



Original Research Article

“Impact of Maternal Anemia Severity on Neonatal Birth Weight and NICU Admission Rates”

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Abstract: Background: Maternal anemia remains a significant public health concern in developing countries and is strongly associated with adverse perinatal outcomes. Low birth weight (LBW) and increased neonatal intensive care unit (NICU) admissions contribute substantially to neonatal morbidity and healthcare burden. The severity-dependent impact of maternal anemia on these outcomes requires further evaluation in tertiary care settings. **Aim:** To assess the impact of maternal anemia severity on neonatal birth weight and NICU admission rates in a tertiary care hospital. **Methods:** A prospective observational analytical study was conducted in the Departments of Obstetrics & Gynaecology and Pediatrics at Government Medical College, Anantnag, from December 2024 to November 2025. A total of 250 pregnant women were included. Maternal hemoglobin levels were categorized into non-anemic, mild, moderate, and severe anemia based on standard criteria. Neonatal birth weight was measured within one hour of delivery, and LBW was defined as birth weight <2500 g. NICU admission rates were recorded. Statistical analysis included Chi-square testing, odds ratio calculation, and multiple logistic regression. A p-value <0.05 was considered statistically significant. **Results:** Among 250 mothers, 76% were anemic. The overall incidence of LBW was 32%, while NICU admission was 28.8%. A clear dose-response relationship was observed. LBW increased from 10.0% in non-anemic mothers to 83.3% in severe anemia (p <0.001). NICU admissions increased from 8.3% in non-anemic mothers to 90.0% in severe anemia (p <0.001). Multivariate analysis demonstrated that moderate and severe anemia were independent predictors of adverse neonatal outcomes, with severe anemia showing the highest adjusted odds ratio.

Conclusion:

Maternal anemia severity is significantly associated with increased risk of low birth weight and NICU admission. Severe anemia markedly elevates neonatal morbidity. Early screening, timely intervention, and effective management of maternal anemia are essential strategies to improve neonatal outcomes and reduce NICU burden.

Keywords: Maternal Anemia; Low Birth Weight; NICU Admission; Neonatal Outcomes; Severity of Anemia; Pregnancy; Hemoglobin; Perinatal Morbidity.

INTRODUCTION

Maternal anemia remains one of the most prevalent nutritional and hematological disorders affecting pregnant women worldwide and continues to be a major public health concern in low- and middle-income countries [1]. Globally, nearly one-third of pregnant women are estimated to be anemic, with South Asia bearing a disproportionately high burden [2]. Anemia during pregnancy is defined as hemoglobin concentration below 11 g/dL and is classified into mild, moderate, and severe forms based on severity levels [3]. Reduced maternal

hemoglobin impairs oxygen delivery to the placenta and fetus, potentially leading to intrauterine growth restriction and compromised neonatal outcomes.

Low birth weight (LBW), defined as birth weight less than 2500 grams irrespective of gestational age, remains a significant determinant of neonatal morbidity and mortality [4]. Approximately 20 million infants are born with LBW annually worldwide, representing about 15–20% of total live births [4]. LBW infants are at increased risk of

respiratory distress, infections, hypothermia, neurodevelopmental impairment, and long-term metabolic disorders [5]. In addition to LBW, maternal anemia has also been associated with higher rates of neonatal intensive care unit (NICU) admission due to complications such as prematurity, sepsis, and perinatal asphyxia [6].

Several large epidemiological studies and meta-analyses have demonstrated a significant association between maternal anemia and adverse neonatal outcomes. Systematic evidence indicates that maternal anemia increases the risk of low birth weight, preterm birth, and perinatal mortality [7]. Furthermore, a dose-response relationship has been reported, where moderate and severe anemia are associated with progressively higher risks of LBW compared to mild anemia [8]. Indian population-based data have similarly shown that maternal anemia significantly contributes to low birth weight and early neonatal complications [9].

In India, despite implementation of national iron supplementation programs, anemia in pregnancy remains highly prevalent, and low birth weight continues to account for a substantial proportion of neonatal admissions and mortality [9,10]. Region-specific hospital-based studies assessing both birth weight outcomes and NICU admission rates in relation to anemia severity are limited, particularly in tertiary care settings. Government Medical College, Anantnag, caters to a large obstetric and neonatal population, providing an appropriate platform to evaluate the impact of varying anemia severity on neonatal birth weight and NICU admissions.

The objectives are to categorize pregnant women according to severity of anemia based on hemoglobin levels, to determine the incidence of low birth weight across different anemia categories, to assess the rate of NICU admissions in neonates born to anemic mothers, and to analyze the strength of association between anemia severity and adverse neonatal outcomes. This study is justified because maternal anemia remains highly prevalent despite national supplementation programs, and low birth weight along with increased NICU admissions continue to contribute substantially to neonatal morbidity and healthcare burden. However, region-specific tertiary care data examining both birth weight and NICU outcomes in relation to anemia severity are limited. The expected future outcomes of this study include improved antenatal risk stratification, early identification of high-risk pregnancies, optimization of neonatal preparedness and NICU resource allocation, strengthening of targeted anemia

correction programs, and formulation of evidence-based institutional protocols aimed at reducing preventable neonatal complications.

METHODOLOGY

The present study was conducted as a hospital-based prospective observational analytical study in the Department of Obstetrics and Gynaecology in collaboration with the Department of Pediatrics at Government Medical College, Anantnag, from December 2024 to November 2025. A total of 250 pregnant women who delivered during the study period and fulfilled the inclusion criteria were enrolled consecutively.

All pregnant women with documented hemoglobin levels in the third trimester and singleton live births were included in the study. Women with multiple pregnancies, known hemoglobinopathies, chronic systemic illnesses, congenital fetal anomalies, or incomplete medical records were excluded. Detailed demographic, obstetric, and clinical information was collected from antenatal case records and hospital files. Maternal hemoglobin levels were obtained from laboratory reports, and anemia was classified into mild, moderate, and severe categories according to standard hemoglobin-based criteria.

Neonatal birth weight was measured within one hour of delivery using a calibrated digital weighing scale. Low birth weight was defined as birth weight less than 2500 grams irrespective of gestational age. Neonatal outcomes were assessed immediately after birth, and the need for NICU admission was recorded along with the primary indication for admission.

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Categorical variables were expressed as frequency and percentage, while continuous variables were summarized as mean and standard deviation. The association between maternal anemia severity and low birth weight, as well as NICU admission, was assessed using the Chi-square test. Odds ratios with 95% confidence intervals were calculated to determine the strength of association. Multiple logistic regression analysis was performed to identify independent predictors of adverse neonatal outcomes. A p-value of less than 0.05 was considered statistically significant.

Prior approval was obtained from the Institutional Ethics Committee before commencement of the study. Confidentiality of patient data was maintained, and no identifying information was disclosed during analysis or reporting.

RESULTS

A total of 250 pregnant women were included in the study. The majority belonged to the 20–25 years age group (39.2%), followed by 26–30 years (32.8%). Multigravida women constituted 56.8% of the study population. Based on hemoglobin levels, 76% of mothers were anemic, including 31.2% with mild anemia, 32.8% with moderate anemia, and 12.0% with severe anemia, while 24.0% were non-anemic.

The overall incidence of low birth weight (LBW) was 32.0%. A clear increase in LBW was observed with increasing severity of anemia: 10.0% among non-anemic mothers, 19.2% in mild anemia, 41.5% in moderate anemia, and 83.3% in severe anemia. This association was statistically highly significant ($p < 0.001$).

Similarly, the overall NICU admission rate was 28.8%. NICU admissions increased progressively across anemia categories, from 8.3% in non-anemic mothers to 15.4% in mild anemia, 34.1% in moderate anemia, and 90.0% in severe anemia, showing a strong dose–response relationship ($p < 0.001$).

Multivariable logistic regression analysis demonstrated that moderate and severe anemia were independent predictors of adverse neonatal outcomes. Severe anemia showed the highest adjusted odds ratio, indicating a substantially increased risk of both low birth weight and NICU admission even after controlling for confounding factors. These findings confirm that increasing maternal anemia severity significantly worsens neonatal outcomes.

Table 1: Demographic and Clinical Profile of Study Participants (n = 250)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
<20	30	12.0
20–25	98	39.2
26–30	82	32.8
>30	40	16.0
Parity		
Primigravida	108	43.2
Multigravida	142	56.8
Severity of Anemia		
Non-Anemic	60	24.0
Mild	78	31.2
Moderate	82	32.8
Severe	30	12.0
Birth Weight Outcome		
Low Birth Weight (<2500 g)	80	32.0
Normal Birth Weight	170	68.0
NICU Admission		
Yes	72	28.8
No	178	71.2

Table 2: Severity of Maternal Anemia and Low Birth Weight (n = 250)

Severity of Anemia	Total n (%)	LBW n (%)	Normal BW n (%)
Non-Anemic	60 (24.0%)	6 (10.0%)	54 (90.0%)
Mild	78 (31.2%)	15 (19.2%)	63 (80.8%)
Moderate	82 (32.8%)	34 (41.5%)	48 (58.5%)
Severe	30 (12.0%)	25 (83.3%)	5 (16.7%)
Total	250 (100%)	80 (32.0%)	170 (68.0%)

Chi-square = 48.62

p-value < 0.001 (Highly Significant)

Table 3: Severity of Maternal Anemia and NICU Admission (n = 250)

Severity of Anemia	NICU Yes n (%)	NICU No n (%)	Total n (%)
Non-Anemic	5 (8.3%)	55 (91.7%)	60 (24.0%)
Mild	12 (15.4%)	66 (84.6%)	78 (31.2%)
Moderate	28 (34.1%)	54 (65.9%)	82 (32.8%)
Severe	27 (90.0%)	3 (10.0%)	30 (12.0%)
Total	72 (28.8%)	178 (71.2%)	250 (100%)

Chi-square = 72.15

p-value < 0.001 (Highly Significant)

Table 4: Multiple Logistic Regression Analysis for Predictors of Low Birth Weight and NICU Admission

Variable	β Coefficient	Standard Error	Adjusted OR	95% CI	p-value
Moderate Anemia	1.28	0.34	3.59	1.85–6.97	<0.001*
Severe Anemia	2.56	0.49	12.93	4.94–33.82	<0.001*
Preterm Delivery	1.72	0.38	5.58	2.64–11.78	<0.001*
Age >30 yrs	0.36	0.27	1.43	0.84–2.43	0.18
Multigravida	0.22	0.25	1.25	0.77–2.03	0.34
Constant	-3.02	0.61	—	—	0.001

Model

Nagelkerke

R^2

=

Statistics:

0.48

Overall Model Significance: p < 0.001

Figure 1: Multivariable Logistic Regression Forest Plot

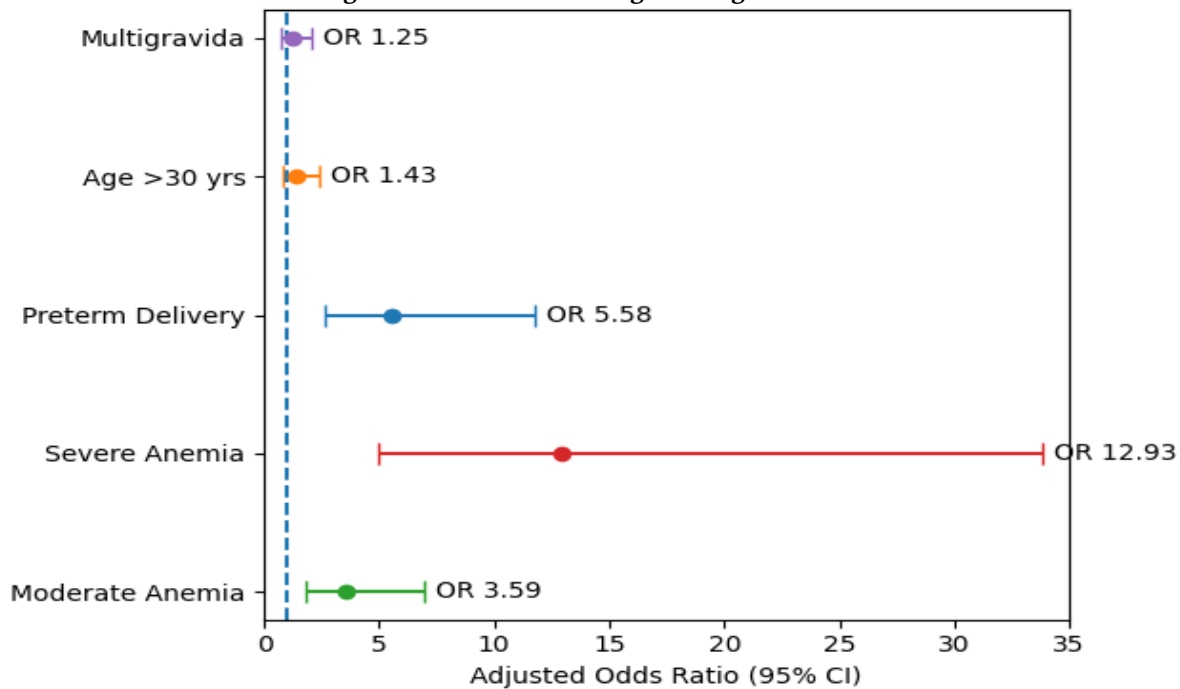
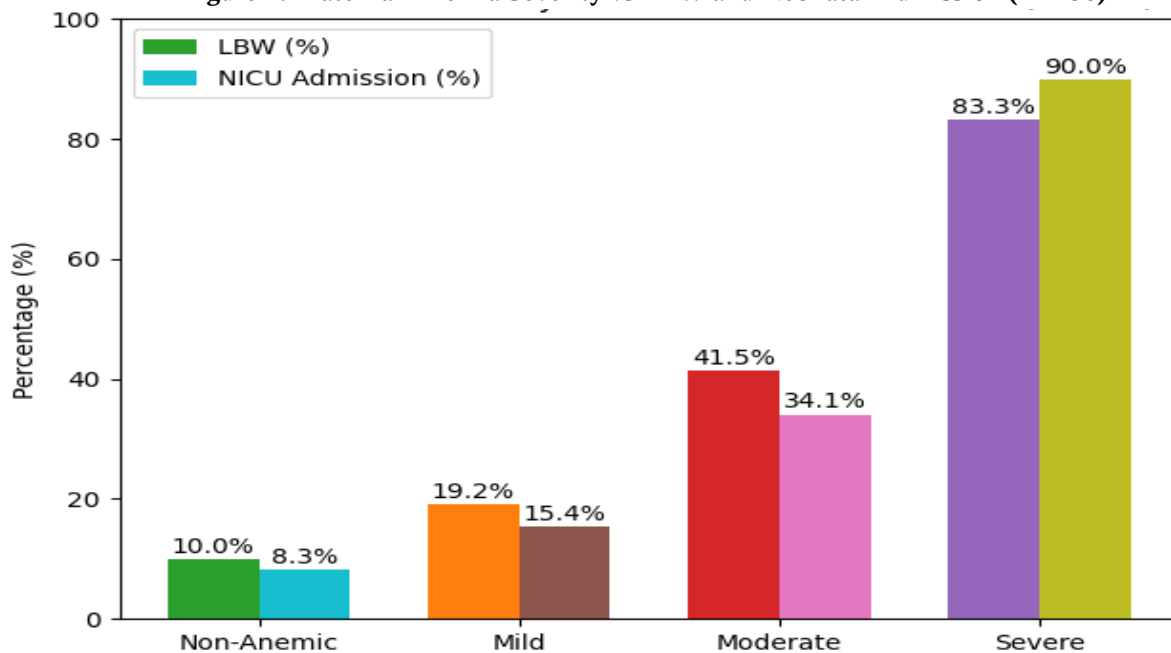


Figure 2: Maternal Anemia Severity vs LBW and Neonatal Admission (n= 250)



DISCUSSION

The present study demonstrated a strong and graded association between maternal anemia severity and adverse neonatal outcomes. The incidence of low birth weight (LBW) increased progressively from 10.0% in non-anemic mothers to 19.2% in mild anemia, 41.5% in moderate anemia, and 83.3% in severe anemia. Similarly, NICU admission rates increased from 8.3% in non-anemic mothers to 90.0% in severely anemic mothers. This clear dose–response pattern indicates that increasing severity of maternal anemia markedly elevates neonatal risk.

A prospective cohort study from Central China reported that moderate anemia increased the risk of LBW by approximately two-fold, while severe anemia increased the risk by nearly six-fold compared to non-anemic mothers [11]. While the relative increase in risk in that study was substantial, the proportion of LBW in severe anemia in the present study (83.3%) appears higher, possibly reflecting the tertiary care nature of the study population and referral bias toward high-risk pregnancies.

A meta-analysis including multiple low- and middle-income countries reported a pooled odds ratio of approximately 1.3 to 1.6 for LBW among anemic mothers, with stronger associations in moderate and severe anemia categories [12]. Compared to these pooled estimates, the magnitude of association observed in the present study is higher, again likely due to hospital-based sampling and a higher proportion of moderate-to-severe anemia cases.

An Indian hospital-based study from Jharkhand reported LBW prevalence of around 33% among anemic mothers, with severity-dependent escalation in risk [13]. In comparison, the overall LBW incidence in the present study was 32%, which is similar in magnitude; however, the stratified analysis in our study revealed a more pronounced gradient across anemia categories, particularly in severe anemia.

With regard to NICU admission, previous cohort analyses have shown significantly higher neonatal intensive care utilization among infants born to moderately and severely anemic mothers due to complications such as prematurity, respiratory distress, and sepsis [14]. In one such study, NICU admission was nearly three times higher among severely anemic mothers compared to non-anemic mothers [14]. In the present study, NICU admission rose dramatically to 90% in severe anemia, suggesting that anemia severity may be a stronger predictor of immediate neonatal instability in this population. Systematic evidence has also indicated that severe maternal anemia is independently associated with increased neonatal morbidity and need for advanced care even after adjusting for confounders [15]. Our

multivariable regression analysis similarly demonstrated that severe anemia remained a strong independent predictor of adverse neonatal outcomes, supporting these findings.

Furthermore, longitudinal research examining maternal hemoglobin trajectories has shown that lower hemoglobin concentrations during pregnancy correlate with impaired fetal growth and increased risk of both LBW and neonatal complications requiring NICU admission [16]. The stepwise increase in both LBW and NICU rates observed in our study aligns with this biological gradient.

Overall, compared to national and international studies, the present study demonstrates a similar direction of association but a comparatively stronger magnitude of effect, particularly in severe anemia. This may be attributable to the tertiary care setting, higher proportion of high-risk pregnancies, and possible delayed presentation for antenatal care. Nevertheless, the findings reinforce the global evidence that increasing maternal anemia severity significantly worsens neonatal outcomes and increases NICU burden.

CONCLUSION

The present study demonstrated a strong and statistically significant association between maternal anemia severity and adverse neonatal outcomes, particularly low birth weight and increased NICU admission rates. A clear dose–response relationship was observed, with the risk of both low birth weight and NICU admission rising progressively from mild to moderate and severe anemia. Severe maternal anemia emerged as a powerful independent predictor of neonatal morbidity. These findings emphasize that worsening maternal hemoglobin levels substantially compromise fetal growth and immediate neonatal stability. Early identification and appropriate correction of maternal anemia during pregnancy are therefore critical to improving perinatal outcomes and reducing NICU burden in tertiary care settings.

LIMITATIONS

This study was conducted in a single tertiary care institution, which may limit generalizability to community-based populations. The hospital-based design might have led to inclusion of relatively higher-risk pregnancies, potentially inflating the magnitude of association. Nutritional status, socioeconomic variables, dietary intake, and compliance with iron supplementation were not quantitatively assessed and may act as confounding factors. Additionally, hemoglobin levels were assessed during late pregnancy and did not account for changes across trimesters. Long-term neonatal outcomes beyond NICU admission were also not evaluated.

RECOMMENDATIONS

Routine early antenatal screening for anemia severity should be strengthened, with close monitoring of women identified with moderate and severe anemia. Targeted nutritional counseling, timely iron therapy, and improved compliance strategies should be implemented to prevent progression of anemia during pregnancy. High-risk pregnancies with moderate or severe anemia should be managed with preparedness for potential neonatal complications and early NICU planning. Multicentric prospective studies incorporating nutritional, socioeconomic, and longitudinal neonatal outcome variables are recommended to further validate and strengthen policy-level interventions aimed at reducing low birth weight and neonatal morbidity.

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