007). Thus, maternal educational status was found to be a strong determinant of LBW. Among the less educated parents, both poverty and poor knowledge of a balanced diet contribute to LBW (Muula, Siziya & Rudatsikara, 2011). Less educated mothers are more likely to have poor health habits (e.g. smoking, drug or substance uses) and have limited access to prenatal care (Kader & Perera, 2014; Muula *et al.,* 2011) The present study also found that the rate of LBW was higher among less educated mothers compared to highly educated mothers. Therefore, intervention to improve the educational level of females is important to reduce the prevalence of LBW in Bangladesh.

Mothers from poor famiies are more likely to have LBW children than mothers from rich families. Previous studies also found the wealth index to be an important LBW factor (Yasmeen & Azim, 2011; Dasgupta & Basu, 2011). The present study found that female babies were more likely to be LBW than male babies. Similar results have been found in previous studies in India (Kader & Perera, 2014). In Bangladesh, if it is known that the mother is carrying a male foetus, she is given better care and this is one of the reasons for male children having a better birth weight than female children. The quality of antenatal service and receiving tetanus injection were found to be preventive against LBW. The antenatal care of the mother was significantly and positively associated with improvements in dietary practice; also monitoring and encouragement to reach expected weight gain during pregnancy by ante-natal staff resulted in improvements in neonatal outcomes. This finding was consistent with that of several other studies (Khanal, Zhao & Sauer,, 2014; Awiti, 2014; Ahmed, Khoja & Tirmizi, 2012; Qadar *et al*., 2012; Krans & Davis, 2011). Therefore, necessary facilities and utilisation of antenatal care should be further investigated to understand the obstacles and opportunities in the way of improved services. The undernutrition of the mother is the crucial factor for the LBW of a child. In our study, it was observed that undernourished mothers were more likely to give birth to LBW infants than normal weight mothers. Previous studies had found maternal malnutrition status to be a strong determinant of LBW (Louiza *et al*., 2010; Dharmalingam, Navaneetham & Krishnakumar, 2010). Therefore, proper nutrition should be provided to the mother during pregnancy, and pre-natal and post-natal care.

Limitations of the study

In Bangladesh, at the time of the BDHS 2011 survey, 71% of the deliveries took place at home where the weight of the new born was not noted. In the BDHS 2011 survey, the mother's report of a child being "very small" or "smaller than average" was noted as LBW, and normal weight was defined as average or above; however, these terms were observd to be subjective (NIPORT, 2013). The present study considered the risk factors for LBW children in Bangladesh which were available in the data set collected by BDHS-2011. Other possible influences on LBW children include mother's smoking habits, gestational age at delivery, mothers' pre-gestational BMI, mothers' caffeine intake, mothers' alcohol consumption during pregnancy, gestational diabetes, and weight gain during pregnancy. Clearly, more research will be required to provide a more definitive answer for LBW children in Bangladesh.

CONCLUSION AND RECOMMENDATIONS

Mothers' age, parents' education, antenatal visits and receiving tetanus injection during pregnancy, poverty and undernutrition are the most important predictors for LBW infants. The prevalence of LBW among female children is noted to be higher than in male children in Bangladesh.

Government and non-government organisations should take measures to address the factors that lead to LBW, as a priority. Besides, the government should ensure safe motherhood and safe delivery by ensuring trained manpower and functioning institutions. Government and non-government organisations should establish an effective mechanism for recording birth weight of every neonate immediately after delivery. Emphasis should be given on effective Advocacy, Communication and Social Mobilisation (ACSM) to promote proper nutrition, appropriate ante- and post-natal care and vaccination of pregnant women. Finaly, child marriages should be prevented to ensure healthy babies are born to mothers.

Conflict of interest

All authors declare that they have no conflict of interest. There was no grant, technical or corporate support for this research project.

ACKNOWLEDGEMENTS

The Ministry of Health and Family Welfare (MOHFW), Bangladesh has supported this study with data and reports. The authors are very grateful to MOHFW, Bangladesh for this support. The authors gratefully acknowledge the support extended by Department of Population Science and Human Resource Development, Rajshahi University, Bangladesh, where the study was conducted.

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