



Correlation of maternal anaemia during pregnancy with neonatal birth weight, gestational age, and early neonatal complications: a prospective maternal–neonatal study.

¹Dr. Sneha M. H., ²Dr. Jyothi Mallappa Myageri, ³Dr. Soujanya Hyati

¹Senior Resident MBBS, MS (Obstetrics & Gynaecology) KLE JGMMMC, Hubli, Karnataka, India

²Senior Resident MBBS, MD (Pediatrics) KLE JGMMMC, Hubli, Karnataka, India

³Senior Resident MBBS, MS (Obstetrics & Gynaecology) Karnataka Medical College and Research Institute (KMCRI), Hubballi, Karnataka, India



Correspondence:

Dr. Soujanya Hyati.

Senior Resident MBBS, MS
(Obstetrics & Gynaecology)
Karnataka Medical College and
Research Institute (KMCRI),
Hubballi, Karnataka, India.

Received: 01-02-2026

Revised: 27-02-2026

Accepted: 02-03-2026

Published: 25-03-2026

Abstract

Background: Maternal anaemia is a common pregnancy-associated condition and may adversely affect fetal growth, gestational duration, and neonatal health. The present study was undertaken to evaluate the relationship between maternal anaemia during pregnancy and neonatal birth weight, gestational age, and early neonatal complications.

Materials and Methods: This prospective observational maternal–neonatal study was conducted in the Department of Obstetrics and Gynaecology in collaboration with the Department of Neonatology, KLE JGMM Medical College and Hospital, Hubli, over a period of 6 months. A total of 150 pregnant women fulfilling the eligibility criteria were included consecutively and followed until delivery. Maternal haemoglobin levels and anaemia severity were assessed. Neonatal outcomes including birth weight, gestational age at delivery, and early neonatal complications were recorded. The association between maternal anaemia and neonatal outcomes was analysed using appropriate statistical tests, and correlation between maternal haemoglobin and neonatal parameters was assessed. A p-value <0.05 was considered statistically significant. **Results:** Among the 150 pregnant women, 102 (68.0%) had anaemia, with mild anaemia being the most common category (38.7%). Preterm delivery occurred in 27 (18.0%) pregnancies, while 49 (32.7%) newborns had low birth weight. Mean neonatal birth weight was significantly lower among infants born to anaemic mothers than those born to non-anaemic mothers (2.58±0.48 kg vs. 2.91±0.43 kg; p<0.001). Preterm delivery was more frequent among anaemic mothers (22.5%) than non-anaemic mothers (8.3%), with a statistically significant association (p=0.041). Maternal haemoglobin showed a significant positive correlation with neonatal birth weight (r=0.42, p<0.001) and gestational age (r=0.29, p<0.001). Maternal haemoglobin was also significantly lower among mothers of low-birth-weight and preterm newborns (p<0.001 for both). Early neonatal complications were reported more frequently among newborns of anaemic mothers (35.3% vs. 18.8%; p=0.041). **Conclusion:** Maternal anaemia was significantly associated with lower neonatal birth weight, preterm delivery, and increased early neonatal complications. Maternal haemoglobin demonstrated a positive correlation with neonatal birth weight and gestational age. Early detection and appropriate management of maternal anaemia during pregnancy may contribute to improved neonatal outcomes.

Keywords: Maternal anaemia; haemoglobin; birth weight; low birth weight; gestational age; preterm birth; neonatal complications.



This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).

INTRODUCTION

Maternal anaemia is one of the most common nutritional and haematological disorders encountered during pregnancy and remains an important public-health concern, particularly in low- and middle-income countries. Increased iron requirements during pregnancy, inadequate dietary intake, repeated pregnancies and other nutritional or medical factors can contribute to reduced maternal haemoglobin concentrations. Maternal anaemia has been associated with adverse maternal, fetal and neonatal outcomes. [1,2]

The effect of maternal anaemia on fetal growth and neonatal outcome is of particular clinical importance. Reduced maternal haemoglobin may compromise oxygen delivery to the placenta and fetus, potentially affecting fetal growth and increasing the risk of low birth weight. Several systematic reviews and meta-analyses have reported an association between maternal

anaemia and low birth weight, although the magnitude of the association varies according to the timing and severity of anaemia. [3,4]

Preterm birth is another important outcome associated with maternal anaemia. Evidence from large systematic reviews indicates that maternal anaemia is associated with an increased risk of preterm delivery. However, the relationship may vary according to the trimester in which haemoglobin is measured and the severity of anaemia. [2,5] A prospective cohort study from India and Pakistan also demonstrated that severe maternal anaemia was associated with adverse fetal and neonatal outcomes, including preterm birth and low birth weight. [6]

In addition to birth weight and gestational age, maternal anaemia may influence early neonatal morbidity. Low birth weight and prematurity themselves increase the likelihood of respiratory problems, neonatal jaundice, need for intensive care and other early neonatal complications. Evidence from systematic reviews suggests that maternal anaemia is associated with several adverse neonatal outcomes, although individual studies have reported variable findings. [1,6,7]

Assessment of maternal haemoglobin as a continuous variable may provide additional information beyond simple classification into anaemic and non-anaemic groups. A systematic review and meta-analysis involving more than four million pregnancies reported associations between lower maternal haemoglobin concentrations and poor birth outcomes, including low birth weight and preterm birth. [8] Similarly, evidence suggests that increasing maternal haemoglobin may be associated with higher birth weight, although the relationship is influenced by the timing of haemoglobin assessment and other maternal factors. [9]

Despite substantial evidence linking maternal anaemia with adverse pregnancy outcomes, assessment of the relationship between maternal haemoglobin concentration and neonatal outcomes in individual hospital populations remains important. Therefore, the present prospective maternal–neonatal study was undertaken at KLE JGMM Medical College and Hospital, Hubli, to evaluate the correlation of maternal anaemia during pregnancy with neonatal birth weight, gestational age and early neonatal complications.

MATERIALS AND METHODS

Study Design and Setting

A prospective observational maternal–neonatal study was conducted in the Department of Obstetrics and Gynaecology in collaboration with the Department of Neonatology, KLE JGMM Medical College and Hospital, Hubli. The study was carried out over a period of 6 months. A total of 150 pregnant women fulfilling the eligibility criteria were enrolled and followed until delivery, with assessment of neonatal birth weight, gestational age and early neonatal complications.

Study Population

Pregnant women admitted for antenatal care and/or delivery during the study period were screened for eligibility. Maternal haemoglobin status during pregnancy was recorded, and participants were followed prospectively to assess pregnancy and neonatal outcomes.

Sample Size

A total sample of **150 pregnant women** was included in the study. Consecutive eligible participants were enrolled during the study period until the required sample size was achieved.

Inclusion Criteria

- Pregnant women willing to participate in the study.
- Women with documented haemoglobin estimation during pregnancy.
- Women who delivered at the study institution.
- Singleton pregnancies with available neonatal outcome data.

Exclusion Criteria

- Multiple pregnancies.
- Major congenital anomalies in the newborn.
- Pregnancies with incomplete maternal or neonatal records.
- Women unwilling to participate or lost to follow-up before delivery.

Maternal Assessment

After obtaining informed consent, relevant maternal demographic and obstetric details were recorded using a structured proforma. These included maternal age, parity, gestational age at delivery and antenatal haemoglobin level. Maternal

anaemia was identified based on the recorded haemoglobin concentration during pregnancy and categorized according to the severity documented in the study records.

Assessment of Neonatal Outcomes

Following delivery, each newborn was assessed for birth weight and gestational age. Birth weight was measured using a calibrated neonatal weighing scale soon after birth. Gestational age was determined from the available antenatal dating information and obstetric records.

Early neonatal outcomes were assessed during the immediate neonatal period. The presence of complications such as low birth weight, prematurity, respiratory complications, neonatal jaundice, need for neonatal intensive care and other clinically documented early neonatal complications was recorded.

Study Variables

The primary study variables were:

1. Maternal haemoglobin level/anaemia status.
2. Neonatal birth weight.
3. Gestational age at delivery.

Secondary variables included documented early neonatal complications and relevant maternal and obstetric characteristics.

Data Collection

Maternal and neonatal information was collected prospectively using a predesigned structured data collection proforma. Maternal haemoglobin values were obtained from antenatal investigations, while neonatal birth weight, gestational age and early neonatal complications were recorded from delivery and neonatal records.

Statistical Analysis

Data were entered into a spreadsheet and analyzed using appropriate statistical methods. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequency and percentage. The association between maternal anaemia and neonatal outcomes was assessed using appropriate statistical tests. Correlation between maternal haemoglobin levels and continuous neonatal outcomes such as birth weight and gestational age was assessed using Pearson's or Spearman's correlation coefficient, as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

The present prospective maternal–neonatal study was conducted at KLE JGMM Medical College and Hospital, Hubli, over a period of 6 months. A total of 150 pregnant women were included and followed until delivery. Maternal haemoglobin status was assessed and its association with neonatal birth weight, gestational age and early neonatal complications was evaluated.

Table 1. Maternal Age Distribution

Maternal age (years)	Number (n=150)	Percentage
<20	8	5.3
20–24	42	28.0
25–29	61	40.7
30–34	31	20.7
≥ 35	8	5.3
Total	150	100.0

The majority of participants belonged to the 25–29 years age group (40.7%), followed by 20–24 years (28.0%).

Table 2. Maternal Anaemia Status

Anaemia status	Number	Percentage
No anaemia	48	32.0
Mild anaemia	58	38.7
Moderate anaemia	38	25.3
Severe anaemia	6	4.0
Total	150	100.0

Anaemia was present in **102 (68.0%)** women, with mild anaemia being the most frequent category.

Table 3. Gestational Age at Delivery

Gestational age	Number	Percentage
<37 weeks	27	18.0
37–40 weeks	118	78.7
>40 weeks	5	3.3
Total	150	100.0

Most women delivered at term, while 18.0% had preterm delivery.

Table 4. Neonatal Birth Weight Distribution

Birth weight	Number	Percentage
<1.5 kg	7	4.7
1.5–2.49 kg	42	28.0
2.5–3.49 kg	87	58.0
≥3.5 kg	14	9.3
Total	150	100.0

Low birth weight (<2.5 kg) was observed in 49 (32.7%) newborns.

Table 5. Comparison of Neonatal Birth Weight According to Maternal Anaemia

Maternal anaemia status	Mean birth weight (kg)	SD	p-value
No anaemia	2.91	0.43	
Anaemia	2.58	0.48	<0.001

Newborns of mothers with anaemia had a lower mean birth weight compared with those born to mothers without anaemia, and the difference was statistically significant.

Table 6. Association Between Maternal Anaemia and Preterm Birth

Maternal anaemia status	Preterm <37 weeks	Term ≥37 weeks	p-value
No anaemia (n=48)	4 (8.3%)	44 (91.7%)	
Anaemia (n=102)	23 (22.5%)	79 (77.5%)	0.041
Total	27 (18.0%)	123 (82.0%)	

Preterm delivery was more frequent among women with anaemia, with a statistically significant association.

Table 7. Correlation Between Maternal Haemoglobin and Neonatal Birth Weight

Variables	Correlation coefficient (r)	p-value
Maternal Hb vs neonatal birth weight	0.42	<0.001

A significant positive correlation was observed between maternal haemoglobin concentration and neonatal birth weight.

Table 8. Correlation Between Maternal Haemoglobin and Gestational Age

Variables	Correlation coefficient (r)	p-value
Maternal Hb vs gestational age	0.29	<0.001

Maternal haemoglobin showed a significant positive correlation with gestational age at delivery.

Table 9. Early Neonatal Complications

Early neonatal outcome	Number	Percentage
No complication	105	70.0
Low birth weight	49	32.7
Prematurity	27	18.0
Respiratory complications	18	12.0
Neonatal jaundice	21	14.0
NICU admission	24	16.0

Categories may overlap because a newborn could have more than one complication.

Table 10. Association Between Maternal Anaemia and Early Neonatal Complications

Maternal anaemia status	Complications present	No complications	p-value
No anaemia (n=48)	9 (18.8%)	39 (81.2%)	
Anaemia (n=102)	36 (35.3%)	66 (64.7%)	0.041

Early neonatal complications were more frequently observed among neonates born to mothers with anaemia.

Table 11. Maternal Haemoglobin According to Neonatal Outcome

Neonatal outcome	Mean maternal Hb (g/dL)	SD	p-value
Normal birth weight	10.42	1.08	
Low birth weight	9.51	1.12	<0.001
Term birth	10.25	1.14	
Preterm birth	9.42	1.09	<0.001

Lower maternal haemoglobin levels were observed among mothers who delivered low-birth-weight and preterm newborns.

DISCUSSION

The present prospective study included 150 pregnant women and evaluated the relationship between maternal haemoglobin status and important neonatal outcomes. Anaemia was identified in 102 (68.0%) participants, with mild anaemia being the most frequent category (38.7%), followed by moderate anaemia (25.3%) and severe anaemia (4.0%). This relatively high frequency of maternal anaemia is consistent with the continuing burden of anaemia reported among pregnant women in South Asian populations. A systematic review and meta-analysis specifically examining South Asian countries reported significant associations between maternal anaemia and low birth weight and preterm birth. [2]

In the present study, neonates born to anaemic mothers had a lower mean birth weight than those born to mothers without anaemia (2.58 ± 0.48 kg vs 2.91 ± 0.43 kg, $p < 0.001$). Furthermore, maternal haemoglobin demonstrated a significant positive correlation with neonatal birth weight ($r = 0.42$, $p < 0.001$). These findings indicate that lower maternal haemoglobin levels were associated with lower neonatal birth weight in the study population. Similar findings have been reported in previous systematic reviews showing an increased risk of low birth weight among infants born to anaemic mothers. [3,4]

Rahmati et al. reported an association between maternal anaemia and low birth weight, particularly when anaemia was present during early pregnancy. [3] Another systematic review involving studies from low- and middle-income countries found that maternal anaemia was associated with an increased risk of low birth weight. [1] The biological explanation may include reduced maternal oxygen-carrying capacity and impaired oxygen delivery to the placenta and fetus, although the relationship is likely multifactorial and may also be influenced by nutritional status, maternal illness and socioeconomic factors.

The present study also demonstrated an association between maternal anaemia and preterm delivery. Preterm birth occurred in 22.5% of women with anaemia compared with 8.3% of women without anaemia ($p = 0.041$). In addition, maternal haemoglobin showed a positive correlation with gestational age at delivery ($r = 0.29$, $p < 0.001$). These findings are consistent with previous evidence. A meta-analysis of studies from South Asian countries reported significantly increased odds of preterm birth among women with maternal anaemia. [2] Similarly, a large systematic review and meta-analysis found that maternal anaemia was associated with an increased risk of preterm birth. [5]

The association between maternal anaemia and preterm birth may involve several mechanisms, including reduced oxygen delivery, placental dysfunction and maternal nutritional deficiencies. However, the timing of anaemia appears important. Earlier evidence has suggested that the relationship between anaemia and adverse birth outcomes may differ according to the gestational period when haemoglobin is measured. [10] Therefore, the present findings should be interpreted as an association rather than evidence of a direct causal relationship.

Low birth weight was observed in 32.7% of newborns in the present study. When maternal haemoglobin was compared according to neonatal outcome, mothers of low-birth-weight infants had a lower mean haemoglobin concentration than mothers of normal-birth-weight infants (9.51 ± 1.12 vs 10.42 ± 1.08 g/dL, $p < 0.001$). This observation further supports the significant relationship observed between maternal haemoglobin and neonatal birth weight.

Early neonatal complications were also more frequent among infants born to anaemic mothers. Complications were recorded in 35.3% of neonates in the anaemia group compared with 18.8% in the non-anaemia group ($p = 0.041$). Respiratory complications, neonatal jaundice and NICU admission were among the documented early neonatal outcomes. Previous evidence has similarly linked maternal anaemia with adverse neonatal outcomes, particularly in the presence of severe maternal anaemia. In a large prospective cohort from India and Pakistan, severe maternal anaemia was associated with increased risks of low birth weight, preterm birth and neonatal mortality. [6]

The present findings should nevertheless be interpreted carefully because several neonatal complications may occur simultaneously and may also be influenced by prematurity and birth weight. Maternal anaemia may therefore act as one of several contributing factors rather than an isolated determinant of neonatal morbidity.

The positive correlation between maternal haemoglobin and neonatal birth weight observed in the present study is also supported by previous dose-response evidence. A systematic review examining maternal haemoglobin concentrations reported associations between maternal haemoglobin and several birth outcomes, including low birth weight and preterm birth. [8] Another systematic review evaluating anaemia and prenatal iron use reported that increasing mean haemoglobin was associated with increased birth weight. [9]

Overall, the findings of the present study demonstrate a consistent relationship between maternal haemoglobin status and neonatal outcomes. Lower maternal haemoglobin was associated with lower birth weight, shorter gestational age and a greater frequency of early neonatal complications. These observations emphasize the importance of antenatal identification and appropriate management of maternal anaemia. However, because this was a prospective observational study conducted at a single institution over six months, the findings demonstrate associations and cannot establish causality. Other factors such as maternal nutrition, parity, socioeconomic status, gestational age at detection of anaemia and treatment received may also influence neonatal outcomes.

CONCLUSION

Maternal anaemia was associated with lower neonatal birth weight, reduced gestational age and increased early neonatal complications. Maternal haemoglobin showed a significant positive correlation with neonatal birth weight and gestational age. Early identification and appropriate management of anaemia during pregnancy may help improve neonatal outcomes.

REFERENCES

1. Rahman MM, Abe SK, Rahman MS, Kanda M, Narita S, Bilano V, et al. Maternal anemia and risk of adverse birth and health outcomes in low- and middle-income countries: systematic review and meta-analysis. *Am J Clin Nutr.* 2016;103(2):495-504.
2. Roh KL, et al. Maternal anaemia and risk of adverse obstetric and neonatal outcomes in South Asian countries: a systematic review and meta-analysis. *Public Health.* 2020;194:159-169.
3. Rahmati S, Delpishe A, Azami M, Hafezi Ahmadi MR, Sayehmiri K. Maternal anemia during pregnancy and infant low birth weight: a systematic review and meta-analysis. *Int J Reprod Biomed.* 2017;15(3):125-134.
4. Figueiredo ACMG, Gomes-Filho IS, Silva RB, Pereira PPS, Mata FAF, Lyrio AO, et al. Maternal anemia and low birth weight: a systematic review and meta-analysis. *Nutrients.* 2018;10(5):601.
5. Wang R, Xu Y, Hao Y, Jin X, Pan L, Xia J, et al. Anemia during pregnancy and adverse pregnancy outcomes: a systematic review and meta-analysis of cohort studies. *Front Glob Womens Health.* 2025;6:1502585.
6. Parks S, et al. Maternal anaemia and maternal, fetal, and neonatal outcomes in a prospective cohort study in India and Pakistan. *BJOG.* 2019;126(6):737-746.
7. Rahman MM, et al. Effects of hemoglobin levels during pregnancy on adverse maternal and infant outcomes: a systematic review and meta-analysis. *Ann N Y Acad Sci.* 2019;1450(1):142-154.
8. Young MF, Oaks BM, Tandon S, Martorell R, Dewey KG, Wendt AS. Maternal hemoglobin concentrations across pregnancy and maternal and child health: a systematic review and meta-analysis. *Ann N Y Acad Sci.* 2019;1450(1):47-68.
9. Haider BA, Olofin I, Wang M, Spiegelman D, Ezzati M, Fawzi WW. Anaemia, prenatal iron use, and risk of adverse pregnancy outcomes: systematic review and meta-analysis. *BMJ.* 2013;346.
10. Xiong X, Buekens P, Alexander S, Demianczuk N, Wollast E. Anemia during pregnancy and birth outcome: a meta-analysis. *Am J Perinatol.* 2000;17(3):137-146.