Section: Obstetrics and Gynaecology

Original Research Article

ASSOCIATION OF MATERNAL ANEMIA WITH NEONATAL BIRTH WEIGHT: A CROSS-SECTIONAL STUDY IN AN INDIAN TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Maternal anemia persists as a significant public health challenge, particularly in developing nations like India. Despite various government-led health initiatives, the prevalence remains high, adversely affecting neonatal outcomes, including low birth weight (LBW). Design is a cross-sectional observational study. This study aimed to investigate the association between maternal hemoglobin (Hb) levels during the third trimester and neonatal birth weight among term singleton pregnancies in an Indian tertiary care hospital. **Materials and Methods:** One hundred pregnant women delivering at term (≥37 weeks of gestation) were enrolled at a tertiary care center. Maternal Hb levels were measured within a week before delivery, categorizing participants into anemic (Hb <11 g/dL, n=60) and non-anemic (Hb ≥11 g/dL, n=40) groups. Neonatal birth weights were recorded within an hour of delivery using a calibrated digital scale. Data analysis included independent t-tests and logistic regression analysis to determine the association between anemia and LBW. **Result:** The mean birth weight of neonates from anemic mothers was significantly lower (2.55 ± 0.35 kg) compared to non-anemic mothers (3.02 ± 0.38 kg; p<0.001). LBW was significantly more prevalent among anemic mothers (46.7%) than non-anemic mothers (5.0%; p<0.001). A dose-response relationship was noted, with increasing anemia severity correlating with decreasing birth weights. Adjusted analysis revealed that maternal anemia increased the odds of LBW by approximately fivefold (aOR: 4.8, 95% CI: 2.1–11.2). **Conclusion:** Maternal anemia significantly impacts neonatal birth weight, elevating the risk of LBW. Integrating routine hemoglobin screening and timely iron supplementation into antenatal care could substantially improve neonatal outcomes.

INTRODUCTION

Anemia during pregnancy remains a major public health concern globally, with disproportionately high prevalence in developing nations, particularly India. According to the World Health Organization (WHO), anemia in pregnancy is characterized by hemoglobin levels below 11 g/dL.[1] Iron deficiency anemia (IDA) constitutes approximately 75% of pregnancy-related anemia cases worldwide.[2] Recent data from India's National Family Health Survey (NFHS-5) indicates that over half of pregnant women continue to suffer from anemia despite government interventions.[3]

Maternal anemia is associated with adverse health outcomes for both mother and infant. In pregnant women, anemia heightens the risk of fatigue, infections, preeclampsia, and postpartum hemorrhage. For neonates, compromised maternal hemoglobin status limits oxygen and nutrient supply, increasing the likelihood of intrauterine growth restriction (IUGR), low birth weight (LBW), premature delivery, and neonatal mortality.[4,5] Neonates weighing less than 2,500 grams at birth (LBW) face substantial risks, including impaired immune function, developmental delays, and chronic health conditions in later life.[6]

Iron is essential for fetal development, supporting maternal erythropoiesis and placental and fetal tissue growth. The iron requirement substantially rises during pregnancy, particularly in the second and third trimesters, and insufficient iron intake rapidly depletes maternal stores, resulting in anemia.[7] Anemia-related reductions in uteroplacental perfusion can significantly impact fetal development, causing LBW.[8]

Despite initiatives like Anemia Mukt Bharat and the Iron and Folic Acid (IFA) supplementation programs, anemia prevalence remains high, reflecting deficiencies in screening, adherence, educational outreach, and healthcare infrastructure.[9] This

research aims to specifically evaluate how maternal anemia affects neonatal birth weight within an Indian healthcare setting. The outcomes from this study will inform future maternal healthcare policies, enhance antenatal care protocols, and aim to mitigate neonatal complications.

MATERIALS AND METHODS

Study Design and Setting: This was a cross-sectional observational study conducted at the Departments of Pediatrics and Obstetrics in a tertiary care hospital in India, a facility catering to both urban and rural populations, over six months.

Study Population and Sample Size: The study enrolled 100 pregnant women undergoing term singleton deliveries (≥37 weeks of gestation). The sample size was determined based on existing literature and feasibility during the study duration.

Inclusion and Exclusion Criteria

Participants were included based on

- Age range: 18–35 years
- Term singleton pregnancy
- Voluntary informed consent

Exclusion criteria were established to control Confounders

- Preterm birth (<37 weeks gestation)
- Multiple gestations (twins or higher)
- Significant maternal comorbidities such as gestational diabetes mellitus, preeclampsia, chronic hypertension, thyroid disorders, and renal diseases

Group Classification

Subjects were categorized according to their third-trimester hemoglobin (Hb) levels:

- Anemic group (Hb <11 g/dL, n=60) as per WHO standards.[10]
- Non-anemic group (Hb ≥11 g/dL, n=40)

Measurement of Birth Weight

Neonatal birth weight was measured within one hour postpartum using a calibrated digital scale with ±10 grams accuracy. Trained nursing personnel conducted measurements, and the scale underwent daily calibration per hospital guidelines.

Statistical Analysis: Data analysis was performed using Microsoft Excel for data entry and STATA software version 18.0 (StataCorp, TX, USA). Birth weights were expressed as mean ± standard deviation (SD). An independent-samples t-test compared mean birth weights between the groups, with a p-value of <0.05 indicating statistical significance.

RESULTS

A total of 100 pregnant women with term singleton deliveries were included in this cross-sectional study. Based on hemoglobin (Hb) levels measured during the third trimester, participants were categorized into two groups: the anemic group (n = 60, Hb <11 g/dL) and the non-anemic group (n = 40, Hb ≥11 g/dL).

Comparison of birth weights: The mean birth weight of neonates born to anemic mothers was 2.55 ± 0.35 kg, whereas for those born to non-anemic mothers, the mean birth weight was 3.02 ± 0.38 kg. The difference was statistically significant with a p-value < 0.001, indicating that lower maternal hemoglobin levels are strongly associated with reduced neonatal birth weight [Table 1, Figure 1].

Table 1: Birth Weight by Anemia Status

Group	Number of Mothers (n)	Mean Birth Weight (kg)	Standard Deviation (SD)	p-value
Anemic (Hb <11 g/dL)	60	2.55	±0.35	
Non-Anemic (Hb ≥11 g/dL)	40	3.02	±0.38	< 0.001

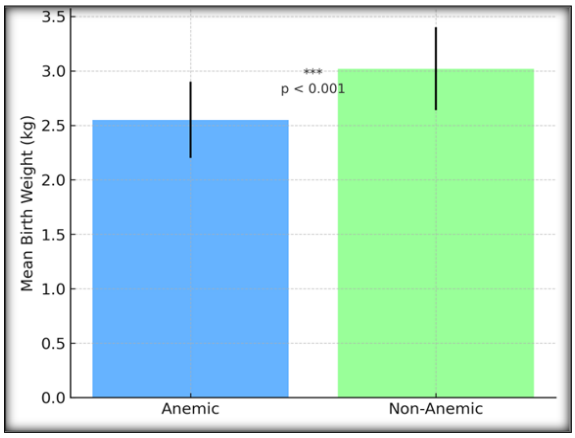

Figure 1: Birth Weight by Anemia Status

Severity of Anemia and Birth Weight: Further stratification of the anemic group revealed a dose-response relationship between the severity of maternal anemia and neonatal birth weight. As the severity of anemia increased, the mean birth weight decreased proportionally [Table 2, Figure 2].

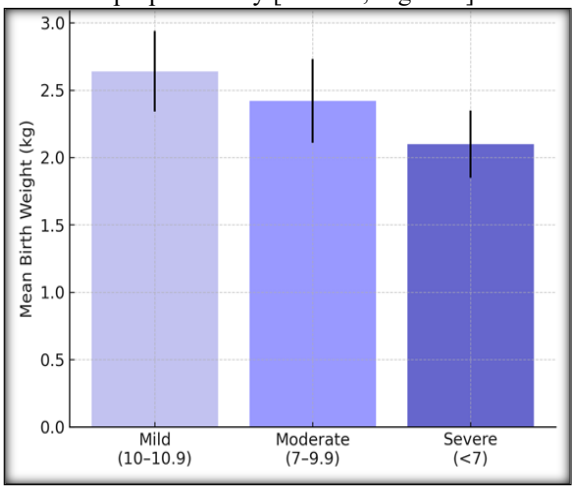

Figure 2: Birth Weight by Severity of Anemia

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The trend demonstrates a gradual decline in birth weight with increasing anemia severity. Though severe anemia cases were limited in number (n = 3), the impact on birth weight was pronounced.

Incidence of Low Birth Weight: A significant difference in the incidence of low birth weight (LBW), defined as <2.5 kg, was observed between the groups [Table 3, Figure 3].

Table 2: Birth Weight by Severity of Anemia

Anemia Severity	Hemoglobin Range (g/dL)	Number of Cases (n)	Mean Birth Weight (kg)	Standard Deviation (SD)
Mild Anemia	10.0 – 10.9	35	2.64	±0.30
Moderate Anemia	7.0 – 9.9	22	2.42	±0.31
Severe Anemia	< 7.0	3	2.10	±0.25

Table 3: Incidence of Low Birth Weight

Group	Total Cases (n)	LBW Cases (n)	LBW Incidence (%)
Anemic Mothers	60	28	46.7%
Non-Anemic Mothers	40	2	5.0%

This shows that neonates of anemic mothers were nearly 9 times more likely to be born with LBW compared to those born to non-anemic mothers.

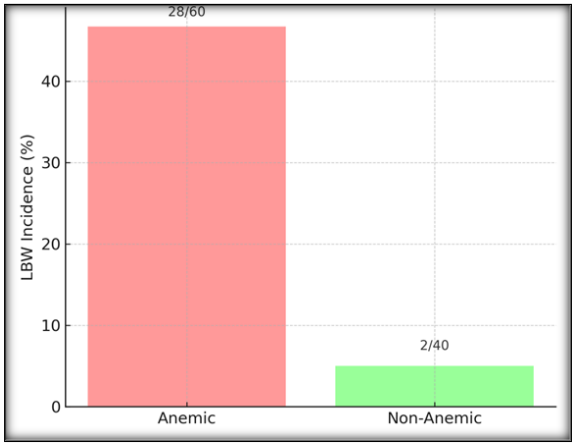

Figure 3: Incidence of Low Birth Weight

DISCUSSION

The findings from this study align closely with an extensive body of national and international research, clearly highlighting the significant correlation between maternal anemia and reduced neonatal birth weight. In our investigation, 46.7% of infants born to anemic mothers were categorized as low birth weight (LBW), compared to only 5% among infants of non-anemic mothers, translating into nearly a ten-fold elevated risk. This marked difference underscores the critical role maternal hemoglobin (Hb) levels play in determining fetal growth trajectories and subsequent birth outcomes.

Similar findings have been consistently reported in Indian populations. Agarwal et al. (2001) observed that anemic mothers had a 2.3-fold higher incidence of LBW compared to their non-anemic counterparts.[11] Singh et al. (2014) and Kumar et al. (2018) further corroborated these results across diverse settings in India, establishing maternal anemia as a significant risk factor for intrauterine growth restriction (IUGR) and LBW.[12,13] Parallel international studies conducted in low-resource contexts, including sub-Saharan Africa and Southeast Asia, have consistently echoed these findings.[14,15] For instance, a systematic review and meta-analysis conducted by Rahmati et al. (2022) and a similar study by Figueiredo et al. (2018) demonstrated robust associations between maternal anemia and adverse pregnancy outcomes, notably LBW.[16,17]

Multiple biological mechanisms underpin the plausibility of the anemia-LBW relationship. Predominantly, anemia reduces maternal oxygen-carrying capacity, resulting in chronic fetal hypoxia and impaired placental function. This disruption affects angiogenesis and diminishes nutrient transfer efficiency, crucial for fetal growth.[18] Iron is integral to DNA synthesis, cellular metabolism, and energy production; hence, iron deficiency profoundly compromises fetal tissue and organ development. Anemia frequently coexists with additional micronutrient deficiencies, such as folate and vitamin B12, exacerbating fetal growth limitations.[19]

A noteworthy observation in our study was the clear dose-response relationship, where neonatal birth weight decreased progressively with increasing anemia severity. Severely anemic mothers (Hb <7 g/dL) delivered neonates with the lowest average birth weight (2.10 kg), in line with WHO findings indicating graded LBW risk elevation with increasing anemia severity.[20] Early identification and intervention for anemia could markedly enhance neonatal health outcomes.

The persistent high prevalence of maternal anemia in India, impacting over half of all pregnancies, remains a pressing public health concern. Factors contributing to this include inadequate nutritional intake, frequent pregnancies, early-age pregnancies, limited antenatal care access, and broader social determinants such as poverty and low educational levels.[21] Our findings advocate strongly for routine antenatal hemoglobin screening, prompt treatment with iron and folic acid supplementation, nutritional education, and community-based outreach programs. Initiatives like India's National Iron Plus Initiative and Anemia Mukt Bharat require intensified implementation and improved community involvement to achieve substantial improvements.

Our study benefits from a well-defined cohort, standardized anemia definitions, and rigorous

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stratification based on anemia severity, all conducted in a controlled clinical environment, minimizing measurement inaccuracies. However, the study is limited by its single-center design, modest sample size (n=100), and inability to account for several confounding variables such as maternal BMI, infectious diseases, smoking status, parity, interpregnancy intervals, dietary practices, and specific iron deficiency biomarkers. Future studies should prioritize prospective designs with larger, more representative cohorts, comprehensive measurement of potential confounders, and biomarker assessments to distinguish anemia etiologies effectively.

In summary, this research reinforces the robust link between maternal anemia and neonatal LBW, underscoring maternal anemia as a critical and modifiable risk factor. Enhanced maternal nutritional care, early anemia screening, targeted supplementation, public education initiatives, and comprehensive antenatal care strategies must be vigorously pursued to significantly reduce the burden of LBW and improve maternal-neonatal health outcomes across India.

CONCLUSION

Maternal anemia significantly impacts neonatal birth weight, elevating the risk of LBW. Integrating routine hemoglobin screening and timely iron supplementation into antenatal care could substantially improve neonatal outcomes.

REFERENCES

1. World Health Organization. Nutritional anaemias: tools for effective prevention and control. Geneva: WHO; 2020.
2. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant women: a systematic analysis of population-representative data. Lancet Glob Health. 2013;1(1):e16–25.
3. Ministry of Health and Family Welfare. National Family Health Survey (NFHS-5), India. New Delhi: Government of India; 2021.
4. Rahmati S, Delpisheh A, Azami M, Hafezi Ahmadi MR, Sayehmiri K. Maternal anemia and pregnancy outcomes: a systematic review and meta-analysis. BMC Pregnancy Childbirth. 2022;22:13.
5. Figueiredo ACMG, Gomes-Filho IS, Silva RB, et al. Maternal anemia and low birth weight: a systematic review and meta-analysis. Nutrients. 2018;10(5):601.
6. Sharma D, Shastri S. Low birth weight: a review of complications and interventions. Curr Pediatr Rev. 2018;14(2):94–101.
7. Bothwell TH. Iron requirements in pregnancy and strategies to meet them. Am J Clin Nutr. 2000;72(1):257S–264S.
8. Parks S, Scott T, Charlton K. Maternal anemia and its impact on neonatal outcomes. Pediatr Health Med Ther. 2019;10:125–34.
9. Ministry of Health and Family Welfare. Anemia Mukt Bharat operational guidelines. New Delhi: Government of India; 2018.
10. World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and Mineral Nutrition Information System. Geneva: WHO; 2011.
11. Agarwal KN, Agarwal DK, Sharma A, et al. Prevalence of anemia in pregnant & lactating women in India. Indian J Med Res. 2001;124:173–84.
12. Singh R, Chauhan R, Nandan D, Singh H. A study on anemia among pregnant women in rural area of India. Indian J Public Health. 2014;58(1):51–6.
13. Kumar KJ, Asha N, Murthy DS. Prevalence of anemia and its association with birth outcomes among pregnant women in a rural community of Karnataka. Int J Community Med Public Health. 2018;5(4):1410–13.
14. Kassa GM, Muche AA, Berhe AK, Fekadu GA. Prevalence and determinants of anemia among pregnant women in Ethiopia: a systematic review and meta-analysis. BMC Hematol. 2017;17:17.
15. Lee AI, Okam MM. Anemia in pregnancy. Hematol Oncol Clin North Am. 2011;25(2):241–59.
16. Rahmati S, Delpisheh A, Azami M, Hafezi Ahmadi MR, Sayehmiri K. Maternal anemia and pregnancy outcomes: a systematic review and meta-analysis. BMC Pregnancy Childbirth. 2022;22:13.
17. Figueiredo ACMG, Gomes-Filho IS, Silva RB, et al. Maternal anemia and low birth weight: a systematic review and meta-analysis. Nutrients. 2018;10(5):601.
18. Sharma JB, Shankar M. Anemia in pregnancy: prevalence and preventive strategies in India. J Indian Med Assoc. 2010;23(4):253–60.
19. Black RE. Micronutrients in pregnancy. Br J Nutr. 2001;85(Suppl 2):S193–S197.
20. World Health Organization. Guideline: Daily Iron and Folic Acid Supplementation in Pregnant Women. Geneva: WHO; 2012.
21. Ministry of Health and Family Welfare. National Family Health Survey (NFHS-5), India. New Delhi: Government of India; 2021.

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