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Original Research Article

Maternal Risk Factors for Preterm Low Birth Weight Babies: A Prospective Study

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Abstract: ***Background*:** Low birth weight (LBW) and preterm birth (PTB) are significant public health issues in developing countries, contributing to 60% of under-five mortality in Bangladesh. These conditions are influenced by various maternal factors**. Objective:** This study aimed to assess the maternal factors associated with delivering preterm low birth weight (PLBW) babies in Bangladesh, focusing on demographic, behavioral, medical, and obstetric conditions. **Methods:** A case-control study was conducted from July to December 2015 at Shaheed Ziaur Rahman Medical College Hospital, Bogura. Cases included preterm low birth weight neonates, while controls were term normal weight neonates from the same population. Data on maternal demographic, behavioral, and medical factors were collected. Statistical analyses included calculating mean weight gain during pregnancy, calorie and protein intake, and maternal disease prevalence. The p-value and standard deviation were computed to assess significance. ***Results:*** The study found that 73.6% of mothers of PLBW babies came from poor and lower-middle-class families. Mothers of PLBW babies gained less weight (6.3 kg) compared to normal birth weight mothers (7.5 kg) (p = 0.001). Additionally, PLBW mothers had significantly lower caloric intake and avoided fish and milk (p = 0.004). Statistical analysis revealed a standard deviation of ±2.4 kg for weight gain and a p-value of 0.003 for the relationship between food intake and PLBW. The study also highlighted a significant increase in PLBW risk in mothers with anaemia, malnutrition, high fever, and PROM. ***Conclusion:*** Multiple maternal factors, including poor nutrition, specific food avoidance, and medical conditions like anaemia and PROM, significantly contribute to the birth of PLBW babies.

Keywords: Low birth weight (LBW), Preterm birth (PTB), Maternal Factors, Anaemia, Malnutrition.

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Introduction

Low birth weight (LBW) and preterm birth (PTB) are two of the most critical public health challenges in developing countries, contributing significantly to perinatal morbidity and mortality rates.[1] LBW is defined as a birth weight of less than 2500 grams (5.5 pounds), and PTB refers to infants born before 37 weeks of gestation. However, among these neonates, those weighing less than 1500 grams, termed as very low birth weight (VLBW), present the highest levels of perinatal morbidity and mortality.[2] The global incidence of LBW is

alarming, with over 18 million babies born each year, accounting for approximately 16% of all live births worldwide.[3] In developing countries, LBW rates are disproportionately high, contributing to over 95% of global LBW births, in stark contrast to the lower levels observed in developed countries. The high incidence of LBW in low-income settings is linked to both intrauterine growth restriction (IUGR) and preterm births, whereas, in high-income countries, PTB remains the primary cause of LBW.[4] Maternal health factors such as preeclampsia, poor nutritional status, anemia, infections (e.g., malaria, HIV), and inadequate prenatal care exacerbate the risk of preterm births and LBW, thereby posing significant threats to the health of both mothers and neonates.[5] Moreover, untreated medical conditions such as bacterial vaginosis and maternal syphilis have been shown to increase the likelihood of LBW, emphasizing the importance of prenatal healthcare and early medical intervention. Studies have highlighted several risk factors for LBW, including maternal anemia, malnutrition, high blood pressure, infections, and lifestyle factors such as smoking and alcohol use. However, the results are not always consistent, with some studies showing no significant associations.[6] Research has consistently demonstrated that anemia, particularly during early pregnancy, is a key factor contributing to LBW and preterm birth.[7] These findings suggest that both nutritional factors and the prevention of maternal diseases could have a substantial impact on reducing the incidence of LBW. The repercussions of LBW are severe, not only immediately after birth but also in the long term. LBW infants face a higher risk of cognitive and neurological impairments, chronic diseases such as hypertension, diabetes, and obesity, as well as impaired immune function and developmental delays. These long-term consequences underscore the urgency of addressing the root causes of LBW. In fact, LBW infants are 25 to 30 times more likely to die during the neonatal period compared to those with a normal birth weight.[8] The survival rates of LBW infants have improved over time, but they still require extensive medical care, which significantly increases healthcare costs. The cost of managing extremely low birth weight (ELBW) babies is estimated to be six times higher than that of normal birth weight infants, further exacerbating the financial burden on healthcare systems.[9] Given the widespread incidence of LBW and its association with high morbidity and mortality rates, it is imperative to identify the key risk factors that contribute to this condition, particularly in developing countries. Understanding these factors will enable healthcare professionals and policymakers to implement effective intervention strategies aimed at reducing the prevalence of LBW and improving maternal and neonatal health outcomes. The international community has recognized the urgent need to address this issue, with a call for dedicated efforts to reduce the number of infants dying each year due to preterm birth and LBW, as well as to improve the quality of life for those who survive. This research is crucial in guiding healthcare interventions and public health policies that can help reduce the incidence of LBW, particularly in resource-limited settings.

Aims and Objective

The aim of this study is to identify and analyze the maternal risk factors associated with preterm low birth weight (PLBW) neonates. Specifically, it seeks to explore maternal demographics, behavioral factors, medical conditions, and obstetric diseases that contribute to the development of PLBW, ultimately guiding preventive strategies.

Materials and Methods

Study Design

This study utilized a case-control observational design to investigate maternal risk factors for preterm low birth weight (PLBW) neonates. The study aimed to compare preterm low birth weight neonates with term normal weight neonates to identify factors contributing to PLBW. By examining demographic, behavioral, medical, and obstetric factors, the study provided comprehensive insights into maternal conditions that may influence birth outcomes. The case-control study design was chosen to assess differences in maternal characteristics between two distinct groups: cases (PLBW neonates) and controls (term normal weight neonates).

Inclusion Criteria

The inclusion criteria for this study were as follows: singleton pregnancy, a complete and accurate medical record, and informed consent provided by the parents for the participation of their neonates in the study. The selected mothers had to be in a stable

condition during delivery and willing to cooperate in data collection and clinical assessments. Only those neonates meeting the specified birth weight and gestational age criteria were included in the study.

Exclusion Criteria

Neonates with incomplete or unclear medical records were excluded from the study to ensure data accuracy and reliability. Additionally, neonates born from multiple pregnancies were excluded, as these pregnancies have different risk factors compared to singleton pregnancies. Mothers with conditions that prevented the accurate measurement of gestational age or birth weight, such as severe medical complications or unknown delivery dates, were also excluded from participation.

Data Collection

Data were collected by interviewing the mothers and conducting clinical examinations of the neonates within 24 hours of birth for pediatric ward admissions, and within 3 days for neonates born in the obstetric ward. Variables of interest, including maternal demographics, behavioral factors, and clinical conditions, were recorded. Gestational age was assessed using the Last Menstrual Period (LMP) and the Neo Ballard score. Clinical measurements such as birth weight, length, and occipitofrontal circumference (OFC) were also obtained.

Data Analysis

Data were processed and analyzed using SPSS version 16.0. Descriptive statistics were used to summarize the demographic and clinical data. For categorical variables, the Chi-square ($\chi 2$) test was applied to determine the association between maternal risk factors and PLBW. For continuous variables, the student's t-test was used to compare differences between the case and control groups. A significance level of $p < 0.05$ was considered statistically significant for all analyses.

Procedure

This study followed a structured, step-by-step approach to achieve its objectives. First, preterm low birth weight neonates were selected as cases and term normal weight neonates as controls. Data collection began with maternal interviews and neonatal clinical assessments. The mothers were questioned about their socio-demographic background, lifestyle factors, and medical history. Detailed medical examinations were performed on neonates to record birth weight, length, and occipitofrontal circumference (OFC). Gestational age was calculated using the LMP and Neo Ballard score. Neonates born in the pediatric ward were examined within 24 hours, and those delivered in the obstetrics ward were assessed within 3 days. The inclusion and exclusion criteria ensured that the study population was representative of the target group. The collected data were then processed and analyzed using SPSS version 26.0. Statistical tests, including Chi-square and Student's t-test, were applied to examine the relationships between maternal risk factors and the occurrence of PLBW. This step-by-step approach allowed for the identification of significant maternal factors that may contribute to preterm low birth weight in neonates, providing valuable insights for public health interventions.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Shaheed Ziaur Rahman Medical College Hospital, Bogura. Informed consent was obtained from all participating mothers after providing them with detailed explanations of the study purpose and procedures. All participants' data were kept confidential, and the study adhered to ethical guidelines for research involving human subjects.

Result

The distribution of age between case and control groups with mean ages of the former and the latter groups being 23.8 ± 4.0 years and 23.6 ± 4.2 years respectively (p=0.824).

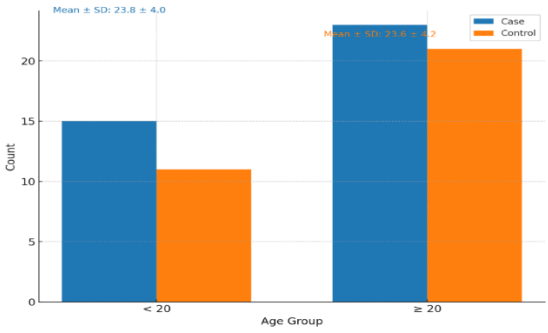

Figure 1. Comparison of Maternal Age Between Case and Control Groups

There was no significant difference between the groups in terms occupation and education (p = 0.205 and p = 0.873 respectively). The cases were generally poor and lower middle class (28.9% and 44.4% respectively), whereas the controls were mostly middle class and upper middle class (53.1% and 18.8% respectively) (p = 0.023). The average monthly income of case and control groups were 10617 and 10931 respectively (p = 0.611).

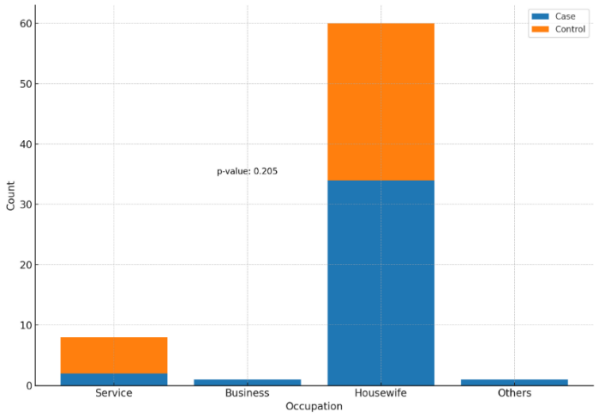

Figure 2. Comparison of Socioeconomic Status Between Groups

Anthropometric Features

Mothers of preterm low birth weight babies gain less weight during antenatal period (6.3 kg) than the mothers of normal birth weight babies (7.5 kg) (p = 0.001). The mean heights of both case and control groups were almost identical (p = 0.858).

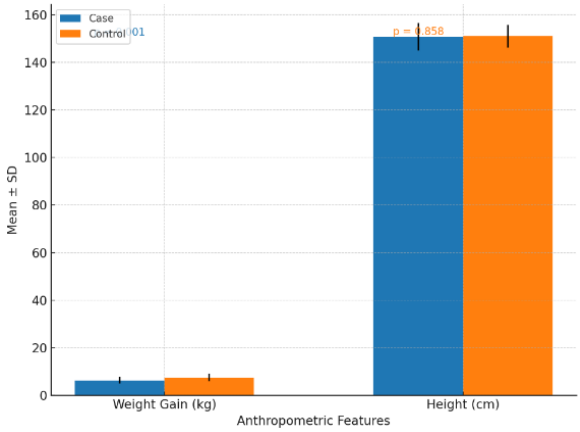

Figure 3. Comparison of Anthropometric Characteristics Between Groups

Data were analyzed using Unpaired t-Test and were presented as mean ± SD.

Obstetric Characteristics

Obstetric characteristics of the case and control groups are illustrated in Table IV. The case and control groups were almost similar with respect to all variables except ANC received, which was much less in the case group (78.9%) than that in the control group (93.8%) (p = 0.075).

Table 1. Comparison of Obstetric Characteristics Between Groups

Obstetric characteristics	Group		p-value
	Case (n = 38)	Control (n = 32)	
Parity			
Primipara	19(50.0)	19(59.4)	0.433
Multipara	19(50.0)	13(40.6)	
past H/O abortion	12(31.6)	8(25.0)	0.544
Past H/O preterm delivery	8(21.1)	1(3.1)	0.026
ANC received	30(78.9)	30(93.8)	0.075
Birth spacing (yrs)	5.8 ± 3.8	4.8 ± 3.3	0.472

Figures in the parentheses indicate corresponding %,

χ^2 Test was done to analyze the data; **Fisher's Exact Test was done to analyze the data.

Data were analyzed using Unpaired t-Test and were presented as mean ± SD.

Behavioural Factors

Physical labour and food behavior of the pregnant mothers are shown in table V. History of hard labour during pregnancy was much higher among mothers of low-birth-weight babies than that among mothers of normal birth weight babies (p = 0.004). Avoidance of fish and milk were more often reported by the case group mothers than those by the control group mothers (p = 0.048 and p = 0.035 respectively). Low food intake was considerably higher in the former group than that in the latter group (p = 0.344).

Table 2. Behavioural Factors During Pregnancy Between Groups.

Behavioural factors	Group		p-value
	Case (n = 38)	Control (n = 32)	
Hard labour	15(39.5)	3(9.4)	0.004
Low food intake during pregnancy	8(21.0)	4(12.4)	0.344
Avoidance of egg	5(13.2)	2(6.2)	0.292

Avoidance of Fish	7(18.4)	1(3.1)	0.048
Avoidance of Meat	9(23.7)	5(15.6)	0.401
Avoidance of Milk	9(23.7)	1(3.1)	0.035

Figures in the parentheses indicate corresponding %,
Chi-squared Test (χ^2) was done to analyze the data.
Fisher's Exact Test (χ^2) was done to analyze the data.

Medical Diseases During Pregnancy

The incidence of anaemia, malnutrition and high fever during pregnancy tend to be significantly associated with preterm LBW babies (p = 0.018, p = 0.005 and p = 0.002 respectively). The prevalences of oedema and hypertension were comparatively high in the former group than those in the latter group, although the difference did not turn to be significant (p = 0.063 and p = 0.255 respectively). UTI was not associated with preterm low birth weight (p = 0.915) (Table 6).

Table 3. Association of Medical Diseases in Pregnancy with Preterm LBW

Medical diseases during pregnancy	Group		p-value
	Case (n = 38)	Control (n = 32)	
Anaemia	33(86.8)	20(62.5)	0.018
Oedema	19(50.0)	9(28.1)	0.063
Hypertension	13(34.2)	7(21.9)	0.255
Malnutrition	30(78.9)	15(46.9)	0.005
High fever	14(36.8)	2(6.2)	0.002
UTI	17(42.5)	14(43.8)	0.915

Figures in the parentheses indicate corresponding **%,**
Chi-squared Test (χ^2) was done to analyze the data.

Obstetric Diseases and Preterm LBW

Oligohydramnios and APH was higher in the case group mothers than those in the control group mothers (p = 0.565 and p = 0.114 respectively). Preeclampsia, PROM and chorioamnionitis were solely reported in case group mothers (p = 0.543, p = 0.154 and p = 0.021 respectively).

Table 4. Association of Obstetric Diseases in Pregnancy with Preterm LBW

Obstetric disease during pregnancy	Group		p-value
	Case (n = 38)	Control (n = 32)	
Oligohydramnios	2(5.2)	1(3.1)	0.565
APH	5(13.2)	2(6.2)	0.298
Preeclampsia	1(2.6)	0(0.0)	0.543
Chorioamnionitis	3(7.9)	0(0.0)	0.154
PROM	6(15.7)	0(0.0)	0.021

Figures in the parentheses indicate corresponding %,
Chi-squared Test (χ^2) was done to analyze the data.
Fisher's Exact Test (χ^2) was done to analyze the data**.**

Discussion

Preterm low birth weight (PLBW) babies have long been a significant public health concern worldwide, with both developed and developing countries grappling with high rates of preterm births and low birth weights.[10] According to Ryan *et al.,* PLBW infants are not only vulnerable to early neonatal morbidity and mortality but also face significant long-term health issues.[11] Globally, more than 20 million babies are born with low birth weight annually, accounting for approximately 15.5% of all births. Alarmingly, 95% of these births occur in developing countries, where the incidence of low birth weight is more than double that observed in developed countries. This disparity underscores the multifaceted nature of the risk factors contributing to low birth weight, particularly in socioeconomically disadvantaged regions. Our study aims to explore the maternal risk factors associated with PLBW in the Bangladeshi population, where the incidence of low birth weight is notably high.

Socioeconomic Factors and Preterm Low Birth Weight

In this study, we found that socioeconomic status had a significant impact on the birth weight of infants. The majority of mothers of PLBW infants (73.6%) came from poor or lower-middle-class families, in stark contrast to the control group, where a significant portion of mothers (71.8%) belonged to middle and upper-middle-class families. This finding aligns with previous research

that highlights poverty as a critical determinant of PLBW. Agrawal *et al.* similarly found that low socioeconomic status was strongly correlated with an increased risk of preterm birth and low birth weight, likely due to limited access to healthcare, inadequate nutrition, and heightened stress levels.[12]

Maternal Weight Gain and Its Role in PLBW

Maternal weight gain during pregnancy is a key factor influencing birth outcomes. In our study, the mothers of PLBW infants gained significantly less weight during pregnancy (6.3 kg) compared to the mothers of normal birth weight infants (7.5 kg), with a statistically significant difference ($p = 0.001$). This result is consistent with previous studies that have highlighted the detrimental effects of inadequate maternal weight gain on birth weight. The reduced weight gain observed in our study could be attributed to a combination of poor dietary intake and strenuous physical labor during pregnancy. A significantly higher proportion of mothers of PLBW infants reported engaging in hard labor during pregnancy (39.5%) compared to the control group (9.4%) ($p = 0.004$). This result corroborates findings from Luyckx *et al.*, who emphasized the negative impact of physical strain and inadequate nutrition on fetal growth.[13]

Nutritional Deficiencies and Its Contribution to PLBW

A critical factor identified in this study was the avoidance of certain nutrient-dense foods, such as fish and milk, by mothers of PLBW infants. These foods are rich in essential nutrients like proteins and omega-3 fatty acids, which are vital for fetal development. Our study found that mothers of PLBW infants were significantly more likely to avoid fish and milk compared to mothers of normal birth weight infants ($p = 0.048$ and $p = 0.035$, respectively). These dietary restrictions may contribute to the insufficient nutritional intake required for healthy fetal growth. Several studies have demonstrated that maternal protein-energy malnutrition is a major contributor to low birth weight and preterm birth, and our findings support this association.[14]

Medical Conditions and PLBW: Anemia and Malnutrition

In our study, medical conditions such as anemia, malnutrition, and high fever were significantly associated with PLBW. Anemia was found to be particularly prevalent in the case group, with 86.8% of mothers of PLBW infants being anemic compared to 62.5% in the control group ($p = 0.018$). This finding is consistent with studies by Abu-Ouf *et al.*, and Huang *et al.*, which have shown that anemia during pregnancy significantly increases the risk of preterm birth and low birth weight.[15, 16] Anemia likely affects placental blood flow, reducing fetal oxygenation and nutrient delivery, which adversely impacts fetal growth. Malnutrition, another significant risk factor identified in this study ($p = 0.005$), exacerbates this effect, as it deprives the fetus of essential nutrients necessary for growth and development. High fever, which was also found to be more common in the case group ($p = 0.002$), is another factor that can impair fetal growth, likely due to the systemic inflammatory response and potential placental insufficiency caused by infection.

Obstetric Complications and Their Association with PLBW

Obstetric complications such as premature rupture of membranes (PROM) were significantly associated with PLBW in our study. PROM was exclusively reported in the mothers of PLBW infants ($p = 0.021$). The association between PROM and preterm birth is well-documented, as the rupture of membranes before term often leads to infection, inflammation, and preterm labor.[17] Similarly, the study found that the prevalence of other obstetric complications such as oligohydramnios, preeclampsia, and chorioamnionitis was higher in the case group, although the differences were not always statistically significant ($p = 0.565$, $p = 0.543$, and $p = 0.154$, respectively). The absence of significant results for some of these conditions could be due to the small sample size of our study and suggests the need for further research with larger cohorts.

Antenatal Care and Its Protective Effect

Our study also revealed that mothers of PLBW infants received less frequent antenatal care (ANC) compared to the control group, with 78.9% of case group mothers attending ANC compared to 93.8%

of control group mothers. This difference, although not statistically significant (p = 0.075), underscores the importance of regular prenatal care in preventing adverse pregnancy outcomes. Studies have consistently shown that adequate ANC helps detect and manage maternal health conditions, monitor fetal growth, and provide necessary nutritional support, all of which can reduce the risk of PLBW.[18] Our study supports the notion that improving access to and utilization of ANC could play a vital role in reducing the incidence of preterm birth and low birth weight in resource-poor settings like Bangladesh.

Comparison with Existing Literature

The findings of our study are consistent with several other studies that have identified multiple maternal factors contributing to preterm birth and low birth weight. Han *et al.* emphasized the role of maternal smoking, infections, and low socioeconomic status as key risk factors for preterm birth, and our study found similar associations.[19] Agrawal *et al.* also highlighted maternal malnutrition and inadequate prenatal care as significant contributors to PLBW, which aligns with our findings that show a strong relationship between poor nutrition and low birth weight.[12] Moreover, studies by Van Vliet *et al.* and Bowers *et al.* have linked maternal anemia, malnutrition, and infections to an increased risk of PLBW, which is reflected in our results.[17, 20] However, while our study shares common findings with previous research, there are some differences, particularly regarding the role of some obstetric complications. In our study, PROM emerged as a significant risk factor for PLBW, while other studies have not consistently reported such an association.[20] This suggests that the impact of specific obstetric complications on PLBW may vary depending on the local context and healthcare setting.

Limitations and Future Directions

One significant limitation of our study is the reliance on self-reported data for maternal behavioral factors, which could be subject to recall bias. Additionally, the study was conducted in a single hospital in Bangladesh, which may limit the generalizability of the findings to other regions or countries with different healthcare systems or socio-economic conditions. Future studies should consider larger sample sizes and multi-center designs to confirm the findings and explore additional risk factors, such as maternal stress or environmental pollutants, which may also contribute to PLBW.

Conclusion

This study has highlighted several maternal risk factors associated with preterm low birth weight (PLBW) in Bangladesh, including low socio-economic status, inadequate maternal weight gain, poor dietary habits, anemia, malnutrition, and obstetric complications such as premature rupture of membranes (PROM). These findings emphasize the critical need for improved maternal healthcare, particularly through enhanced nutritional support, more frequent antenatal visits, and early intervention for medical conditions. Addressing these factors will help reduce the incidence of PLBW and improve maternal and neonatal health outcomes in resource-limited settings.

Recommendations

Promote regular antenatal care visits to monitor and manage maternal health.
Implement nutrition-focused interventions to improve maternal diet during pregnancy.
Strengthen healthcare access for women in low socio-economic backgrounds to reduce the burden of PLBW.

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