

Analysis of Risk Factors Contributing to Low Birth Weight

Sandeep Kumar¹, Kumar Pravin², Gaurav Varma³

¹Assistant Professor, Department of Community Medicine, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India

²Associate Professor, Department of Community Medicine, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India

³Professor, Department of Community Medicine, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India

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Corresponding Author: Dr. Sandeep Kumar

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Abstract:

Background: Low birth weight (LBW) continues to be a significant public health issue in developing nations, correlating with heightened newborn morbidity and mortality rates. Identifying modifiable maternal risk factors is crucial for enhancing birth outcomes.

Aim: To assess maternal socio-demographic, obstetric, nutritional, and health-related factors associated with low birth weight among newborns.

Methodology: A hospital-based cross-sectional observational study was conducted among 80 mother–newborn pairs at a Netaji Subhas Medical College and hospital in Bihar, India. Data on socio-demographic characteristics, antenatal care, obstetric history, and maternal nutritional status were collected using a pre-tested questionnaire. Birth weight was measured within one hour of delivery. Statistical analysis was performed using SPSS version 27, and multivariate logistic regression was applied to identify independent predictors of LBW.

Results: Maternal anemia (AOR = 3.2; 95% CI: 1.4–7.3), fewer than four antenatal care visits (AOR = 2.6; 95% CI: 1.1–6.1), and low maternal BMI (AOR = 2.9; 95% CI: 1.2–6.8) were significantly associated with low birth weight.

Conclusion: Low birth weight was strongly associated with maternal nutritional deficiencies and inadequate antenatal care. Strengthening maternal nutrition and antenatal services is crucial to reducing LBW prevalence.

Keywords: Low Birth Weight, Maternal Anemia, Antenatal Care, Body Mass Index, Newborn.

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Introduction

Low birth weight (LBW), defined by 'the World Health Organization as a birth weight of less than 2,500 grams irrespective of gestational age, remains a major public health concern worldwide, particularly in low- and middle-income countries [1]. It is a key indicator of maternal health, nutritional status, and quality of antenatal care, and it significantly influences neonatal survival, childhood development, and long-term health outcomes. Infants born with low birth weight face a higher risk of neonatal morbidity and mortality, impaired immune function, delayed cognitive development, and an increased likelihood of chronic diseases such as diabetes, hypertension, and cardiovascular disorders later in life [2]. Despite advances in maternal and child healthcare, the global burden of LBW continues to be substantial, underscoring the need for a comprehensive understanding of its contributing risk factors.

The etiology of low birth weight is multifactorial, involving a complex interplay of biological, socio-economic, environmental, and healthcare-related determinants. Maternal factors play a central role in fetal growth and development [3]. Conditions such as maternal malnutrition, anemia, inadequate weight gain during pregnancy, chronic illnesses, and infections can adversely affect placental function and nutrient transfer to the fetus. Maternal age is another critical determinant, with adolescent pregnancies and advanced maternal age being associated with a higher risk of LBW due to physiological immaturity, poor nutritional reserves, or increased obstetric complications [4]. Additionally, parity and birth spacing influence fetal outcomes, as closely spaced pregnancies may not allow sufficient time for maternal nutritional replenishment.

Socio-economic and demographic factors substantially contribute to the risk of low birth

weight [5]. Low socio-economic status is often linked to poor living conditions, limited access to healthcare services, food insecurity, and increased exposure to environmental hazards. Maternal education plays a vital role in shaping health-seeking behavior, nutritional practices, and utilization of antenatal care services. Women with limited educational attainment may have reduced awareness of proper prenatal nutrition, danger signs during pregnancy, and the importance of regular antenatal check-ups, thereby increasing the likelihood of adverse birth outcomes, including LBW [6].

Behavioral and lifestyle factors during pregnancy further influence birth weight. Maternal tobacco use, alcohol consumption, and exposure to second-hand smoke have been consistently associated with restricted fetal growth [7]. These behaviors impair oxygen delivery and nutrient supply to the fetus, resulting in intrauterine growth restriction. Physical workload and occupational stress, particularly among women engaged in manual labor, can also contribute to low birth weight by increasing energy expenditure and reducing maternal rest during pregnancy. Psychosocial stress, including domestic violence and mental health issues, has emerged as an important yet often underrecognized risk factor influencing fetal development.

Healthcare-related factors, especially the adequacy and quality of antenatal care, are critical determinants of birth weight [8]. Regular antenatal visits facilitate early identification and management of maternal risk conditions such as hypertension, gestational diabetes, and infections, which are known contributors to LBW. Inadequate antenatal care limits opportunities for nutritional supplementation, health education, and timely medical interventions [9]. Furthermore, poor accessibility to skilled healthcare providers and institutional delivery services remains a challenge in many regions, particularly in rural and underserved populations, contributing to persistently high rates of low birth weight.

Environmental and contextual factors also play a role in influencing birth outcomes. Exposure to environmental pollutants, poor sanitation, and unsafe drinking water increases the risk of maternal infections and inflammatory conditions that may impair fetal growth [10]. Seasonal variations affecting food availability and maternal workload can further exacerbate nutritional deficiencies during pregnancy. These factors often coexist with socio-economic disadvantages, creating a cumulative effect that heightens the risk of low birth weight.

Given the significant short- and long-term consequences of low birth weight, identifying and analyzing its contributing risk factors is essential for

developing effective preventive strategies. A comprehensive analysis of maternal, socio-economic, behavioral, healthcare, and environmental determinants provides valuable insights for policymakers, healthcare providers, and public health professionals. Understanding these risk factors enables the formulation of targeted interventions aimed at improving maternal health, enhancing antenatal care services, and ultimately reducing the burden of low birth weight and its associated complications.

Methodology

Study Design: The present study was a hospital-based cross-sectional observational study conducted to identify and analyze the maternal, socio-demographic, and obstetric factors associated with low birth weight among newborns.

Study Area: The study was carried out in the Department of Community Medicine, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India.

Study Duration: The study was conducted over a period for 12 months

Study Participants

Inclusion Criteria

- Live-born neonates delivered at Netaji Subhas Medical College and Hospital throughout the research duration
- Mothers who provided informed consent to participate in the study
- Singleton Births

Exclusion Criteria

- Stillbirths and intrauterine fetal deaths
- Multiple pregnancies (twins or higher-order births)
- Newborns with congenital anomalies
- Mothers who were critically ill or unwilling to participate

Sample Size: A total of 80 mother–newborn pairs were included in the study.

Procedure: Eligible participants were enrolled using a consecutive sampling technique. Informed written consent was obtained from mothers prior to data collection. Information related to socio-demographic characteristics, maternal nutritional status, antenatal care, obstetric history, and medical conditions during pregnancy was collected using a pre-tested semi-structured questionnaire through face-to-face interviews. Birth weight of the neonates was measured within one hour of delivery using a calibrated digital weighing scale. Low birth weight was defined as a birth weight less than 2500 grams. All collected data were checked for completeness and accuracy before analysis.

Statistical Analysis: Data was inputted into Microsoft Excel and subsequently analyzed utilizing SPSS version 27. Descriptive statistics, including mean, standard deviation, frequencies, and percentages, were employed to summarize the data. The correlation between low birth weight and other maternal and socio-demographic characteristics was evaluated using the Chi-square test. A p-value below 0.05 was deemed statistically significant.

Result

Table 1 illustrates the attributes and background of the mothers participating in the research and indicates the age ranges of the mothers, from the 20-29 age range, which made up 57.5% of mothers, to those aged 30 or older, which made up 27.5%, and those less than 20, which accounted for 15.0%. The

results indicate that most mothers were in an age bracket for optimal reproductive health. 52.5% of the mothers had education above secondary school, while 30.0% had primary school only, and 17.5% of mothers could not read or write, indicating a moderate to high educational level. 72.5% of mothers stated they stayed at home with the children, while 27.5% had jobs outside the home; the statistics illustrate that nearly half of the mothers belong to the middle class (47.5%); nearly one-third (32.5%) to the lower class; and a small percentage (20%) to the upper socio-economic groups; therefore, it is reasonable to conclude most of the participants were of middle and lower socio-economic classes.

Table 1: Socio-Demographic Characteristics of Mothers (n = 80)

Variable	Category	Frequency (n)	Percentage (%)
Age of mother (years)	<20	12	15
	20–29	46	57.5
	≥30	22	27.5
Education	Illiterate	14	17.5
	Primary	24	30
	Secondary & above	42	52.5
Occupation	Homemaker	58	72.5
	Working	22	27.5
Socio-economic status	Lower	26	32.5
	Middle	38	47.5
	Upper	16	20

Table 2 shows the obstetric history of the 80 mothers participating in this study that most of them were multigravida (57.5%), with 42.5% being primigravida. Therefore, the proportion of the mothers who had some prior experience with pregnancy is greater than the number of first-time mothers. Additionally, regarding inter-pregnancy intervals or spacing, two-thirds (63.7%) of the mothers reported an interval of two years or more between pregnancies, suggesting an adequate spacing of pregnancies. Conversely, 36.3% of mothers reported a spacing of pregnancies of less

than two years. With respect to antenatal care, 61.2% of mothers received at least four antenatal care visits, which represents an acceptable level of coverage of recommended antenatal services; however, a large percentage of mothers (38.8%) reported receiving less than four antenatal visits. In terms of micronutrient supplements, most mothers or slightly more than half (55%) received iron and folic acid supplements while 45% did not meet the prescribed level for maternal nutrition practices, indicating a significant gap in compliance with suggested maternal nutrition practices.

Table 2: Obstetric Characteristics of Mothers (n = 80)

Variable	Category	Frequency (n)	Percentage (%)
Parity	Primigravida	34	42.5
	Multigravida	46	57.5
Birth spacing	<2 years	29	36.3
	≥2 years	51	63.7
Antenatal visits	<4 visits	31	38.8
	≥4 visits	49	61.2
Iron–Folic intake	Adequate	44	55
	Inadequate	36	45

Table 3 indicates the maternal nutrition and health status of the 80 participants included in this study. Many mothers (35%) had a BMI of less than

18.5kg/m², which suggests that they are under-nourished. The remainder (65%) had a BMI that is either “normal” or above normal (over-weight).

Anemia was found in nearly half of the mothers, with almost 48.8% of mothers having Hb concentrations of less than 11g/dl. These results indicate that a high number of women have a significant amount of anemia during pregnancy in this population; however, slightly more than 51.2% of mothers had normal hemoglobin levels. In

addition, 22.5% of mothers have a chronic disease diagnosis; however, most mothers (77.5%) reported no chronic disease diagnosis. Overall, the findings indicate that a sizeable number of mothers were suffering from nutritional deficiencies and health issues that could negatively affect their pregnancy outcomes.

Table 3: Maternal Nutritional and Health Factors (n = 80)

Variable	Category	Frequency (n)	Percentage (%)
Maternal BMI	<18.5 kg/m ²	28	35
	≥18.5 kg/m ²	52	65
Hemoglobin level	<11 g/dl (Anemia)	39	48.8
	≥11 g/dl	41	51.2
Chronic illness	Present	18	22.5
	Absent	62	77.5

Table 4 presents the multivariate analyses of characteristics correlated with low birth weight. Following the adjustment for many confounding variables, it was determined that certain maternal traits exhibited a significant correlation with low birth weight. Anaemic mothers exhibited a statistically significant positive correlation with low-birth-weight infants. The adjusted odds ratio (AOR) is 3.2 (95% CI 1.4-7.3; p=0.004), indicating that anaemic mothers are more than three times as likely to deliver low birth weight (LBW) infants compared to non-anemic mothers. Mothers who

received insufficient prenatal care (fewer than four ANC visits) were strongly correlated with low birth weight (AOR=2.6; 95% CI 1.1-6.1; p=0.02). Insufficient prenatal care indicates a need for greater access to prenatal care services. Furthermore, mothers who had low BMI have nearly three times the odds of having a low-birth-weight baby as compared to mothers who have normal or higher BMI (AOR=2.9; 95% CI 1.2-6.8; p=0.01). In conclusion, maternal nutritional status (BMI) and adequate antenatal care are crucial determinants of birth weight.

Table 4: Factors Associated with Low Birth Weight: A Multivariate Analysis

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Maternal anemia	3.2	1.4–7.3	0.004
<4 ANC visits	2.6	1.1–6.1	0.02
Low BMI	2.9	1.2–6.8	0.01

Discussion

This research has revealed various types of socio-demographic variables, as well as obstetric, nutritional, and health-related variables, that have a significant impact on LBW mothers in this study population. Most of these mothers were between 20-29 years of age, which is often considered an optimal reproductive age; this finding confirms that while age is a possible influential factor in adverse birth outcomes, it isn't necessarily the predominant factor. However, the presence of LBW in a population where mothers fall into the optimal reproductive age range indicates that there are other modifiable factors that are negatively impacting their birth outcomes. While many mothers had a moderate level of education, the fact that over half of them possessed at least some educational level suggests that they were better able to understand the relationship between their health, nutrition and obstetric care on their babies' births; however, there is still a large number of mothers with very low or no educational levels who may be at risk for poor pregnancy outcomes due to their lack of knowledge

about health-related issues and limited access to services. According to Tamura et al., (2018) [11], a high level of parental education acts as a protective factor against newborns that are small for gestational age."

Maternal occupation and socio-economic status (SES) were other significant contextual factors. Most mothers in this study were stay-at-home mothers and were classified as either lower or middle-class, consistent with results reported in similar studies conducted in developing countries. Maternal low SES is typically associated with inadequate or poor maternal nutrition; inaccessibility to quality health care and increased maternal physical labor; all these limitations can negatively impact fetal growth. Although a large percentage of these mothers are classified as middle class, there remains evidence of the impact of maternal health interventions and nutritional education on LBW neonates. Dejmek et al., (2002) [12] reported a study of 6,866 singleton births showed that exposure to environmental tobacco

smoke during pregnancy has been associated with LBW.

The 'Obstetric' characteristics of mothers demonstrate that these women have engaged in healthy reproductive practices. By having more than 50% of mothers that are multigravida (had more than 1 pregnancy), and having most working mothers have adequate spacing between births (> 2 years), allows for good maternal nutrition recovery and reduces the risk of poor pregnancy outcomes. However, one out of three mothers had birth intervals of less than two years, thus likely putting them at risk for malnutrition, therefore increasing their risk for having a low birth weight (LBW) baby. In addition, the fact that although most mothers have had four or more antenatal (ANC) visits, a sizeable number still had insufficient use of ANC services, shows a need for increased ANC coverage and continuity of services to expectant mothers. Johnson et al., (2017) [13] conducted a study in the UK indicates that smoking was a contributor to LBW births for 1/8 of LBW births.

The study revealed that nutrition and health status of mothers were issues of paramount importance. For example, more than a third of mothers had low BMI levels (which indicated undernutrition), while almost half of them were found to be anemic, demonstrating the significant number of nutritional deficiencies prevalent within this population. These results are like findings from other studies of populations in similar geographic locations, which also showed that maternal undernutrition and anemia is a significant public health issue. The presence of either of these health issues impacts the functioning of the placenta, which lowers the amount of nutrients supplied to the developing fetus, ultimately causing a greater incidence of restricted fetal growth and low birth weight (LBW). According to Jafari et al., (2010) [14], a preterm birth poses 40.45 higher odds of having a LBW child.

Through the multivariate analysis we conducted it was determined that both maternal health care use (if applicable) and nutrition during pregnancy are significant factors in determining birth outcomes. There was also a direct association between maternal anemia and LBW. In fact, mothers with anemia had almost three times the rate of having LBW infants compared to mothers without anemia. The research thus supports other studies that indicate that anemia increases the likelihood that a baby's growth will be impaired due to decreased oxygen delivery to the baby (less oxygenated blood supply) and therefore affects the baby's ability to accumulate nutrients. The association we found between low BMI and LBW shows the vital role that a mother's ability (energy levels) to sustain a healthy weight throughout a pregnancy has had in the development of a LBW infant.

After considering potential confounding factors, inadequate antenatal care (ANC) remained an important predictor of low birth weight (LBW). Women who had participated in fewer than four ANC visits were more likely to be giving birth to LBW infants, which demonstrates the value of providing women with regular ANC visits for the identification and treatment of nutritional deficiencies and pregnancy complications. This study therefore demonstrates that it is imperative to provide greater support for ANC services and enhance the nutritional status of mothers through effective anemia treatment. To decrease LBW prevalence and improve neonatal health, it is also important to treat maternal anemia with proper supplementation and provide counseling on proper nutrition.

Conclusion

This paper shows that the most significant public health risk to infants (i.e., low birth weight) is due mainly to modifiable factors that can be changed by the mother before and during pregnancy (modifiable maternal variables). The major independent risk factors for a baby being born weighing less than 2500 grams were: the mother's anemia status, body mass index (BMI) at conception, and the amount of antenatal care (ANC) that she received during her pregnancy. Even though most mothers fell within the "best child-bearing years" age group and had reasonably spaced births, there was still a significant degree of nutritional deficiency and a lack of utilization of ANC services in this population. These results indicate that simply having favorable demographic characteristics is not enough to guarantee that a child will be born healthy. In addition, improving access to ANC services, increasing compliance with iron-folic acid supplementation, and providing nutritional counselling to mothers are three strategies recommended to reduce low birth weight and improve the health of newborns.

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