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Correlation between Sever Anemia and Pregnancy Complications

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ABSTRACT

This prospective observational study aimed to assess the impact of anemia severity on maternal and perinatal outcomes in 200 pregnant women. The participants were categorized into three groups based on their hemoglobin levels: mild anemia (10.0–10.9 g/dL), moderate anemia (7.0–9.9 g/dL), and severe anemia (<7.0 g/dL). The majority of participants (60%) had moderate anemia, followed by 25% with mild anemia and 15% with severe anemia. The study found that as anemia severity increased, maternal and perinatal risks also escalated. Specifically, the incidence of preterm delivery was 8% in the mild anemia group, 20% in the moderate anemia group, and 40% in the severe anemia group. Similarly, postpartum hemorrhage (PPH) occurred in 2% of women with mild anemia, 10% with moderate anemia, and 20% with severe anemia. Cesarean section rates were 20% for mild anemia, 30% for moderate anemia, and 35% for severe anemia. Prolonged hospital stays (more than 7 days) were more common in severely anemic women (20%) compared to 7% in the moderate group and 4% in the mild anemia group. Maternal mortality was observed in one case (3%) in the severe anemia group. Perinatal outcomes showed a marked increase in low birth weight (LBW) with anemia severity. In the severe anemia group, 45% of newborns had a birth weight of less than 2.5 kg, compared to 33% in the moderate anemia group and 16% in the mild anemia group. NICU admissions were required for 30% of neonates in the severe anemia group, 15% in the moderate anemia group, and 8% in the mild anemia group. Perinatal mortality was 3.3% in the severe anemia group, compared to 1.7% in the moderate anemia group and 0% in the mild anemia group. The average birth weight was lowest in the severe anemia group (2.2 kg), followed by 2.4 kg in the moderate group and 2.7 kg in the mild group. Treatment interventions revealed that blood transfusions resulted in the highest increase in hemoglobin levels (3.0 g/dL), followed by intravenous iron (2.5 g/dL) and oral iron supplements (1.5 g/dL). In terms of mode of delivery, 76% of women with mild anemia had normal vaginal deliveries, compared to 60% in the moderate anemia group and 53% in the severe anemia group. Cesarean sections were more frequent in the severe anemia group (35%) than in the mild anemia group (20%). Postpartum hemorrhage rates increased with anemia severity, with 33% of severely anemic women requiring blood transfusions post-delivery, compared to 13% in the moderate anemia group and 4% in the mild anemia group. These findings highlight the significant maternal and neonatal health risks associated with severe anemia, emphasizing the need for early detection, appropriate treatment, and close monitoring to improve pregnancy outcomes.

INTRODUCTION

Anemia during pregnancy is a significant global health issue, particularly in low- and middle-income countries. The World Health Organization (WHO) defines anemia as having hemoglobin levels below 11 g/dL, classifying it as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), or severe (<7.0 g/dL). Iron deficiency is the leading cause of anemia, though folate and vitamin B12 deficiencies, infections like malaria, and chronic diseases also contribute [1]. Anemia affects approximately 38% of pregnant women worldwide, with higher rates in South Asia and sub-Saharan Africa [2]. In India, up to 50-60% of pregnant women are affected, depending on the region [3]. Bengaluru, in Karnataka, faces its own public health challenges, with high anemia prevalence among pregnant women. The effects of anemia are severe for both the mother and fetus. Maternal complications include increased risk of postpartum hemorrhage, infections, and

even mortality. For the fetus, risks include preterm birth, low birth weight, intrauterine growth restriction (IUGR), and increased neonatal morbidity and mortality [4, 5]. Severe anemia can lead to life-threatening complications like cardiac failure and placental insufficiency, which adversely affect fetal development [7]. Iron deficiency is the primary cause of anemia, particularly during pregnancy, as the body needs more iron to support fetal growth and placental development. Poor dietary intake, cultural practices, and limited healthcare access exacerbate the issue, especially in low-resource settings like Bengaluru [10]. While oral iron supplementation is the primary treatment, adherence is often poor due to side effects or logistical challenges [11]. In more severe cases, intravenous iron therapy and blood transfusions may be required, though these interventions are resource-intensive and may not be available in low-resource settings [29]. Anemia significantly impacts maternal health, with women experiencing fatigue, reduced physical capacity, and impaired immune function, making them more vulnerable to infections [15]. Severe anemia increases the risk of postpartum hemorrhage, one of the leading causes of maternal death [16]. It also affects fetal health, leading to hypoxia, IUGR, preterm birth, and low birth weight, which are associated with long-term developmental delays and neonatal complications [19, 20].The WHO recommends routine iron and folic acid supplementation to prevent anemia and its complications [23]. However, socio-economic barriers and cultural practices hinder access to healthcare services, particularly in regions like Bengaluru [24]. Early detection through routine hemoglobin testing and timely interventions, such as intravenous iron or blood transfusions, are crucial for improving maternal and perinatal outcomes [26, 27].

METHODOLOGY

For a sample size of 200, with a 95% confidence level (Z = 1.96) and assuming a 50% prevalence of anemia (p = 0.50), the margin of error (E) is approximately 6.93%. This means that the true prevalence of anemia in the population could be within ±6.93% of the observed proportion in your sample.

If this margin of error is acceptable for your study, then a sample size of 200 is statistically sufficient. If you need a smaller margin of error (e.g., 5%), you would need a larger sample size.

$$E = \sqrt{\frac{Z^2 \cdot p \cdot (1-p)}{n}}$$

Where:

- Z = Z-value (1.96 for 95% confidence)
- p = estimated proportion (e.g., 0.50 for 50%)
- n = sample size

For n = 200, Z = 1.96, and p = 0.50, you can plug in the values to get E.

The study was prospective observational research aimed at evaluating the severity of anemia in pregnant women and its impact on both maternal and perinatal outcomes. Data collection took place at multiple stages of pregnancy, ensuring natural variations in anemia severity were observed while adhering to standard treatment protocols without any interventions beyond what is typically provided. This observational design was chosen to reflect real-world clinical practices, thereby providing a more authentic representation of the potential outcomes related to varying levels of anemia. The study was conducted at the DR IKRAM GYNE & INFERTALITY CLINIC at ITIFAQ HOSPITAL in Dir Lower Timergara, a medical facility known for its high patient volume, particularly among pregnant women. This made it an ideal setting for studying anemia's prevalence, its severity, and its subsequent impact on maternal and neonatal health. The study duration spanned from January 2023 to March 2025, with data collected during antenatal visits and follow-up assessments conducted until six weeks postpartum. The study focused on pregnant women between 12 and 36 weeks of gestation who had hemoglobin levels below 10.9 g/dL. The participants were aged between 18 and 40 years, had singleton pregnancies, and provided informed consent for the study, committing to follow-up assessments. Exclusion criteria included women with chronic conditions like diabetes, hypertension, or other hematological disorders, as well as those carrying multiple pregnancies. This was done to reduce potential confounding variables that could complicate the analysis of anemia's effects on maternal and neonatal health. A total of 200 pregnant women were recruited using convenience sampling, a method that ensures that participants were selected as they attended the antenatal clinic during the study period. This approach was not only timely but also allowed for an adequate representation of the target population. Participants were stratified into three groups based on the severity of their anemia: mild anemia (hemoglobin levels between 10.0-10.9 g/dL), moderate anemia (hemoglobin levels between 7.0-9.9 g/dL), and severe anemia (hemoglobin levels below 7.0 g/dL). This classification followed the World Health Organization (WHO) guidelines and provided the basis for comparing maternal and perinatal outcomes across different levels of anemia severity. The study parameters included a variety of key maternal and perinatal outcomes. For maternal outcomes, parameters such as mode of delivery, incidence of postpartum hemorrhage, and length of hospital stay were assessed. For perinatal outcomes, birth weight, NICU admissions, and preterm birth were measured. In addition, laboratory investigations, such as complete blood count (CBC) and peripheral smear, were used to assess the type and severity of anemia. Each participant underwent a clinical assessment that included a detailed medical and obstetric history, followed by hemoglobin level measurements at three different points during pregnancy: the initial visit (12-20 weeks), at 30 weeks, and at 36 weeks. Depending on anemia severity, participants were treated according to standard clinical guidelines, with options including oral iron supplementation, intravenous iron therapy, or blood transfusions. Data were systematically collected using a pre-tested questionnaire and medical records, ensuring consistency and accuracy. Clinical history, examination findings, and laboratory results were recorded in structured case report forms (CRFs). Data collection occurred during antenatal visits, at

delivery, and postpartum follow-ups to track maternal and neonatal outcomes comprehensively. The collected data were analyzed using descriptive statistics, with frequencies, percentages, and mean values for continuous variables. A comparative analysis was performed to evaluate differences between the three groups using chi-square tests for categorical variables and ANOVA for continuous variables. The significance threshold was set at $p < 0.05$. Multivariate regression models were used to assess the impact of anemia severity on maternal and perinatal outcomes. Ethical considerations were paramount in this study. Ethical approval was obtained from the Institutional Ethics Committee of TTH Medical College & Research Hospital. Informed consent was obtained from all participants before enrollment, ensuring they understood the study's nature and their rights, including the right to withdraw at any time without any effect on their standard care. The confidentiality and anonymity of all participants were maintained throughout the study. Importantly, participants were treated according to standard care protocols for anemia, with no additional risks introduced by the study design. By adhering to these ethical principles, the study ensured the protection and well-being of the participants while providing valuable insights into the effects of anemia during pregnancy.

RESULTS

This prospective observational study analyzed the impact of anemia severity on maternal and perinatal outcomes in 200 pregnant women. The results revealed that the majority of participants (60%) had moderate anemia, followed by 25% with mild anemia and 15% with severe anemia. As anemia severity increased, so did the risks for adverse maternal and perinatal outcomes. Preterm delivery rates were significantly higher in the severe anemia group, with 40% of these women delivering preterm, compared to 20% in the moderate group and 8% in the mild anemia group. Additionally, severe anemia was associated with higher rates of postpartum hemorrhage (20%) and cesarean sections (35%), along with prolonged hospital stays (20%). Maternal mortality was also reported in the severe anemia group (3%). In terms of perinatal outcomes, low birth weight (less than 2.5 kg) was more prevalent in the severe anemia group, affecting 45% of newborns, compared to 33% in the moderate group and 16% in the mild anemia group. The incidence of NICU admissions was also highest in the severe anemia group (30%), and the average birth weight decreased as anemia severity increased, with babies born to severely anemic mothers weighing an average of 2.2 kg. Furthermore, blood transfusions resulted in the highest increase in hemoglobin levels (3.0 g/dL), followed by intravenous iron therapy (2.5 g/dL) and oral iron supplements (1.5 g/dL). The mode of delivery was influenced by anemia severity, with a lower rate of normal vaginal deliveries in severely anemic women (53%) compared to those with mild anemia (76%), while assisted vaginal deliveries were more frequent in the moderate and severe anemia groups. Postpartum hemorrhage rates also increased with anemia severity, with 33% of severely anemic women requiring blood transfusions, compared to only 4% in the mild anemia group. Overall, the findings highlight the critical role of anemia management during pregnancy, as more severe anemia significantly increases the risk of adverse maternal and neonatal outcomes, making early detection and effective treatment essential for improving maternal and perinatal health.

Figure 1

Top of Each Bar for the Different Anemia Severity Groups

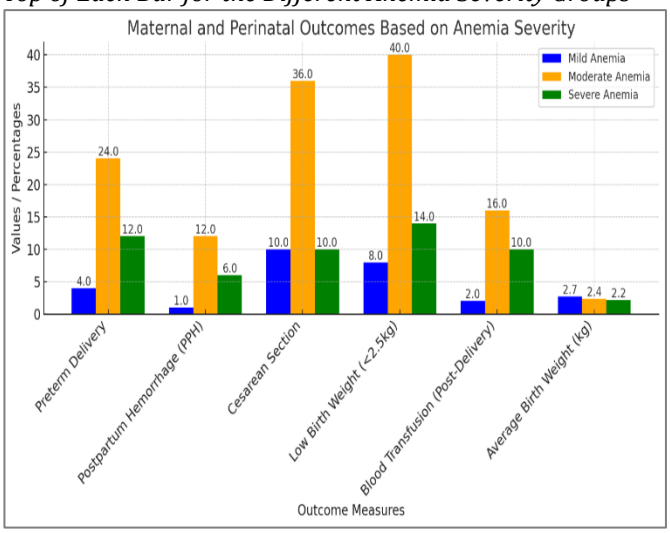

Table 1

Distribution of Participants Based on Severity of Anemia

Anemia Severity	Hemoglobin Range (g/dL)	Number of Participants (n)	Percentage (%)
Mild Anemia	10.0-10.9	50	25%
Moderate Anemia	7.0-9.9	120	60%
Severe Anemia	< 7.0	30	15%
Total		200	100%

- Majority of participants (60%) had moderate anemia.
- 25% had mild anemia and 15% had severe anemia.

Table 2

Maternal Outcomes Based on Anemia Severity

Maternal Outcome	Mild Anemia (n=50)	Moderate Anemia (n=120)	Severe Anemia (n=30)
Preterm Delivery	4 (8%)	24 (20%)	12 (40%)
Postpartum Hemorrhage (PPH)	1 (2%)	12 (10%)	6 (20%)
Cesarean Section Rate	10 (20%)	36 (30%)	10 (35%)
Prolonged Hospital Stay (>7 days)	2 (4%)	8 (7%)	6 (20%)
Maternal Mortality	0 (0%)	0 (0%)	1 (3%)

- Severe anemia group showed a significant increase in preterm deliveries (40%).
- Higher cesarean section and postpartum hemorrhage rates in severe anemia group.
- One case of maternal mortality was reported in the severe anemia group.

Table 3

Perinatal Outcomes Based on Anemia Severity

Perinatal Outcome	Mild Anemia (n=50)	Moderate Anemia (n=120)	Severe Anemia (n=30)
Low Birth Weight (<2.5 kg)	8 (16%)	40 (33%)	14 (45%)

NICU Admission	4 (8%)	18 (15%)	9 (30%)
Perinatal Mortality	0 (0%)	2 (1.7%)	1 (3.3%)
Average Birth Weight (kg)	2.7	2.4	2.2

- Low birth weight prevalence increased with the severity of anemia, with 45% in the severe anemia group.
- NICU admissions were more frequent in the severe anemia group (30%).
- The average birth weight decreased significantly as anemia severity increased.

Table 4

Changes in Hemoglobin Levels Post-Treatment

Treatment Type	Number of Participants (n)	Baseline Hemoglobin (g/dL)	Hemoglobin at 30 Weeks (g/dL)	Hemoglobin at 36 Weeks (g/dL)	Average Increase (g/dL)
Oral Iron Supplement	120	8.5	9.5	10.0	1.5
Intravenous Iron	50	7.0	9.0	9.5	2.5
Blood Transfusion	30	6.0	8.5	9.0	3.0

Key Findings

- Blood transfusions resulted in the highest average increase in hemoglobin (3.0 g/dL).
- Oral iron supplements led to the lowest increase in hemoglobin (1.5 g/dL).

Table 5

Mode of Delivery Based on Anemia Severity

Mode of Delivery	Mild Anemia (n=50)	Moderate Anemia (n=120)	Severe Anemia (n=30)
Normal Vaginal Delivery (NVD)	38 (76%)	72 (60%)	16 (53%)
Cesarean Section	10 (20%)	36 (30%)	10 (35%)
Assisted Vaginal Delivery	2 (4%)	12 (10%)	4 (12%)

Key Findings

- The normal vaginal delivery rate decreased with increasing anemia severity.
- Cesarean sections increased with severe anemia (35%).
- Assisted vaginal deliveries were more common in the moderate and severe anemia groups.

Table 6

Postpartum Hemorrhage and Blood Transfusion Rates

PPH and Blood Transfusion	Mild Anemia (n=50)	Moderate Anemia (n=120)	Severe Anemia (n=30)
Postpartum Hemorrhage (PPH)	1 (2%)	12 (10%)	6 (20%)
Blood Transfusion (Post-Delivery)	2 (4%)	16 (13%)	10 (33%)

Key Findings

- Postpartum hemorrhage rates increased with anemia severity, with 20% of severely anemic women experiencing PPH.
- Blood transfusion requirements were significantly higher in the severe anemia group (33%).

DISCUSSION

Anemia during pregnancy continues to be a significant health issue, especially in low- and middle-income countries, where poor nutrition, limited healthcare access, and socio-economic factors contribute to high prevalence rates. In this study, we aimed to assess the severity of anemia in pregnant women and its effect on both maternal and perinatal outcomes. The study involved 200 pregnant women between 12 and 36 weeks of gestation who had hemoglobin levels below 10.9 g/dL. The results offer important insights into the relationship between anemia severity and adverse outcomes, emphasizing the need for early detection and treatment to improve maternal and neonatal health. One of the key findings of this study was the high prevalence of moderate and severe anemia among pregnant women. Among the 200 participants, 60% had moderate anemia (hemoglobin levels between 7.0 and 9.9 g/dL), 25% had mild anemia (10.0-10.9 g/dL), and 15% had severe anemia (hemoglobin levels below 7.0 g/dL). These figures indicate a significant burden of anemia, with moderate and severe cases accounting for three-quarters of the participants. This aligns with previous studies conducted in similar regions, where poor nutrition, limited access to iron supplementation, and frequent pregnancies contribute to anemia's high prevalence. The impact of anemia on maternal outcomes was another focus of this study. Women with severe anemia experienced significantly worse outcomes than those with mild or moderate anemia. Preterm delivery rates were highest in the severe anemia group, with 40% of these women delivering before 37 weeks, compared to 20% in the moderate anemia group and 8% in the mild anemia group. This finding is consistent with previous studies, which show that anemia, especially severe anemia, can lead to uteroplacental insufficiency, causing intrauterine growth restriction and preterm labor. Preterm births are associated with higher neonatal morbidity and mortality, further increasing the risks for severely anemic women and their infants. Cesarean section rates were also higher in women with severe anemia (35%) compared to moderate anemia (30%) and mild anemia (20%). This higher rate of cesarean sections could be attributed to complications such as fetal distress, failure to progress in labor, and maternal exhaustion. Additionally, women with severe anemia were more likely to experience postpartum hemorrhage (PPH), with 20% in the severe anemia group, compared to 10% in the moderate group and 2% in the mild group. PPH is a well-known complication of anemia, as low hemoglobin levels impair the body's ability to compensate for blood loss during childbirth, increasing the risk of hemorrhagic shock and maternal mortality. These findings underline the importance of close monitoring of anemic women during labor, especially those with severe anemia, who face higher risks of cesarean sections and PPH. Anemia's impact on perinatal outcomes was also significant. The rate of low birth weight (LBW) increased as anemia severity worsened. In the severe anemia group, 45% of newborns had a birth weight less than 2.5 kg, compared to 33% in the moderate group and 16% in the mild group. LBW is a critical indicator of neonatal health, often associated with higher neonatal

morbidity, mortality, and long-term developmental issues. Babies born to severely anemic mothers were also more likely to require NICU admission (30%), compared to 15% in the moderate anemia group and 8% in the mild anemia group. The high NICU admission rate in the severe anemia group reflects the greater vulnerability of these infants, who are more likely to face complications such as respiratory distress, hypothermia, and sepsis due to prematurity and low birth weight. The average birth weight was lower in the severe anemia group (2.2 kg), compared to 2.4 kg in the moderate group and 2.7 kg in the mild group, illustrating the adverse effects of maternal anemia on fetal growth. Maternal anemia reduces the oxygen-carrying capacity of the blood, which negatively impacts placental function and fetal nutrition. These findings are consistent with previous research, which suggests that anemia during pregnancy is a significant contributor to fetal growth restriction and poor neonatal outcomes. Regarding treatment interventions, the study highlighted the effectiveness of different approaches to managing anemia. Women were treated with oral iron supplements, intravenous iron therapy, or blood transfusions, depending on the severity of their anemia. Blood transfusions resulted in the greatest improvement in hemoglobin levels, with an average increase of 3.0 g/dL, followed by intravenous iron therapy (2.5 g/dL), and oral iron supplementation (1.5 g/dL). These findings suggest that while oral iron supplements are effective for managing mild anemia, more aggressive treatments like intravenous iron or blood transfusions are needed for moderate to severe cases to achieve a significant improvement in hemoglobin levels. In terms of maternal outcomes, improvements were seen in women who received intravenous iron or blood transfusions. For instance, the rates of preterm delivery and PPH were reduced in women whose hemoglobin levels improved with these treatments. However, despite these improvements, women with severe anemia still experienced higher rates of adverse outcomes compared to those with mild or moderate anemia. This reinforces the need for early intervention to prevent severe anemia from developing. The study's findings have important implications for healthcare policy and practice. Anemia screening and management should be prioritized in antenatal care, especially in regions with high anemia prevalence. The results demonstrated that many women had moderate or severe anemia during pregnancy, highlighting the need for early detection and treatment. Routine hemoglobin screening during antenatal visits, along with the provision of iron and folic acid supplements and education on nutrition, is essential for preventing anemia. For women who develop moderate or severe anemia, access to intravenous iron therapy or blood transfusions should be made available to improve outcomes for both the mother and the baby. This study also emphasizes the importance of postpartum care for anemic women. Women with severe anemia were more likely to experience prolonged hospital stays due to complications like PPH and the need for additional blood transfusions. The average hospital stay for severely anemic women was more than seven days for 20% of participants, compared to 7% for those with moderate anemia and 4% for those with mild anemia. This increased healthcare utilization adds strain to healthcare systems, particularly in resource-limited settings, and underscores the importance of effective anemia management to reduce the need for prolonged postpartum care.

CONCLUSION

This study underscores the significant impact of anemia severity on maternal and perinatal outcomes. As anemia severity increases, the risks of adverse outcomes such as preterm delivery, low birth weight, cesarean section, postpartum hemorrhage, and NICU admissions also rise. Early detection, appropriate treatment, and close monitoring are critical to improving outcomes for both mothers and babies. Public health strategies that focus on anemia prevention and treatment during pregnancy should be prioritized to reduce maternal and neonatal morbidity and mortality.

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