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Original Research Article

Impact of Maternal Anemia on Birth Weight among Neonates

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Abstract:

Background: Maternal anemia, particularly iron deficiency anemia, is a major public health concern in developing countries, adversely affecting both maternal and neonatal health. Low birth weight (LBW) is a critical outcome associated with maternal anemia.

Aim: To assess the impact of maternal anemia on neonatal birth weight in a clinical setting.

Methodology: A hospital-based observational analytical study was conducted among 90 pregnant women at MGM Medical College, Jamshedpur. Participants were classified into anemic (Hb <11 g/dL) and non-anemic (Hb ≥11 g/dL) groups. Neonatal birth weight was recorded immediately after delivery and analyzed using statistical methods, including independent t-test.

Results: Among participants, 66.7% were anemic. The mean birth weight was significantly lower in neonates born to anemic mothers (2.48 ± 0.42 kg) compared to non-anemic mothers (2.96 ± 0.38 kg). Low birth weight was more prevalent in the anemic group (63.3%) than in the non-anemic group (26.7%). The difference was statistically significant ($p < 0.001$).

Conclusion: Maternal anemia is highly prevalent and significantly associated with reduced neonatal birth weight. Early detection, nutritional supplementation, and effective antenatal care are essential to improve maternal and neonatal outcomes.

Keywords: Maternal Anemia, Neonatal Birth Weight, Low Birth Weight, Iron Deficiency, Pregnancy Outcomes.

Introduction

Maternal anemia in pregnancy is a major global health issue, especially in developing nations like India, where maternal nutrition and access to healthcare remains a major issue of concern [1]. The world health organization defines anemia in pregnancy as any hemoglobin below 11 g/dL. Iron deficiency anemia (IDA) is the most common of all the different types of anemia, being over 75 percent of all cases of anemia in pregnancy across all of the world [2]. Anemia is a problem that is still affecting a significant percentage of pregnant women despite the public health programs and nutrition programs that have been conducted. As indicated by evidence given by National Family Health Survey (NFHS-5), over half of pregnant women in India continue to be anemic, and this demonstrates persistent failures in the delivery of maternal care and nutritional education.

Maternal anemia has extensively extended effects on maternal and infant health. Anemia during pregnancy predisposes to fatigue, infections and obstetric complications including preeclampsia and postpartum bleeding, which are risk factors towards maternal morbidity and mortality [3]. On a fetal viewpoint, maternal hemoglobin levels should be satisfactory to guarantee maximum oxygen and nutrient delivery through the placenta. Maternal hemoglobin level decreases interfering with this transfer, negatively influencing fetal growth and development. Therefore, maternal anemia has been linked very closely with adverse neonatal complications including intrauterine growth restriction (IUGR), preterm delivery, low birth weight (LBW), and elevated risk of neonatal mortality [4].

Among the most essential indicators of neonatal health, the low birth weight determined by the birth weight lower than 2,500 grams is still low. Babies who are born with LBW are at greater risk of infections, defective thermoregulation, feeding complications, and slow physical and cognitive growth [5]. Moreover, LBW has long-term effects, putting people at risk of long-term health problems, including cardiovascular diseases, diabetes, and low work capacity at adulthood. As such, there is a need to determine the modifiable risk factors of a mother

including anemia to enhance better neonatal outcomes and infant morbidity and mortality rates.

The importance of iron during pregnancy cannot be overstated because the mineral is essential in erythropoiesis of the mother, development of the placenta, and growth of the fetus. It should be noted that the physiological requirement of iron has risen significantly especially in the second and third trimester of pregnancy as a result of increased maternal blood volume and that of the developing fetus. Poor nutrition, malabsorption, and high physiological needs make the maternal iron deposits to be quickly exhausted and anemia occurs [6]. This weakness is not only detrimental to the health of the mother, but also disturbs the circulation of uteroplacenta, which leads to the insufficient supply of oxygen to the fetus. These changes in uteroplacental perfusion are some of the major mechanisms by which maternal anemia plays a major role in causing growth restriction and low birth weight in fetuses.

The high incidence of anemia has led to a series of government programs that have been adopted in India; among them the Anemia Mukt Bharat program and the Iron and Folic Acid (IFA) supplementation program. The goals of these programs are to curb the rate of anemia by screening and specially providing nutritious supplementation to correct anemia and educating them about healthy lifestyles [7]. Nevertheless, even with such efforts, the fact that anemia persists means that there are issues to do with the implementation of the program, which include insufficient awareness, compliance with supplementation, access to healthcare services, and socio-economic factors. The resolution of these problems is necessary to increase the nutritional status of the Women and the outcome of birth.

Since the maternal anemia burden is huge, and it may threaten the neonatal health condition, clinical studies should be focused to learn more about this relationship. Birth weight is one of the most important measures of the neonatal health and the delicate indicator of the intrauterine growth conditions. The analysis of the correlation between maternal anemia and birth weight may be useful to understand the effectiveness of the existing interventions and find the aspects that may be improved.

Thus, the current research will evaluate the influence of maternal anemia on birth weight in the case of neonates in a clinical facility. Through this association, the study aims at enhancing the current body of literature and facilitating the formulation of specific interventions to minimize the occurrence rate of low birth weight and improving the overall health outcomes of mothers and children.

Methodology

Study Design: This study was designed as a hospital-based observational analytical study aimed at assessing the impact of maternal anemia on neonatal birth weight.

Study Area: The study was conducted in the Department of Obstetrics and Gynecology, MGM Medical College, Jamshedpur, Jharkhand, India.

Study Duration: The duration of the study was one year, from 1st April 2003 to 31st March 2004.

Study Participants

Inclusion Criteria

- Pregnant women aged 18–35 years
- Term pregnancies (≥37 weeks of gestation)
- Singleton pregnancies
- Mothers who provided voluntary informed consent
- Women with available hemoglobin reports during the third trimester

Exclusion Criteria

- Preterm deliveries (<37 weeks gestation)
- Multiple pregnancies (twins or higher order gestation)
- Presence of maternal comorbidities such as gestational diabetes mellitus, preeclampsia, chronic hypertension, thyroid disorders, and renal diseases
- Women with known hematological disorders other than nutritional anemia
- Incomplete clinical or laboratory records

Sample Size: A total of 90 pregnant women fulfilling the inclusion criteria were enrolled in the study.

Group Classification

The study participants were classified into two groups based on their hemoglobin (Hb) levels measured during the third trimester:

- Anemic group: Hemoglobin level <11 g/dL (as per WHO criteria)
- Non-anemic group: Hemoglobin level ≥11 g/dL

Procedure: The participants, eligible pregnant women admitted for delivery were enrolled in the study. Detailed demographic and clinical information, including age, parity, antenatal history, and nutritional status, was recorded using a structured proforma. Hemoglobin levels of the participants were obtained from their third-trimester laboratory investigations conducted as part of routine antenatal care.

Based on hemoglobin values, participants were categorized into anemic and non-anemic groups. All deliveries were conducted under standard obstetric care protocols. Immediately after birth, neonatal birth weight was measured within one hour using a calibrated digital weighing scale with an accuracy of ±10 grams. The measurement was performed by

trained nursing staff to ensure consistency and reliability, and the weighing scale was calibrated regularly according to hospital guidelines.

Additional neonatal details such as sex and gestational age were also recorded. Care was taken to minimize measurement bias and ensure uniform data collection procedures. All data were systematically entered into a pre-designed data collection sheet for further analysis.

Statistical Analysis: The collected data were entered into Microsoft Excel and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Continuous variables such as birth weight were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. An independent-samples t-test was used to compare the mean birth weight between anemic and non-anemic mothers. A p-value of less than 0.05 was considered statistically significant.

Result

Table 1 shows the distribution of study participants according to maternal hemoglobin status. Out of the total 90 pregnant women included in the study, a majority, 60 (66.70%), were found to be anemic with hemoglobin levels less than 11 g/dL, while only 30 (33.30%) participants had normal hemoglobin levels (≥11 g/dL). This indicates that anemia was highly prevalent among the study population, affecting nearly two-thirds of the participants, which highlights the significant burden of maternal anemia in the studied group.

Table 1: Distribution of Study Participants According to Maternal Hemoglobin Status		
Hemoglobin Status	**Number (n)**	**Percentage (%)**
Anemic (Hb <11 g/dL)	60	66.70%
Non-anemic (Hb ≥11 g/dL)	30	33.30%
Total	**90**	**100%**

Table 2 presents the demographic characteristics of the study participants in both anemic and non-anemic groups. The mean age of participants in the anemic group was 25.4 ± 3.2 years, which was slightly lower than that of the non-anemic group (26.1 ± 3.5 years), indicating a comparable age distribution between the two groups. Regarding gravidity status, a higher proportion of primigravida women was observed in the anemic group (53.3%) compared to the non-anemic group (46.7%). In contrast, multigravida women were more prevalent in the non-anemic group (53.3%) than in the anemic group (46.7%). Overall, the distribution of participants based on age and gravidity was relatively balanced between the two groups, with a slight predominance of primigravida in the anemic group and multigravida in the non-anemic group.

Table 2: Demographic Characteristics of Study Participants		
Variable	**Anemic Group (n=60)**	**Non-anemic Group (n=30)**
Mean Age (years)	25.4 ± 3.2	26.1 ± 3.5
Primigravida (n, %)	32 (53.3%)	14 (46.7%)
Multigravida (n, %)	28 (46.7%)	16 (53.3%)

Table 3 shows the comparison of mean birth weight between neonates born to anemic and non-anemic mothers. The findings indicate that the mean birth weight of babies born to anemic mothers was 2.48 ± 0.42 kg, whereas those born to non-anemic mothers had a higher mean birth weight of 2.96 ± 0.38 kg. This demonstrates a noticeable difference of approximately 0.48 kg, suggesting that maternal anemia is associated with reduced birth weight in neonates. Additionally, the relatively similar standard deviation values in both groups indicate a comparable level of variability within each group. Overall, the results highlight that maternal anemia has a negative impact on neonatal birth weight, increasing the risk of low birth weight among affected pregnancies.

Table 3: Comparison of Mean Birth Weight Between Groups		
Group	**Mean Birth Weight (kg)**	**Standard Deviation (SD)**
Anemic Mothers	2.48	± 0.42
Non-anemic Mothers	2.96	± 0.38

Table 4 shows the distribution of low birth weight (LBW) among neonates in anemic and non-anemic groups. It was observed that a significantly higher proportion of neonates born to anemic mothers had a birth weight of less than 2.5 kg, accounting for 38 (63.3%) cases, compared to only 8 (26.7%) in the non-anemic group. In contrast, neonates with normal birth weight (≥2.5 kg) were more prevalent in

the non-anemic group, with 22 (73.3%) cases, whereas only 22 (36.7%) neonates in the anemic group fell into this category. These findings indicate a strong association between maternal anemia and increased risk of low birth weight, suggesting that anemia during pregnancy may adversely affect fetal growth and neonatal outcomes.

Table 4: Distribution of Low Birth Weight (LBW) Among Neonates		
Birth Weight Category	**Anemic Group (n=60)**	**Non-anemic Group (n=30)**
<2.5 kg (LBW)	38 (63.3%)	8 (26.7%)
≥2.5 kg	22 (36.7%)	22 (73.3%)
Total	**60 (100%)**	**30 (100%)**

Table 5 shows the comparison of birth weight between anemic and non-anemic mothers. The mean birth weight among neonates born to anemic mothers was 2.48 ± 0.42 kg, whereas it was higher (2.96 ± 0.38 kg) among those born to non-anemic mothers. The mean difference of 0.48 kg indicates a considerable reduction in birth weight in the anemic group. The calculated t-value of 4.72 along with a p-value of <0.001 demonstrates that this difference is statistically highly significant. Thus, the findings clearly suggest that maternal anemia has a significant negative impact on neonatal birth weight, with babies of anemic mothers being more likely to have lower birth weight compared to those of non-anemic mothers.

Table 5: Comparison of Birth Weight Between Groups (Statistical Analysis)	
Parameter	**Value**
Mean Birth Weight (Anemic)	2.48 ± 0.42 kg
Mean Birth Weight (Non-anemic)	2.96 ± 0.38 kg
Mean Difference	0.48 kg
t-value	4.72
p-value	<0.001
Statistical Significance	Significant

Discussion

The present study highlights the substantial burden of maternal anemia and its significant impact on neonatal outcomes, particularly birth weight. In this study, anemia was observed in 66.7% of pregnant women, indicating that nearly two-thirds of the study population were affected. This high prevalence is consistent with earlier reports from developing countries, where maternal anemia remains a major public health concern due to nutritional deficiencies and poor antenatal care (Allen, 2000; Yip, 2000) [8,9]. Similar findings were also reported by Garn et al. (1981) [10], who demonstrated that maternal hematological status plays a crucial role in determining pregnancy outcomes. These observations emphasize the need for early detection and appropriate management of anemia during pregnancy to improve both maternal and fetal health outcomes.

The demographic characteristics of the participants revealed that the mean age distribution between anemic and non-anemic groups was nearly comparable, suggesting that age may not have a strong influence on the occurrence of anemia in this study population. Comparable findings have been reported in earlier studies where maternal age showed no consistent association with anemia prevalence (Murphy et al., 1986) [11]. However, a slightly higher proportion of primigravida women was found in the anemic group, whereas multigravida women were more common in the non-anemic group. This pattern is supported by findings from Scholl et al. (1992), who observed that first-time mothers are often at higher risk of nutritional deficiencies, including anemia, due to increased physiological demands and lack of prior experience with antenatal care.

A key finding of this study was the significant difference in mean birth weight between neonates born to anemic and non-anemic mothers. The mean birth weight was considerably lower in the anemic group (2.48 ± 0.42 kg) compared to the non-anemic group (2.96 ± 0.38 kg), indicating that maternal hemoglobin status has a direct influence on fetal growth. Similar results were reported by Steer et al. (1995) [12], who found a strong relationship between maternal hemoglobin levels and birth weight across different populations. Additionally, Scanlon (2000) [13] also observed that lower maternal hemoglobin levels were significantly associated with reduced neonatal birth weight. The observed reduction of approximately 0.48 kg in the present study is clinically important, as even small decreases in birth weight can increase the risk of neonatal morbidity and mortality.

Furthermore, the distribution of low birth weight among neonates strongly supports the association between maternal anemia and adverse birth outcomes. A significantly higher proportion of low-birth-weight babies (63.3%) was observed among anemic mothers compared to only 26.7% in the non-anemic group. These findings are in agreement with

studies conducted by Klebanoff et al. (1991) [14], who reported that maternal anemia is associated with poor pregnancy outcomes, including low birth weight and preterm birth. Similarly, Godfrey (1991) [15] concluded that iron deficiency anemia during pregnancy is an important determinant of fetal growth restriction and low birth weight.

The statistical analysis further strengthens these observations, as the difference in mean birth weight between the two groups was found to be highly significant ($p < 0.001$). The strong association observed in the present study is consistent with earlier evidence suggesting that anemia adversely affects fetal growth due to impaired oxygen delivery and nutrient transport to the fetus (Garn et al., 1981; Murphy et al., 1986). This reinforces the conclusion that maternal anemia is a significant risk factor affecting neonatal birth weight.

Overall, the findings of this study clearly demonstrate that maternal anemia has a detrimental effect on neonatal outcomes, particularly by increasing the risk of low birth weight. These findings are in line with earlier research highlighting the adverse effects of anemia and iron deficiency on pregnancy outcomes. Addressing maternal anemia through improved nutritional interventions, iron and folic acid supplementation, and regular antenatal monitoring is essential to reduce its adverse effects. Strengthening awareness and early screening programs can play a vital role in minimizing the burden of anemia and improving pregnancy outcomes.

Conclusion

The present study demonstrated that maternal anemia is highly prevalent and significantly influences neonatal birth weight. A large proportion of pregnant women were found to be anemic, reflecting the persistent burden of anemia in the study population. The findings clearly indicated that neonates born to anemic mothers had a significantly lower mean birth weight compared to those born to non-anemic mothers. Additionally, the incidence of low birth weight was considerably higher among the anemic group, establishing a strong association between maternal hemoglobin levels and fetal growth. The statistically significant difference observed further confirms that maternal anemia adversely affects neonatal outcomes. Therefore, early detection, proper nutritional support, and effective antenatal care are essential to prevent anemia and improve birth outcomes.

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