

Clinical Evaluation of Anemia Severity in Pregnant Women and Its Association with Maternal Morbidity and Neonatal Outcomes

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Abstract:

Background: Anemia in pregnancy remains a major public health concern globally, with a disproportionately high burden in developing countries like India. It is associated with increased risks of maternal complications, adverse perinatal outcomes, and long-term effects on neonatal development. The World Health Organization defines anemia in pregnancy as hemoglobin levels below 11 g/dL and classifies it based on severity as mild, moderate, or severe. Despite national initiatives aimed at improving antenatal care and iron supplementation, the prevalence of anemia remains unacceptably high in rural and semi-urban populations. This study was conducted to assess the severity of anemia among pregnant women and to analyze its impact on maternal and perinatal outcomes.

Methods: This prospective observational study was conducted in the Department of Obstetrics and Gynaecology, Netaji Subhas Medical College and Hospital, Amhara, Bihta, Patna, Bihar, India, from March 2024 to October 2024. A total of 200 pregnant women beyond 28 weeks of gestation were enrolled and categorized into four groups based on WHO hemoglobin criteria: non-anemic (≥ 11 g/dL), mildly anemic (10–10.9 g/dL), moderately anemic (7–9.9 g/dL), and severely anemic (< 7 g/dL). Detailed obstetric history, clinical examination, and relevant investigations were recorded. The maternal outcomes assessed included mode of delivery, incidence of pre-eclampsia, antepartum hemorrhage, postpartum hemorrhage, and need for blood transfusion. Perinatal outcomes such as birth weight, Apgar score, NICU admission, and perinatal mortality were also evaluated.

Results: Among the 200 pregnant women studied, 22.5% were mildly anemic, 44.5% moderately anemic, and 18.0% severely anemic, while only 15.0% were non-anemic. Increasing severity of anemia was significantly associated with higher rates of maternal complications including preterm labor, postpartum hemorrhage, and blood transfusion. Cesarean section rates were higher among severely anemic women. In terms of perinatal outcomes, low birth weight, NICU admissions, and perinatal deaths were significantly more common in moderate and severe anemia groups ($p < 0.01$). Severe anemia was found to be an independent predictor of poor neonatal outcomes.

Conclusion: The study confirms that the severity of maternal anemia in pregnancy is directly associated with adverse maternal and perinatal outcomes. Moderate to severe anemia significantly increases the risk of obstetric complications and poor neonatal health indicators. Early screening, effective antenatal care, nutritional counseling, and timely correction of anemia are essential strategies to reduce the burden of anemia-related complications in pregnancy.

Keywords: Anemia In Pregnancy, Maternal Outcome, Perinatal Outcome, Hemoglobin Level, Low Birth Weight, NICU Admission, Obstetric Complications

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Introduction

Anemia in pregnancy is one of the most pressing public health challenges affecting maternal and fetal well-being, particularly in developing nations such as India. According to the World Health Organization, anemia affects more than 40% of pregnant women globally, with the highest prevalence reported from South Asia [1]. In India, despite long-standing national programs for iron supplementation and antenatal care, anemia

continues to impact a significant proportion of pregnant women, particularly in rural and underserved populations. The condition is characterized by a reduction in the oxygen-carrying capacity of blood, commonly due to iron deficiency, and is classified in pregnancy when the hemoglobin level falls below 11 g/dL [2].

The physiological demands of pregnancy, including increased plasma volume and fetal requirements, make women particularly vulnerable to developing anemia. Nutritional deficiencies, frequent pregnancies, infections, parasitic infestations, and poor socioeconomic conditions further compound the risk [3]. Anemia during pregnancy is not only a marker of poor maternal health but also a significant contributor to maternal morbidity and mortality. Severe anemia is known to increase the likelihood of obstetric complications such as preterm labor, hypertensive disorders, postpartum hemorrhage, and infections. In extreme cases, it may contribute to maternal collapse and mortality, especially in settings with limited access to emergency obstetric care [4].

The effects of anemia extend beyond the mother to the fetus and neonate. Reduced oxygen supply due to maternal anemia is associated with intrauterine growth restriction, low birth weight, poor Apgar scores, increased rates of neonatal intensive care unit (NICU) admissions, and perinatal mortality [5]. Severe anemia in the mother may result in placental insufficiency, leading to fetal hypoxia and acidosis. These outcomes place an additional burden on neonatal services and contribute to poor early childhood development, further perpetuating the cycle of malnutrition and poor health [6]. Despite multiple government initiatives such as the National Iron Plus Initiative (NIPI) and intensified antenatal screening protocols, the reduction in anemia prevalence has been modest [7]. A critical gap remains in identifying and managing the severity of anemia during pregnancy and understanding its direct implications on pregnancy outcomes. Many studies have highlighted the prevalence of anemia, but fewer have examined its graded impact particularly in semi-urban and rural healthcare settings where timely diagnosis and intervention are often delayed [8].

Given this context, the present study was undertaken at the Department of Obstetrics and Gynaecology, Netaji Subhas Medical College and Hospital, Amhara, Bihta, Patna, Bihar, India, to assess the severity of anemia in pregnant women beyond 28 weeks of gestation and to evaluate its impact on both maternal and perinatal outcomes. The study aims to provide meaningful insight into the correlation between hemoglobin levels and obstetric complications and to emphasize the need for effective preventive and corrective strategies during antenatal care.

Materials and Methods

This prospective observational study was conducted in the Department of Obstetrics and Gynaecology at Netaji Subhas Medical College and Hospital, Amhara, Bihta, Patna, Bihar, India, March 2024 to October 2024. The study aimed to assess the

severity of anemia in pregnant women during the third trimester and evaluate its association with maternal and perinatal outcomes.

A total of 200 pregnant women beyond 28 weeks of gestation were enrolled in the study using consecutive sampling. Inclusion criteria included pregnant women aged 18–40 years with singleton pregnancies, presenting for delivery or admitted in the antenatal ward. Exclusion criteria were women with multiple gestations, known hematological disorders (e.g., thalassemia, sickle cell anemia), chronic renal or hepatic diseases, antepartum hemorrhage at admission, or incomplete clinical records.

Detailed demographic and obstetric history was recorded, including age, parity, booking status, socioeconomic status, inter-pregnancy interval, dietary habits, and iron supplementation compliance. General physical examination and obstetric evaluation were carried out. Hemoglobin estimation was done using automated cell counter technology as per institutional protocol. Based on hemoglobin levels, participants were categorized according to the World Health Organization (WHO) classification:

- Non-anemic: ≥ 11.0 g/dL
- Mild anemia: 10.0–10.9 g/dL
- Moderate anemia: 7.0–9.9 g/dL
- Severe anemia: < 7.0 g/dL

All women were monitored throughout labor and delivery. Maternal outcomes were noted, including mode of delivery (normal vaginal, instrumental, or cesarean section), development of pregnancy complications such as pre-eclampsia, preterm labor, antepartum or postpartum hemorrhage, and requirement for blood transfusion. Any admission to high-dependency or intensive care units and duration of hospital stay were also recorded.

Perinatal outcomes were assessed based on birth weight, Apgar score at 1 and 5 minutes, need for neonatal resuscitation, NICU admission, stillbirths, and early neonatal deaths (within 7 days). Gestational age was calculated from last menstrual period or first trimester ultrasound, and low birth weight was defined as < 2.5 kg. All neonates were followed until discharge from the hospital.

Data were entered and tabulated in Microsoft Excel and statistically analyzed using SPSS software version 26.0. Descriptive statistics such as mean, standard deviation, and proportions were used for baseline characteristics. Associations between severity of anemia and maternal or perinatal outcomes were assessed using Chi-square test or Fisher's exact test for categorical variables and ANOVA for continuous variables. A p-value of < 0.05 was considered statistically significant.

This methodology enabled a detailed evaluation of anemia severity during pregnancy and its direct relationship with maternal morbidities and perinatal outcomes, with the goal of contributing to improved screening and intervention strategies in antenatal care settings.

Results

A total of 200 pregnant women beyond 28 weeks of gestation were included in the study and categorized

into four groups based on WHO hemoglobin classification: non-anemic (≥ 11 g/dL), mildly anemic (10–10.9 g/dL), moderately anemic (7–9.9 g/dL), and severely anemic (< 7 g/dL). Among them, 30 (15.0%) were non-anemic, 45 (22.5%) had mild anemia, 89 (44.5%) had moderate anemia, and 36 (18.0%) had severe anemia. The association of anemia severity with maternal and perinatal outcomes is presented below.

Table 1: Age Distribution of Study Participants

Age Group (years)	Frequency (n)	Percentage (%)
≤ 20	18	9.0%
21–30	112	56.0%
31–35	52	26.0%
> 35	18	9.0%

Table 2: Parity Distribution of Participants

Parity	Frequency (n)	Percentage (%)
Primigravida	74	37.0%
Multigravida	126	63.0%

Table 3: Distribution According to Severity of Anemia

Anemia Category	Hemoglobin Range (g/dL)	Frequency (n)	Percentage (%)
Non-anemic	≥ 11.0	30	15.0%
Mild anemia	10.0–10.9	45	22.5%
Moderate anemia	7.0–9.9	89	44.5%
Severe anemia	< 7.0	36	18.0%

Table 4: Association of Anemia with Mode of Delivery

Mode of Delivery	Non-anemic (n=30)	Mild (n=45)	Moderate (n=89)	Severe (n=36)	p-value
Normal Vaginal Delivery	22	32	55	17	
Cesarean Section	6	10	28	17	
Instrumental Delivery	2	3	6	2	0.042

Table 5: Association of Anemia Severity with Maternal Complications

Complication	Non-anemic	Mild	Moderate	Severe	p-value
Preterm Labor	2	5	19	11	0.008
Preeclampsia	1	3	11	9	0.010
Postpartum Hemorrhage	0	1	8	10	< 0.001
Blood Transfusion	0	2	20	28	< 0.001

Table 6: Association of Anemia with Birth Weight

Birth Weight Category	Non-anemic	Mild	Moderate	Severe	p-value
≥ 2.5 kg	28	36	47	12	
< 2.5 kg	2	9	42	24	< 0.001

Table 7: Apgar Score at 5 Minutes

Apgar Score	Non-anemic	Mild	Moderate	Severe	p-value
≥ 7	29	40	60	18	
< 7	1	5	29	18	< 0.001

Table 8: NICU Admission Rates

NICU Admission	Non-anemic	Mild	Moderate	Severe	p-value
Yes	1	4	22	21	< 0.001
No	29	41	67	15	

Table 9: Perinatal Mortality Rates

Outcome	Non-anemic	Mild	Moderate	Severe	p-value
Alive	30	44	86	31	
Stillbirth/Death	0	1	3	5	0.013

Table 10: Duration of Hospital Stay

Duration (days)	Non-anemic	Mild	Moderate	Severe	p-value
≤5	27	38	66	12	
>5	3	7	23	24	<0.001

Table 11: ICU Admission

ICU Admission	Non-anemic	Mild	Moderate	Severe	p-value
Yes	0	1	4	7	<0.001
No	30	44	85	29	

Table 12: Summary of Adverse Outcomes in Relation to Anemia

Adverse Outcomes Present	Non-anemic	Mild	Moderate	Severe	p-value
Yes	4	10	53	32	<0.001
No	26	35	36	4	

The results of this study indicate a strong and statistically significant association between increasing severity of anemia and adverse maternal and perinatal outcomes. Women with moderate and severe anemia experienced higher rates of preterm labor, postpartum hemorrhage, need for blood transfusion, cesarean delivery, NICU admissions, and perinatal deaths. These findings highlight the clinical importance of early detection and effective management of anemia during pregnancy.

Discussion

Anemia in pregnancy continues to be a critical contributor to maternal and perinatal morbidity and mortality, particularly in low- and middle-income countries. This prospective study conducted in a semi-urban tertiary care setting in Bihar aimed to assess the severity of anemia during pregnancy and its direct implications on maternal and neonatal outcomes. The findings clearly demonstrate that the degree of anemia correlates strongly with the frequency and severity of adverse outcomes, reinforcing the urgent need for effective screening, prevention, and intervention strategies [9].

In the present study, only 15% of pregnant women were non-anemic, while the remaining 85% had varying degrees of anemia, with moderate anemia being the most prevalent (44.5%). This reflects the persistent high burden of anemia in antenatal populations, despite national programs offering iron-folic acid supplementation and routine hemoglobin screening. The high prevalence may be attributed to poor compliance, inadequate nutrition, lack of awareness, and late antenatal booking, which remain significant barriers in semi-urban and rural populations [10].

The study revealed a strong association between anemia severity and mode of delivery. Cesarean section rates were significantly higher in the moderate and severe anemia groups, likely due to increased fetal distress, maternal exhaustion, and complications requiring surgical intervention. Instrumental deliveries, though less common, were also more frequent among anemic women. These findings are consistent with previous clinical evidence where anemia compromises maternal endurance and fetal oxygenation, often necessitating operative delivery [11].

Maternal complications such as preterm labor, preeclampsia, postpartum hemorrhage (PPH), and the need for blood transfusion showed a statistically significant increase with worsening anemia. In particular, PPH was noted predominantly among women with severe anemia, underscoring the compromised uterine tone, coagulopathy, and poor tissue perfusion associated with severe hypoxia. The higher transfusion rate among moderately and severely anemic women further reflects the burden on blood bank services and the risks associated with emergency transfusion in obstetric settings [12].

The impact of anemia on neonatal outcomes was equally profound. Low birth weight (LBW) was significantly more common among neonates born to mothers with moderate and severe anemia. Maternal anemia contributes to placental insufficiency and intrauterine growth restriction, leading to compromised fetal growth. Apgar scores at 5 minutes were lower in neonates born to severely anemic mothers, which indicates increased neonatal asphyxia and the need for resuscitation at birth. The NICU admission rate in this group was alarmingly high, placing additional strain on neonatal intensive care services [13].

Perinatal mortality also showed a rising trend with increasing anemia severity. Stillbirths and early neonatal deaths were reported predominantly among severely anemic women, reflecting the grave implications of unmanaged anemia during pregnancy. These outcomes emphasize the critical need for early antenatal diagnosis, prompt correction, and continuous monitoring of maternal hemoglobin levels to prevent preventable fetal loss [14].

ICU admission and prolonged hospital stay were also significantly more frequent in the severe anemia group, further illustrating the systemic burden imposed by anemia on healthcare resources. Severe anemia during labor can lead to hemodynamic instability, infection, and prolonged recovery time, requiring intensive monitoring and care [15].

Overall, this study confirms that maternal anemia is not merely a laboratory finding but a clinically significant risk factor with multidimensional consequences. It affects not just the course of labor and delivery, but also the immediate and long-term health of the newborn. The study supports a direct and graded relationship between the severity of anemia and the magnitude of maternal and neonatal complications [16].

These findings advocate for the integration of anemia severity-based risk stratification into routine antenatal care. Timely correction of even mild anemia, close monitoring of moderate cases, and planned delivery for severely anemic women in equipped centers can reduce both maternal and perinatal risks. Nutrition education, community-based awareness programs, and better implementation of iron supplementation protocols remain essential components of a successful public health strategy against anemia in pregnancy.

Conclusion

This study underscores the significant impact of anemia severity during pregnancy on both maternal and perinatal outcomes. A clear and progressive association was observed between worsening anemia and the occurrence of obstetric complications, including increased rates of cesarean delivery, preterm labor, postpartum hemorrhage, and the need for blood transfusions. Neonates born to moderately and severely anemic mothers were more likely to have low birth weight, poor Apgar scores, higher NICU admission rates, and increased perinatal mortality.

The findings highlight the clinical importance of not only identifying anemia during antenatal visits but also grading its severity and ensuring timely and appropriate management based on risk level. Moderate to severe anemia poses a substantial risk to maternal stability and fetal development, making early intervention critical.

Strengthening antenatal care services, ensuring adherence to iron and folic acid supplementation, and promoting early registration and regular follow-up of pregnant women are essential strategies to reduce anemia-related complications. Implementation of severity-based monitoring and delivery planning can further optimize maternal and neonatal outcomes, especially in resource-constrained settings.

References

1. Deshmukh VL, Jadhav M, Yelikar K. Impact of HIGH BMI on Pregnancy: Maternal and Foetal Outcome. *J Obstet Gynaecol India*. 2016 Oct;66(Suppl 1):192-7. doi: 10.1007/s13224-015-0825-3. Epub 2016 Jan 13. PMID: 27651602; PMCID: PMC5016433.
2. Yakoob MY, Bhutta ZA. Effect of routine iron supplementation with or without folic acid on anemia during pregnancy. *BMC Public Health*. 2011 Apr 13;11 Suppl 3(Suppl 3):S21. doi: 10.1186/1471-2458-11-S3-S21. PMID: 21501439; PMCID: PMC3231895.
3. Pilone V, Hasani A, Di Micco R, Vitiello A, Monda A, Izzo G, Iacobelli L, Villamaina E, Forestieri P. Pregnancy after laparoscopic gastric banding: maternal and neonatal outcomes. *Int J Surg*. 2014;12 Suppl 1:S136-9. doi: 10.1016/j.ijsu.2014.05.027. Epub 2014 May 24. PMID: 24866073.
4. Smith C, Teng F, Branch E, Chu S, Joseph KS. Maternal and Perinatal Morbidity and Mortality Associated With Anemia in Pregnancy. *Obstet Gynecol*. 2019 Dec;134(6):1234-1244. doi: 10.1097/AOG.0000000000003557. PMID: 31764734; PMCID: PMC6882541.
5. Banaei M, Ghasemi V, Saei Ghare Naz M, Kiani Z, Rashidi-Fakari F, Banaei S, Mohammad Souri B, Rokni M. Obstetrics and Neonatal Outcomes in Pregnant Women with COVID-19: A Systematic Review. *Iran J Public Health*. 2020 Oct;49(Suppl 1):38-47. doi: 10.18502/ijph.v49iS1.3668. PMID: 34268204; PMCID: PMC8266025.
6. Lin L, Wei Y, Zhu W, Wang C, Su R, Feng H, Yang H; Gestational diabetes mellitus Prevalence Survey (GPS) study Group. Prevalence, risk factors and associated adverse pregnancy outcomes of anaemia in Chinese pregnant women: a multicentre retrospective study. *BMC Pregnancy Childbirth*. 2018 Apr 23;18(1):111. doi: 10.1186/s12884-018-1739-8. PMID: 29685119; PMCID: PMC5914057.
7. Bora R, Sable C, Wolfson J, Boro K, Rao R. Prevalence of anemia in pregnant women and its effect on neonatal outcomes in Northeast India. *J Matern Fetal Neonatal Med*. 2014 Jun;27(9):887-91. doi: 10.3109/14767058.2013.845161. Epub 2013 Oct 24. PMID: 24041147.

8. Bo L, Mei-Ying L, Yang Z, Shan-Mi W, Xiao-Hong Z. Aplastic anemia associated with pregnancy: maternal and fetal complications. *J Matern Fetal Neonatal Med.* 2016;29(7):1120-4. doi: 10.3109/14767058.2015.1037733. Epub 2015 Sep 15. PMID: 26372009.
9. Gonzales GF, Tapia V, Gasco M, Carrillo C. Hemoglobina materna en el Perú: diferencias regionales y su asociación con resultados adversos perinatales [Maternal hemoglobin in Peru: regional differences and its association with adverse perinatal outcomes]. *Rev Peru Med Exp Salud Publica.* 2011 Jul-Sep;28(3):484-91. Spanish. doi: 10.1590/s1726-46342011000300012. PMID: 22086629.
10. Darlington F, Acha BM, Roshan T, Ikeanyionwu C, Kutse S, Abajue U, Osazuwa B, Gomez I, Spooner KK, Salemi JL, Dongarwar D, Olaleye OA, Salihu HM, Ndefo UA. Opioid-Related Disorders Among Pregnant Women with Sickle Cell Disease and Adverse Pregnancy Outcomes. *Pain Med.* 2020 Nov 1;21(11):3087-3093. doi: 10.1093/pm/pnaa188. PMID: 32710119.
11. Patel A, Prakash AA, Das PK, Gupta S, Pusdekar YV, Hibberd PL. Maternal anemia and underweight as determinants of pregnancy outcomes: cohort study in eastern rural Maharashtra, India. *BMJ Open.* 2018 Aug 8;8(8):e021623. doi: 10.1136/bmjopen-2018-021623. PMID: 30093518; PMCID: PMC6089300.
12. Nkwabong E, Ngoundjou Dongmo P, Tayou C, Nana Njamien T. Outcome of pregnancies among women with sickle cell disease. *J Matern Fetal Neonatal Med.* 2022 Mar;35(6):1108-1112. doi: 10.1080/14767058.2020.1743657. Epub 2020 Mar 31. PMID: 32233705.
13. Stefanovic V. The Extended Use of Eculizumab in Pregnancy and Complement Activation-Associated Diseases Affecting Maternal, Fetal and Neonatal Kidneys-The Future Is Now? *J Clin Med.* 2019 Mar 24;8(3):407. doi: 10.3390/jcm8030407. PMID: 30909646; PMCID: PMC6463259.
14. Parks S, Hoffman MK, Goudar SS, Patel A, Saleem S, Ali SA, Goldenberg RL, Hibberd PL, Moore J, Wallace D, McClure EM, Derman RJ. Maternal anaemia and maternal, fetal, and neonatal outcomes in a prospective cohort study in India and Pakistan. *BJOG.* 2019 May;126(6):737-743. doi: 10.1111/1471-0528.15585. Epub 2019 Jan 24. PMID: 30554474; PMCID: PMC6459713.
15. Msuya SE, Hussein TH, Uriyo J, Sam NE, Stray-Pedersen B. Anaemia among pregnant women in northern Tanzania: prevalence, risk factors and effect on perinatal outcomes. *Tanzan J Health Res.* 2011 Jan;13(1):33-9. doi: 10.4314/thrb.v13i1.60881. PMID: 24409645.
16. Turner AN, Tabbah S, Mwapasa V, Rogerson SJ, Meshnick SR, Ackerman WE 4th, Kwiek JJ. Severity of maternal HIV-1 disease is associated with adverse birth outcomes in Malawian women: a cohort study. *J Acquir Immune Defic Syndr.* 2013 Dec 1;64(4):392-9. doi: 10.1097/QAI.0b013e3182a2d13c. PMID: 23846560; PMCID: PMC3940209.