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Maternal Risk Factors Associated with Low Birth Weight in Newborns: A Hospital Based Case-Control Study

SUHA JESMIN[1], SHIFFIN RIJVI[2*], RUMA SENGUPTA[3]

Abstract:

Background: *Birth weight is the single most crucial criterion for determining neonatal and infant survival, hence investigations on risk factors that lead to this condition are critical. This study aimed to maternal factors responsible for delivering low birth weight (LBW) babies in Bangladesh.*

Methods: *This case-control study was conducted at the Obstetrics and Gynaecology ward, BIRDEM general Hospital. All procedures were performed in accordance with the Declaration of Helsinki and informed consent was obtained from all subjects. Fifty mothers of LBW babies (<2500 g) were considered as cases, while 150 mothers of normal birth weight (2500-4000 g) babies were enrolled as controls. Data were collected from both hospital record and direct interview by researcher herself. Data were recorded in separated case record form and analyzed by SPSS 24.*

Results: *Maximum mothers (74.7%) from control group were aged ≤30 years at delivery, while maternal age of 50% cases were >30 years (p=0.001). Multivariate logistic regression analysis found that para ≥3 (AOR=3.63, 95% CI= 1.10-11.96, p=0.034), preterm labor (AOR=3.28, 95% CI= 1.50-7.16, p=0.003), gestational hypertension (AOR=2.87, 95% CI= 1.22-6.77, p=0.016) and pre-mature rupture of membrane (PROM, AOR=3.22, 95% CI= 1.10-9.37, p=0.032) were the independent maternal factors for LBW baby. However, gestational diabetes mellitus, anaemia, previous history of CS, hypothyroidism, UTI, vaginal candidiasis, polyhydramnios and oligohydramnios had no such association with LBW.*

Conclusion: *Para ≥3, preterm labor, gestational hypertension and PROM are the significant maternal factors for LBW babies.*

Keywords: *Low birth weight, LBW, Gestational hypertension, PIH, high parity, PROM*

Background:

Birth weight is now widely recognized as an important determinant of a child's survival, growth, and development, as well as a useful indicator of maternal health, nutrition, and quality of life. Delivery of low birth weight (LBW) baby is a major public health problem worldwide, especially in developing countries.[1] South-central Asia accounts for half of all low-birth-weight babies worldwide, wherein Bangladesh accounts for more than a quarter (30%).[2] Thus, reducing LBW is an important public health concern and a major determinant in the achievement of sustainable development goals.

Being born with LBW is widely considered to be a disadvantage to the child. LBW is responsible for 60 to 80 percent of all newborn deaths. It is a leading cause of perinatal death as well as newborn and childhood morbidity in the short and long term.[3] LBW has been linked to an increased risk of infection,

1. Associate Professor, Department of Obstetrics and Gynaecology, Anwer Khan Modern Medical College, Dhaka.
2. Assistant Professor, Department of Obstetrics and Gynaecology, Anwer Khan Modern Medical College, Dhaka.
3. Assistant Professor, Department of Obstetrics and Gynaecology, BIRDEM General Hospital, Dhaka.

Address of Correspondence: Dr. Shiffin Rijvi, Assistant Professor, Anwer Khan Modern Medical College, Dhaka, Bangladesh, Cell: +8801736416335, Email: drshiffinrijvi74@gmail.com

physical and mental impairments. Children who survive LBW have a higher risk of repeated illness, malnutrition, behavior and learning problems.[2] LBW has also been linked to the high frequency of stunting in low-income nations, and it may have a role in the etiology of adult-onset chronic dietary illnesses such obesity, diabetes, and cardiovascular disease.[4]

Many variables, both maternal and fetal, contribute to LBW. The mother's overall health status has a direct impact on the baby's weight at birth. The most important predictor of birth weight is the mother's environment, and factors that prevent normal circulation through the placenta cause growth restriction by limiting nutrition and oxygen supply to the fetus.[1] The biological and social risk factors for delivering LBW baby are inter; nonetheless, the majority of them are modifiable.[5]

Early detection and management of maternal risk factors is necessary to minimize low birth weight mortality. As a result, the underlying variables must be identified in order to develop appropriate measures for lowering maternal and child health issues. Hence, this study aimed to explore maternal risk factors associated with the prevalence of LBW in newborn babies in order to develop effective and efficient strategies to reduce infant mortality rate in Bangladesh.

Methodology:

This case-control study was performed in the Obstetrics and Gynaecology department, BIRDEM general Hospital, a tertiary care center located in Dhaka, Bangladesh. The study data were collected between January 2016-December 2017 by interview with the mothers, abstraction of medical records and anthropometry. Low birth weight (LBW) was defined as a live newborn weighing less than 2,500 g, irrespective of the period of gestation[4]. All babies were weighed within one hour after birth.

Fifty mothers of LBW babies were considered as cases, while 150 mothers of normal birth weight (2500-4000 g) babies were enrolled as controls. Controls were identified from birth records as the next three consecutive eligible deliveries of a non-LBW baby after a woman delivered a LBW baby.

The quality of the data was ensured by properly designing the tool and the questionnaire was pre-tested in randomly selected 5 cases and 15 controls before actual data collection, and some minor modifications were made accordingly. The principal investigators throughout the data collection process were in close contact and under close supervision. Data were collected from both hospital record (to minimize recall bias) and direct interview. Records and delivery registers were reviewed for patient management and pregnancy outcomes. Maternal and foetal outcomes were assessed using delivery registers and individual maternity booklets. Individual maternity booklets were also reviewed to establish how they were managed during labour and delivery as well as post-partum. Data from the cases and controls were obtained in a similar approach, reducing information bias.

Study variables: Study variables were demographic (maternal age, height, weight at and after delivery) and obstetric history (gestational age at delivery, para, previous caesarian section (CS), gestational diabetes mellitus, gestational hypertension, history of anti-hypertensive medication, hypothyroidism, anaemia, urinary tract infection (UTI), premature rupture of membrane (PROM), vaginal candidiasis, polyhydramnios and oligohydramnios).

Operational definition: Pregnancy induced hypertension (PIH) was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg in a previously normotensive pregnant woman after ≥20 weeks of gestation in the presence of proteinuria or new signs of end-organ dysfunction. The blood pressure readings were documented on at least two occasion 4 hours apart.

Preterm birth was defined as birth below 37 weeks' of gestation.

Premature rupture of membranes (PROM) was defined as the rupture of the fetal membranes before the onset of labor.

Gestational diabetes mellitus (GDM) was defined as 5.1 mmol/L ≤FBG < 7.0 mmol/L at the time of the first pregnancy check-up and meets the requirements of FBG ≥5.1 mmol/l, 1-hour PBG ≥10.0 mol/l or 2-hour PBG ≥8.5 mmol/l during the 75 g glucose tolerance test in 24 - 28 weeks of pregnancy.[6]

Ethical statement: The study was approved by the Ethics Committee of the BIRDEM general Hospital. All procedures were performed in accordance with the Declaration of Helsinki and informed consent was obtained from all subjects.

Data acquisition and statistical analysis: All the data were entered into the SPSS package (version 24). Association of the risk factors under study was assessed by applying chi –square test taking a level of significance of $p < 0.05$. Univariate and multiple logistic regression was done to detect odds ratio (OR) of maternal risk factors in table 2. For skewed data, non-parametric test (Mann Whitney U test) was used for analyzing continuous variables in figure 1.

Result:

Maximum mothers (74.7%) from control group were aged d"30 years at delivery, while maternal age of 50% cases were more than 30 years (p=0.001). Gestational age at delivery was significantly higher in controls compared to cases (36.78±2.23 vs 34.80±2.63 weeks, p<0.001). Maximum cases (68.0%) were delivered before 37 weeks whereas maximum controls (69.0%) were termly delivered (p<0.001). Parity ≥3 were more common in cases compared to controls (36% vs 8.7%, p<0.001). Mothers of 48% cases had gestational hypertension, which was 21.3% in controls (p<0.001). Moreover, 18% mothers of cases had history of taking anti-hypertensive medications while only 7.3% mothers from control group had given such drug history (p=0.029). Besides, premature rupture of the membrane was more frequent in cases than controls (20% vs 8%, p=0.019). Maximum mothers from both cases and controls were anaemic (60% and 52%, respectively, p=0.326). Among other maternal obstetric history; gestational diabetes mellitus, previous CS, hypothyroidism, UTI, vaginal candidiasis, polyhydramnios and oligohydramnios were present in 32.7%, 34%, 4% 14%, 19.3%, 8% and 4.7%, respectively in controls, which were 28.0%, 28.0%, 0%, 12%, 20%, 4% and 10%, respectively in cases without any significant differences (p>0.05). [Table 1]

Univariate logistic regression analysis shows that maternal age >30years, para ≥3, preterm labor, gestational hypertension, history of anti-hypertensive medications and PROM were the significant risk factors for delivering low birth weight baby. After adjusting these factors, multivariate logistic regression analysis found that para ≥3, preterm labor, gestational hypertension and PROM were the independent maternal factors for low birth weight baby. [Table 2]

Figure 1 illustrates the box-plot distribution of birth weight according to gestational hypertension, parity, PROM and preterm labor. Median birth weight was significantly lower in mothers with gestational hypertension, para ≥3 and who had preterm labor (p<0.05). [Figure 1]

Table-I

Maternal obstetric history of cases and controls (n=200)

Variables	Control(n=150)	Case(n=50)	p-value
Maternal age at delivery (years)			
≤30	112 (74.7)	25 (50.0)	0.001[á]
>30	38 (25.3)	25 (50.0)	
Mean±SD	28.10±4.69	28.78±5.03	0.385[â]
Gestational age at delivery (in weeks)	36.78±2.23	34.80±2.63	<0.001[â]
BMI at delivery (kg/m^2)	28.99±4.19	27.92±3.72	0.110[â]
BMI after delivery (kg/m^2)	25.90±3.78	25.27±3.66	0.306[â]
Para			<0.001[á]
<3	137 (91.3)	32 (64.0)	
≥3	13 (8.7)	18 (36.0)	
Preterm labor (gestational age <37 weeks)	47 (31.3)	34 (68.0)	<0.001[á]
Gestational diabetes mellitus	49 (32.7)	14 (28.0)	0.538[á]
Gestational hypertension	32 (21.3)	24 (48.0)	<0.001[á]
H/o anti-hypertensive medication	11 (7.3)	9 (18.0)	0.029[á]
Hypothyroidism	6 (4.0)	0 (0.0)	0.340[ã]
Anaemia	78 (52.0)	30 (60.0)	0.326[ã]
Previous CS	51 (34.0)	14 (28.0)	0.433[á]
UTI	21 (14.0)	6 (12.0)	0.720[á]
Vaginal candidiasis	29 (19.3)	10 (20.0)	0.918[á]
Polyhydramnios	12 (8.0)	2 (4.0)	0.337[á]
Oligohydramnios	7 (4.7)	5 (10.0)	0.169[á]
PROM	12 (8.0)	10 (20.0)	0.019[á]

SD=standard deviation, BMI= Body mass index, CS= caesarian section, UTI= Urinary tract infection, PROM= Premature rupture of the uterus.

Values are expressed within parenthesis percentage (%) over column in total

p-value was determined by [á]Chi-squared Test (c^2), [â]Independent sample T test and [ã]Fisher's exact test

Table-II

Maternal risk factors for delivering low birth weight baby (n=200)

Predictor	Univariate				Multivariate			
	Crude OR	95% CI		p-value	Adjusted OR	95% CI		p-value
		Lower	Upper			Lower	Upper	
Age >30	2.95	1.52	5.73	0.001	1.490	0.529	4.197	0.450
Para e"3	5.93	2.64	13.33	<0.001	3.630	1.102	11.963	0.034
Preterm labor	4.66	2.34	9.26	<0.00	3.278	1.501	7.160	0.003
Gestational hypertension	3.40	1.73	6.71	<0.001	2.867	1.215	6.765	0.016
H/o anti-HTN medication	2.77	1.08	7.15	0.035	1.401	.426	4.609	0.578
PROM	2.88	1.16	7.14	0.023	3.215	1.103	9.374	0.032

OR=Odds ratio, PROM= Premature rupture of the uterus.

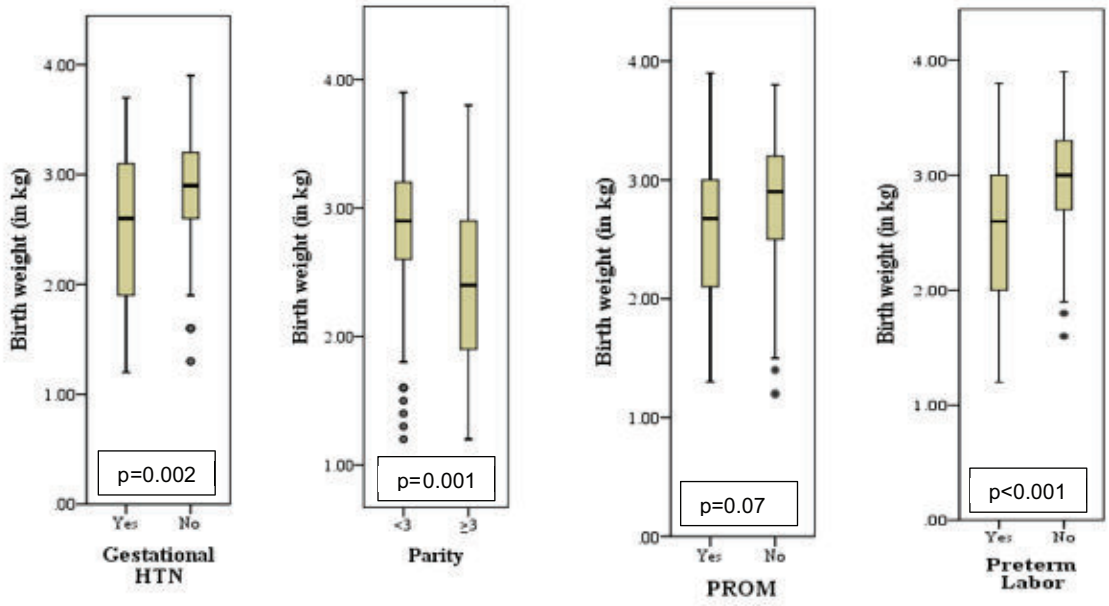

Fig.-1: *Box-plot distribution of birth weight according to gestational hypertension, parity, PROM and preterm labor.*

p-value was determined by Mann-Whitney U test.

Discussion:

LBW is a useful summary measure of a multidimensional public health concern that encompasses long-term maternal malnutrition, ill health, hard work, and poor pregnancy health care on a global scale. This study was conducted to evaluates the maternal risk factors to deliver low birth weight (LBW) babies in Bangladesh.

In this study, maternal age >30years was significantly associated with giving birth to LBW baby (unadjusted OR=2.95, 95% CI= 1.52-5.73, p=0.001), though multivariate analysis did not found any significance (AOR=1.49, 95% CI= 0.529-4.20, p=0.45). Previous studies are inconsistent in determining the effect of maternal age on delivering LBW baby. Bekele et al.,[7] Kozuki et al.,[8] and Arima et al.,[9] found advance maternal age as a significant risk factor for LBW babies, while Kadhum et al.,[5] and Siramaneerat et al.,[10] reported that young women pregnant are found to have LBW significantly. Moreover, Mumbare et al.,[11] Deshpande et al.,[1] and Bora et al.,[12] did not find any effect of maternal age on LBW babies. However, significance of advance maternal age in this study because the study was conducted at a center in metropolitan Dhaka where the mean age of first marriage for females is higher than rural areas of Bangladesh.[13] Hence, it may not reflect the overall country scenario. Nevertheless, we consider that health education in relation to childbearing and pregnancy at the student periods play an important role to prevent delivering LBW babies.

In present study, maternal parity ≥3 were more common in cases compared controls (36% vs 8.7%, p<0.001). In addition, multivariate logistic regression analysis also found that para ≥3 was the independent maternal factors for LBW baby (AOR=3.63, 95% CI= 1.10-11.96, p=0.034). These findings are in accordance with the several previous studies.[14–16] Moreover, Bekele et al.,[7] and Aragaw et al.,[17] found that grand multiparous (p=5 or more) women with term and singleton deliveries had greater risk of delivering LBW babies than primiparous. This risk is likely due to the deterioration of endometrial and corpus uterine functions due to too many giving birth, thus affecting circulatory nutrition and consequently susceptible to LBW.[16] However, Kozuki et al.,[8] and Bora et al.,[12] found that there was a high risk of a baby being underweight in primiparous women than other parity groups. These differences might be due to the fact that there are genetic and environmental (altitude, diet) variations among population.

In this research, mothers of 48% cases had gestational hypertension, which was 21.3% in controls (p<0.001). Moreover, 18% mothers of cases had history of taking anti-hypertensive medications while only 7.3% mothers from control group had given such drug history (p=0.029). Gestational hypertension was found to be a significant risk factor to deliver LBW baby (AOR=2.87, 95% CI= 1.22-6.77, p=0.016). Similarly, several other studies also revealed that gestational hypertension is associated with low birth weight.[1,14,15,18–20] However, Aleem et al.,[21] found no significant effect of PIH on birth weight. It might be due to the fact that they excluded the pre-eclampsia patients, which is associated with significant fetal growth restriction.[22] The association between pregnancy-induced hypertension and low birth weight has been linked to biological factors. The decidualized endothelium and the inner third of the myometrium are invaded by trophoblast cells in a normal pregnancy. This invasion anchors the placenta and connects it to the maternal circulatory system. The trophoblast invasion into the spiral arteries that supply the placenta is thought to be incomplete in pregnancy-induced hypertension or preeclampsia. Hence, intrauterine growth retardation and low birth weight result from decreased uretroplacental blood perfusion.[19] Unfortunately, preventing pregnancy-induced hypertension during pregnancy is difficult. Early diagnosis of women at high risk of pregnancy-induced hypertension, along with more rigorous antenatal care, may help to prevent low birth weight.

In current study, premature rupture of the membrane was more frequent in cases than controls (20% vs 8%, p=0.019). Moreover, multivariate logistic regression analysis found PROM as a significant risk factors for LBW baby (AOR=3.22, 95% CI= 1.10-9.37, p=0.032). However, median birth weight was statistically similar between mothers with and without PROM (p<0.05). Similarly, in a previous Bangladeshi study by Rosy et al.,[2] also found PROM as a significant factor for delivering LBW babies.

This study also found preterm delivery as an independent risk factor to deliver LBW baby (AOR=3.28, 95% CI= 1.50-7.16, p=0.003), which was also in line with previous studies.[9,14,23] Arima et al.,[9] found that preterm delivery had 9.00-fold higher risk of having low birth weight compared to the term delivery (adjusted OR=9.00; 95% CI=6.06–13.38).

Our study has some potential limitations. Its retrospective nature does not allow us to obtain additional detailed information regarding potential confounding factors such as maternal education, nutrition, active or passive smoking history, lifestyle during pregnancy, adverse psychosocial factors and violence/abuse during pregnancy; so it was not possible to test their effects.

Conclusion:

This study found that para ≥3, preterm labor, gestational hypertension and PROM are the significant maternal risk factors to deliver LBW babies. Early diagnosis of women at high risk of pregnancy-induced hypertension, along with more rigorous antenatal care, may help to prevent low birth weight. Besides, to lower the occurrence of LBW, special attention should be paid to deliveries at an advanced age and multiparous situations. Different tactics should be employed depending on the context of the area, with appropriate community intervention. The outcomes of this study may give health professionals and policymakers ideas for future initiatives and interventions to minimize the prevalence of LBW.

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