



PREVALENCE OF ANEMIA IN PREGNANT WOMEN AND ITS EFFECT ON MATERNAL AND FETAL OUTCOMES: A HOSPITAL-BASED OBSERVATIONAL STUDY

Dr Pooja Gehlot*

*Assistant Professor, Department of Obstetrics & Gynecology, Gian Sagar Hospital & Medical College, Patiala, Punjab, India.

***Corresponding Author:** Dr Pooja Gehlot

*Assistant Professor, Department of Obstetrics & Gynecology, Gian Sagar Hospital & Medical College, Patiala, Punjab, India. Mail id- drpgehlot1811@gmail.com

Accepted: 20th September 2023

Published: 19th October 2023

ABSTRACT

Background: Anemia during pregnancy remains a critical public health challenge in India, significantly affecting maternal and fetal health outcomes. This study aimed to determine the prevalence of anemia among pregnant women and evaluate its impact on maternal and fetal outcomes.

Methods: A prospective observational study was conducted at the Department of Obstetrics and Gynecology, Gian Sagar Hospital & Medical College, Patiala, Punjab, from March 2023 to August 2023. A total of 145 pregnant women were enrolled using consecutive sampling technique. Hemoglobin estimation was performed using an automated hematology analyzer, and participants were classified as non-anemic (≥ 11.0 g/dL), mildly anemic (10.0-10.9 g/dL), moderately anemic (7.0-9.9 g/dL), or severely anemic (< 7.0 g/dL) based on WHO criteria. Maternal outcomes including mode of delivery, postpartum hemorrhage, preeclampsia, and puerperal sepsis, along with fetal outcomes including birth weight, gestational age, Apgar scores, NICU admissions, and perinatal mortality were documented. Data were analyzed using SPSS version 23.0, employing chi-square test and independent t-test with $p < 0.05$ considered statistically significant.

Results: The prevalence of anemia was 78.6%, with 31.0% having mild, 40.0% moderate, and 7.6% severe anemia. Anemia severity was significantly associated with increased cesarean section rates ($p = 0.003$), postpartum hemorrhage ($p < 0.001$), preeclampsia ($p = 0.042$), puerperal sepsis ($p = 0.002$), low birth weight ($p < 0.001$), preterm delivery ($p = 0.003$), low Apgar scores ($p < 0.001$), NICU admissions ($p < 0.001$), and perinatal mortality ($p = 0.001$).

Conclusion: The high prevalence of anemia and its significant association with adverse maternal and fetal outcomes necessitates strengthened anemia prevention and management strategies through early screening, improved supplementation compliance, and targeted interventions for high-risk populations.

Keywords: Anemia in pregnancy, maternal outcomes, fetal outcomes, hemoglobin levels, low birth weight

INTRODUCTION

Anemia during pregnancy remains one of the most significant public health challenges globally, particularly in developing nations where nutritional deficiencies and inadequate healthcare access compound the problem. The World Health Organization defines anemia in pregnancy as hemoglobin concentration below 11.0 g/dL, representing a critical condition that affects both maternal health and fetal development (WHO, 2011). The physiological changes during pregnancy, including plasma volume expansion and increased iron demands for fetal growth and placental development, predispose pregnant women to anemia, making them particularly vulnerable to this condition (Gautam et al., 2002).

The global prevalence of anemia in pregnancy varies considerably across regions, with the highest burden observed in South Asian and Sub-Saharan African countries. According to Stevens et al. (2013), approximately 38% of pregnant women worldwide are anemic, with this figure escalating to nearly 50% in developing countries. In India, the situation is particularly alarming, with studies indicating that anemia affects between 50% to 90% of pregnant women, making it a major contributor to maternal mortality and morbidity (Kalaivani, 2009). The National Family Health Survey-4 (NFHS-4) data revealed that more than half of pregnant women in India suffer from some degree of anemia, with iron deficiency being the predominant etiology (IIPS, 2017).

The pathophysiology of anemia during pregnancy is multifactorial, encompassing nutritional deficiencies, particularly iron, folate, and vitamin B12 deficiency, chronic infections such as malaria and helminthic infestations, and genetic hemoglobinopathies. Iron deficiency anemia accounts for approximately 75% of all anemia cases in pregnancy, primarily due to inadequate dietary intake, poor bioavailability of dietary iron, and increased physiological demands (Rukuni et al., 2015). The severity of anemia is classified based on hemoglobin levels: mild (10.0-10.9 g/dL), moderate (7.0-9.9 g/dL), and severe (<7.0 g/dL), with each category carrying different implications for maternal and fetal health outcomes (Drukker et al., 2015).

Maternal complications associated with anemia are extensive and well-documented in medical literature. Anemic pregnant women face increased risks of antepartum and postpartum hemorrhage, preeclampsia, cardiac failure, puerperal sepsis, and maternal mortality (Rahmati et al., 2017). Sharma and Shankar (2010) demonstrated that moderate to severe anemia significantly increases the likelihood of cesarean deliveries and prolonged labor. Furthermore, anemia impairs maternal immune function, rendering pregnant women more susceptible to infections, which can precipitate preterm labor and other obstetric complications (Kumar et al., 2013).

The fetal consequences of maternal anemia are equally concerning and have long-lasting implications for child health and development. Intrauterine growth restriction, preterm birth, low birth weight, and perinatal mortality are strongly associated with maternal anemia, particularly when present during the second and third trimesters (Haider et al., 2013). Studies by Lone et al. (2004) revealed that babies born to severely anemic mothers had significantly lower birth weights and Apgar scores compared to those born to non-anemic mothers. Additionally, maternal anemia adversely affects fetal neurodevelopment, potentially leading to cognitive and behavioral deficits that persist into childhood and beyond (Georgieff, 2020).

Despite numerous national programs aimed at reducing anemia prevalence, including the National Nutritional Anemia Control Program and the distribution of iron and folic acid supplements, the condition remains inadequately controlled in India. Several factors contribute to the persistence of this problem, including poor compliance with iron supplementation due to gastrointestinal side effects, cultural dietary practices that limit iron absorption, frequent pregnancies with short inter-pregnancy intervals, and limited awareness about nutritional requirements during pregnancy (Rao et al., 2012). Socioeconomic factors such as poverty, low literacy levels, and limited access to quality healthcare services further exacerbate the situation, particularly in rural and semi-urban areas (Bharati et al., 2008).

The timing of anemia detection and intervention is crucial for optimizing pregnancy outcomes. Early identification through routine antenatal screening and prompt management with appropriate

supplementation and dietary counseling can significantly reduce adverse outcomes (Reveiz et al., 2011). However, Sarin (1995) noted that many pregnant women in India present late for antenatal care, missing the critical window for early intervention. This underscores the importance of strengthening antenatal care services and improving community awareness about the importance of early and regular pregnancy monitoring.

Understanding the local epidemiology of anemia and its impact on pregnancy outcomes is essential for designing targeted interventions and allocating healthcare resources effectively. Regional variations in anemia prevalence and associated risk factors necessitate context-specific research to inform evidence-based policy decisions (Toteja et al., 2006). Studies conducted in North Indian populations have shown varying prevalence rates and outcome patterns, suggesting the need for region-specific data to guide clinical practice and public health initiatives. This observational study was therefore conceived to provide comprehensive data on anemia prevalence and its maternal and fetal consequences in a tertiary care setting, contributing valuable insights to the existing body of knowledge and potentially informing local healthcare strategies.

The aim of this study was to determine the prevalence of anemia among pregnant women and to assess its impact on various maternal outcomes including mode of delivery, postpartum hemorrhage, puerperal sepsis, and maternal mortality, as well as fetal outcomes including birth weight, gestational age at delivery, Apgar scores, neonatal intensive care unit admissions, and perinatal mortality.

METHODOLOGY

Study Design

A hospital-based prospective observational study.

Study Site

The study was conducted at the Department of Obstetrics and Gynecology, Gian Sagar Hospital & Medical College, Patiala, Punjab, India.

Study Duration

The study was conducted over a period of six months, from March 2023 to August 2023.

Sampling and Sample Size

A consecutive sampling technique was employed for participant recruitment, wherein all pregnant women who met the eligibility criteria and presented to the antenatal clinic or labor room during the study period were invited to participate. The sample consisted of 145 pregnant women, which was determined based on the expected prevalence of anemia in the region (approximately 60%), a desired precision of 8%, and a 95% confidence level.

Inclusion and Exclusion Criteria

Pregnant women aged 18 to 40 years with singleton pregnancies, who were attending antenatal clinic or admitted for delivery at Gian Sagar Hospital & Medical College during the study period, and who provided informed consent were included in the study. Women with multiple pregnancies, those with known chronic medical conditions such as chronic kidney disease, chronic liver disease, hemoglobinopathies, hematological disorders other than nutritional anemia, women who had received blood transfusion within the previous three months, those with incomplete medical records, and women who did not consent to participate were excluded from the study. These exclusion criteria were established to minimize confounding variables that could independently affect pregnancy outcomes and to ensure the study focused specifically on nutritional anemia.

Data Collection Tools and Techniques

A structured, pre-tested questionnaire was utilized for data collection, which captured comprehensive information regarding sociodemographic characteristics including age, education, occupation, socioeconomic status, parity, gestational age, booking status, dietary habits, compliance with iron-folic acid supplementation, and relevant medical and obstetric history. Hemoglobin estimation was performed using an automated hematology analyzer, with blood samples collected during the antenatal visit or at the time of admission for delivery. Based on WHO criteria, pregnant women were classified as non-anemic (hemoglobin ≥ 11.0 g/dL), mildly anemic (10.0-10.9 g/dL), moderately anemic (7.0-9.9 g/dL), or severely anemic (< 7.0 g/dL). Detailed information regarding pregnancy outcomes was prospectively recorded, including mode of delivery, occurrence of complications such as antepartum hemorrhage, postpartum hemorrhage, preeclampsia, eclampsia, puerperal sepsis, and maternal mortality. Fetal and neonatal outcomes documented included birth weight measured immediately after delivery using a calibrated electronic weighing scale, gestational age at delivery, Apgar scores at one and five minutes, requirement for neonatal intensive care unit admission, and perinatal mortality. All data were collected by trained researchers using standardized protocols to ensure consistency and reliability.

Data Management and Statistical Analysis

All collected data were coded, entered into a computerized database using Microsoft Excel, and subsequently transferred to Statistical Package for Social Sciences (SPSS) version 23.0 for analysis. Descriptive statistics were computed for all variables, with categorical variables presented as frequencies and percentages, while continuous variables were expressed as means with standard deviations or medians with interquartile ranges depending on the distribution. The chi-square test was employed to assess associations between categorical variables, while the independent t-test or Mann-Whitney U test was used for comparing continuous variables between groups based on their distribution characteristics. Multivariate logistic regression analysis was performed to identify independent predictors of adverse maternal and fetal outcomes while controlling for potential confounders. A p-value of less than 0.05 was considered statistically significant for all analyses. Results were presented using tables and graphs to facilitate clear interpretation and communication of findings.

Ethical Considerations

The study protocol was submitted to and received approval from the Institutional Ethics Committee of Gian Sagar Hospital & Medical College, Patiala, prior to the commencement of data collection. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and adhered to the Indian Council of Medical Research guidelines for biomedical research involving human participants. All eligible pregnant women were provided with detailed information regarding the study objectives, procedures, potential risks and benefits, and their right to withdraw from the study at any point without affecting their clinical care. Written informed consent was obtained from all participants in their preferred language before enrollment. Participants' confidentiality and anonymity were strictly maintained throughout the study by assigning unique identification codes and storing all data in password-protected electronic files accessible only to authorized research personnel.

RESULTS

Table 1: Sociodemographic and Obstetric Characteristics of Study Participants (N=145)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	18-25	58	40.0
	26-30	52	35.9
	31-35	28	19.3

Characteristic	Category	Frequency (n)	Percentage (%)
	36-40	7	4.8
Education	Illiterate	23	15.9
	Primary	35	24.1
	Secondary	48	33.1
	Higher Secondary and above	39	26.9
Occupation	Homemaker	98	67.6
	Working	47	32.4
Socioeconomic Status	Lower	42	29.0
	Middle	76	52.4
	Upper	27	18.6
Parity	Primigravida	61	42.1
	Multigravida	84	57.9
Gestational Age	Second Trimester	34	23.4
	Third Trimester	111	76.6
ANC Registration	Booked	89	61.4
	Unbooked	56	38.6
IFA Compliance	Regular	52	35.9
	Irregular	67	46.2
	Non-compliant	26	17.9

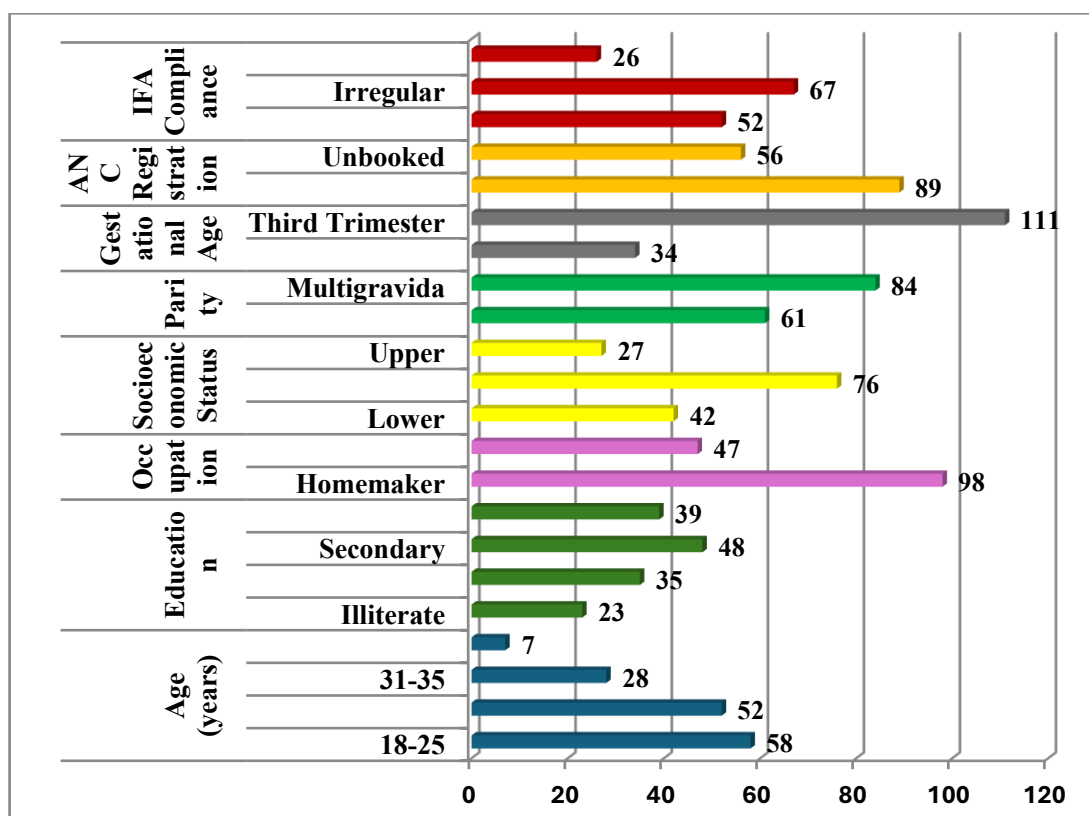


Figure:1

Table 2: Prevalence and Severity of Anemia Among Pregnant Women (N=145)

Anemia Status	Hemoglobin Level (g/dL)	Frequency (n)	Percentage (%)	Mean Hb $\pm$ SD
Non-anemic	≥ 11.0	31	21.4	11.8 ± 0.6
Mild Anemia	10.0-10.9	45	31.0	10.4 ± 0.3
Moderate Anemia	7.0-9.9	58	40.0	8.6 ± 0.8
Severe Anemia	< 7.0	11	7.6	6.2 ± 0.5
Total Anemic	< 11.0	114	78.6	9.4 ± 1.4
Overall Mean Hemoglobin	-	-	-	9.8 ± 1.6

Table 3: Association Between Anemia and Maternal Outcomes (N=145)

Maternal Outcome	Non-anemic (n=31)	Mild Anemia (n=45)	Moderate Anemia (n=58)	Severe Anemia (n=11)	p-value
Mode of Delivery					
Normal Vaginal Delivery	24 (77.4%)	28 (62.2%)	25 (43.1%)	3 (27.3%)	0.003
Cesarean Section	7 (22.6%)	17 (37.8%)	33 (56.9%)	8 (72.7%)	
Postpartum Hemorrhage					
Present	2 (6.5%)	7 (15.6%)	18 (31.0%)	6 (54.5%)	< 0.001
Absent	29 (93.5%)	38 (84.4%)	40 (69.0%)	5 (45.5%)	
Preeclampsia					
Present	3 (9.7%)	8 (17.8%)	15 (25.9%)	4 (36.4%)	0.042
Absent	28 (90.3%)	37 (82.2%)	43 (74.1%)	7 (63.6%)	
Puerperal Sepsis					
Present	1 (3.2%)	4 (8.9%)	12 (20.7%)	4 (36.4%)	0.002
Absent	30 (96.8%)	41 (91.1%)	46 (79.3%)	7 (63.6%)	
Blood Transfusion					
Required	0 (0.0%)	3 (6.7%)	16 (27.6%)	9 (81.8%)	< 0.001
Not Required	31 (100%)	42 (93.3%)	42 (72.4%)	2 (18.2%)	
Hospital Stay (days)	3.2 ± 1.1	4.1 ± 1.4	5.8 ± 2.3	8.4 ± 3.2	< 0.001

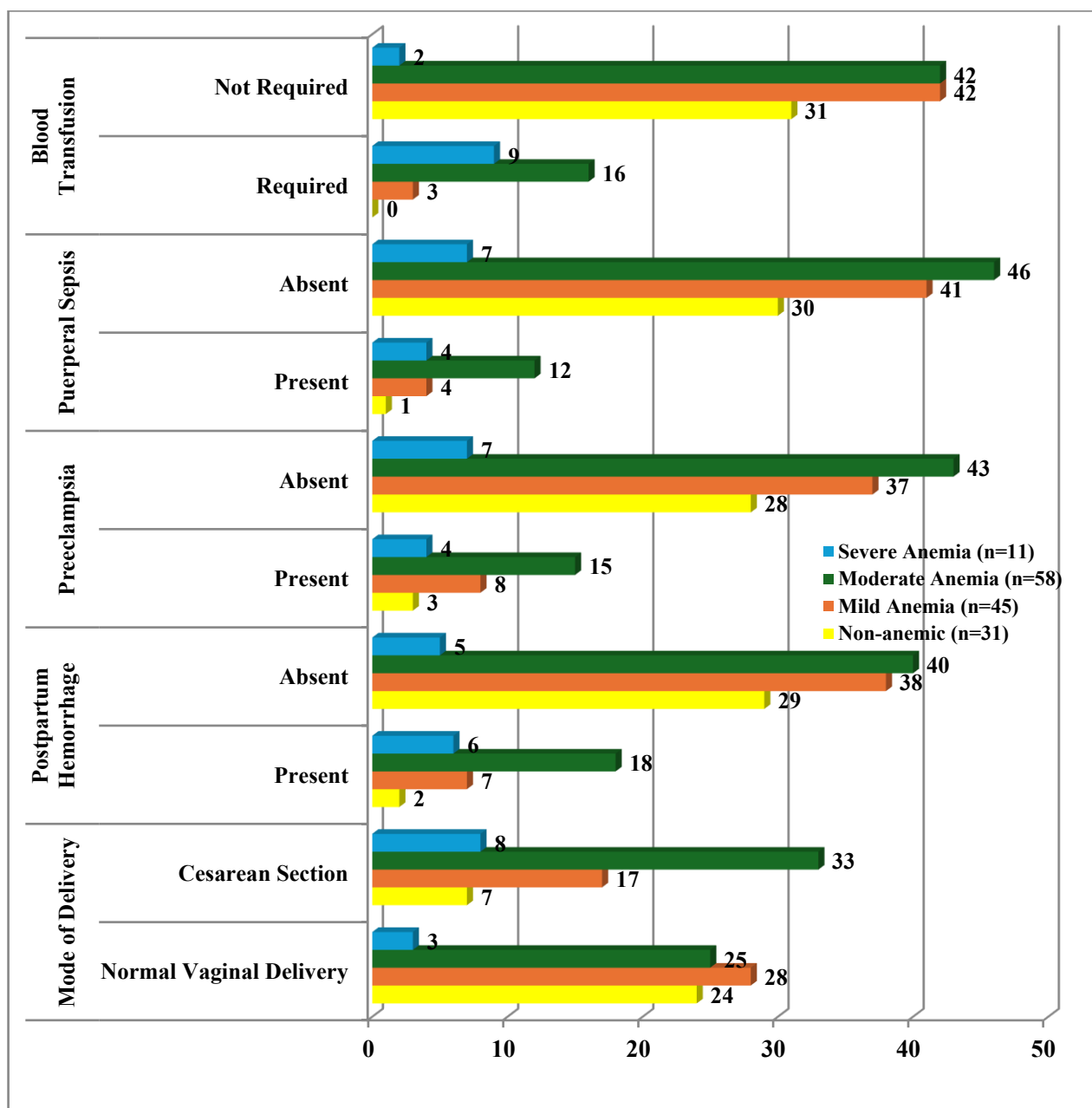


Figure:2

Table 4: Association Between Anemia and Fetal Outcomes (N=145)

Fetal Outcome	Non-anemic (n=31)	Mild Anemia (n=45)	Moderate Anemia (n=58)	Severe Anemia (n=11)	p-value
Birth Weight					
Normal (≥ 2.5 kg)	28 (90.3%)	34 (75.6%)	28 (48.3%)	3 (27.3%)	<0.001
Low (<2.5 kg)	3 (9.7%)	11 (24.4%)	30 (51.7%)	8 (72.7%)	
Mean Birth Weight (kg)	2.96 $\pm$ 0.38	2.71 $\pm$ 0.42	2.38 $\pm$ 0.46	2.12 $\pm$ 0.38	<0.001
Gestational Age at Delivery					
Term (≥ 37 weeks)	29 (93.5%)	38 (84.4%)	41 (70.7%)	6 (54.5%)	0.003

Fetal Outcome	Non-anemic (n=31)	Mild Anemia (n=45)	Moderate Anemia (n=58)	Severe Anemia (n=11)	p-value
Preterm (<37 weeks)	2 (6.5%)	7 (15.6%)	17 (29.3%)	5 (45.5%)	
Apgar Score at 5 min					
≥7	30 (96.8%)	41 (91.1%)	46 (79.3%)	7 (63.6%)	0.005
<7	1 (3.2%)	4 (8.9%)	12 (20.7%)	4 (36.4%)	
Mean Apgar Score	8.6 ± 0.7	8.2 ± 1.1	7.4 ± 1.4	6.8 ± 1.6	<0.001
NICU Admission					
Required	2 (6.5%)	8 (17.8%)	22 (37.9%)	7 (63.6%)	<0.001
Not Required	29 (93.5%)	37 (82.2%)	36 (62.1%)	4 (36.4%)	
Perinatal Mortality					
Present	0 (0.0%)	1 (2.2%)	5 (8.6%)	3 (27.3%)	0.001
Absent	31 (100%)	44 (97.8%)	53 (91.4%)	8 (72.7%)	

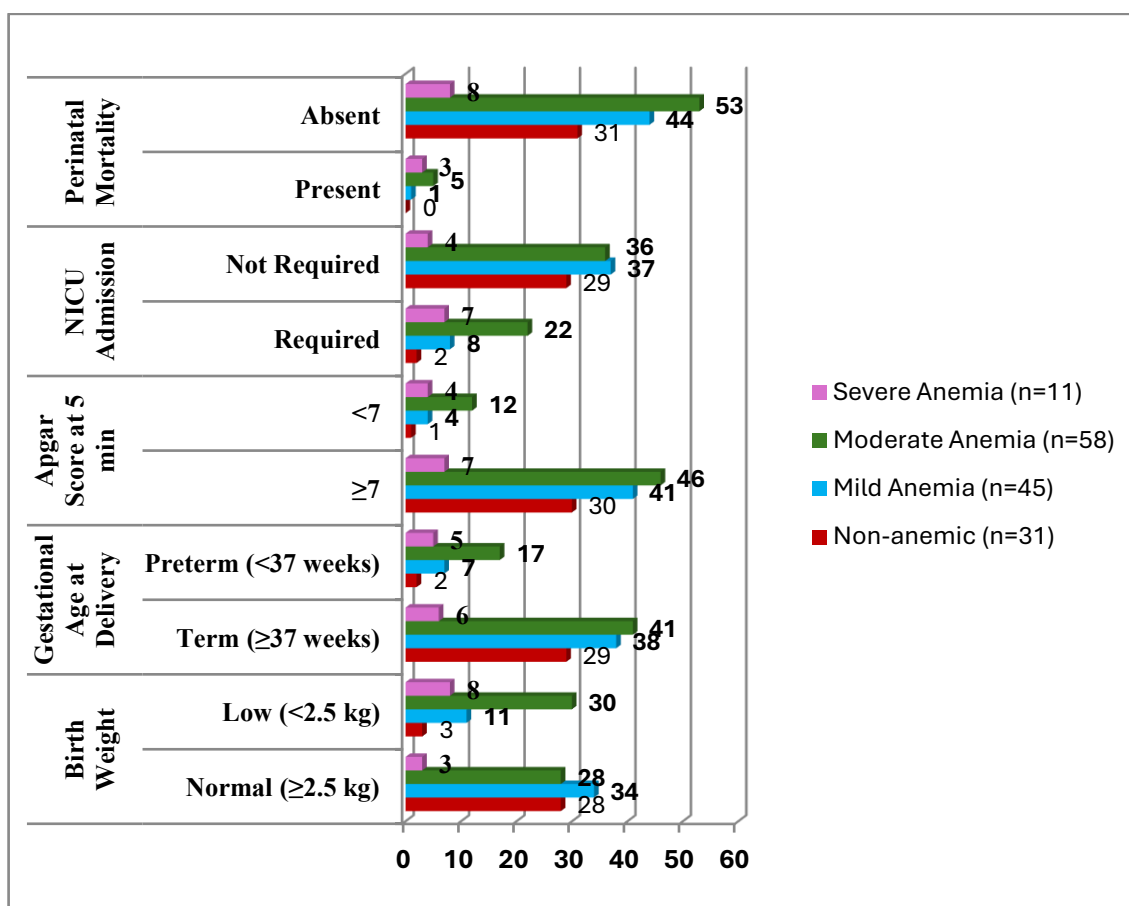


Figure:3

DISCUSSION

The present study revealed an alarmingly high prevalence of anemia among pregnant women, with 78.6% of participants being anemic (hemoglobin <11.0 g/dL), of which 31.0% had mild anemia, 40.0% had moderate anemia, and 7.6% had severe anemia. This finding is consistent with the

broader pattern observed across India, where anemia continues to be a major public health concern. The prevalence observed in our study aligns closely with the findings of Kalaivani (2009), who reported that 50-90% of pregnant women in India suffer from anemia, with regional variations contributing to the wide range. Similarly, Toteja et al. (2006) documented anemia prevalence ranging from 50% to 84% across 16 districts in India, reinforcing the endemic nature of this condition in the country.

The high prevalence observed in our study can be attributed to multiple interconnected factors evident in Table 1. Approximately 40% of participants were illiterate or had only primary education, and 29% belonged to lower socioeconomic status, both of which are established risk factors for anemia. Bharati et al. (2008) demonstrated that socioeconomic vulnerability significantly influences anemia prevalence, as poverty limits access to nutritious food and healthcare services. Furthermore, our data revealed that 38.6% of participants were unbooked cases who presented late for antenatal care, missing opportunities for early detection and intervention. This finding resonates with Sarin (1995), who emphasized that delayed presentation for antenatal care is a significant contributor to uncontrolled anemia in pregnancy.

The issue of poor compliance with iron-folic acid supplementation was evident in our study, with only 35.9% of participants reporting regular compliance, while 46.2% were irregular and 17.9% were completely non-compliant. This pattern is consistent with the observations of Rao et al. (2012), who identified poor compliance due to gastrointestinal side effects and lack of awareness as major barriers to anemia prevention programs. The physiological demands of pregnancy, combined with inadequate dietary intake and poor supplementation adherence, create a perfect storm for the development and progression of anemia, particularly in populations with limited nutritional resources.

Table 3 demonstrates a clear and statistically significant association between anemia severity and adverse maternal outcomes. The rate of cesarean section progressively increased with anemia severity, from 22.6% in non-anemic women to 72.7% in severely anemic women ($p=0.003$). This finding corroborates the work of Sharma and Shankar (2010), who reported that moderate to severe anemia significantly increases the likelihood of operative deliveries due to maternal exhaustion, fetal distress, and failure to progress in labor. Drukker et al. (2015) similarly documented that iron deficiency anemia at admission for labor was associated with increased cesarean section rates and adverse maternal outcomes, supporting our observations.

Postpartum hemorrhage emerged as a particularly concerning complication in our study, affecting 54.5% of severely anemic women compared to only 6.5% of non-anemic women ($p<0.001$). This dramatic increase in hemorrhagic complications with increasing anemia severity aligns with the findings of Rahmati et al. (2017), who demonstrated through meta-analysis that maternal anemia significantly increases the risk of postpartum hemorrhage. The pathophysiology underlying this association involves multiple mechanisms, including impaired uterine contractility, reduced oxygen-carrying capacity leading to tissue hypoxia, and compromised hemostatic mechanisms in severely anemic women.

The association between anemia and preeclampsia observed in our study, with prevalence increasing from 9.7% in non-anemic women to 36.4% in severely anemic women ($p=0.042$), adds to the growing body of evidence linking anemia to hypertensive disorders of pregnancy. While the exact mechanism remains incompletely understood, Kumar et al. (2013) suggested that anemia-induced hypoxia may trigger endothelial dysfunction and oxidative stress, contributing to the development of preeclampsia. Additionally, our study documented a significant increase in puerperal sepsis rates with increasing anemia severity ($p=0.002$), which can be explained by the immunosuppressive effects of anemia. As demonstrated by Kumar et al. (2013), anemia impairs maternal immune function, rendering women more susceptible to postpartum infections.

The requirement for blood transfusion increased dramatically with anemia severity, with 81.8% of severely anemic women requiring transfusion compared to none in the non-anemic group ($p<0.001$). This finding has important implications for blood bank resource planning and highlights the

preventable nature of many transfusion requirements if anemia is addressed proactively during pregnancy. The mean hospital stay also increased significantly with anemia severity, from 3.2 days in non-anemic women to 8.4 days in severely anemic women ($p<0.001$), representing substantial healthcare costs and family disruption that could be avoided through effective anemia prevention programs.

Table 4 reveals the profound impact of maternal anemia on fetal wellbeing, with low birth weight being particularly prevalent among babies born to anemic mothers. The proportion of low birth weight babies increased from 9.7% in non-anemic mothers to 72.7% in severely anemic mothers ($p<0.001$), with a corresponding decrease in mean birth weight from 2.96 kg to 2.12 kg. These findings strongly support the work of Lone et al. (2004), who demonstrated that babies born to severely anemic mothers had significantly lower birth weights compared to those born to non-anemic mothers. The biological mechanism underlying this association involves reduced oxygen and nutrient delivery to the fetus due to decreased maternal oxygen-carrying capacity, resulting in intrauterine growth restriction.

Haider et al. (2013) conducted a comprehensive systematic review and meta-analysis that confirmed the strong association between maternal anemia and adverse birth outcomes, including low birth weight and preterm birth. Our study corroborates these findings, with preterm delivery rates increasing from 6.5% in non-anemic mothers to 45.5% in severely anemic mothers ($p=0.003$). The mechanism for anemia-induced preterm labor likely involves multiple pathways, including increased susceptibility to infections, placental dysfunction, and activation of inflammatory cascades that trigger premature uterine contractions.

The association between maternal anemia and compromised neonatal condition at birth was evident from the Apgar score data in our study. Mean Apgar scores at 5 minutes decreased progressively with increasing anemia severity, from 8.6 in babies born to non-anemic mothers to 6.8 in those born to severely anemic mothers ($p<0.001$). This finding aligns with the observations of Lone et al. (2004), who reported lower Apgar scores in neonates born to anemic mothers. The reduced Apgar scores reflect neonatal compromise resulting from chronic intrauterine hypoxia and are predictive of short-term neonatal morbidity and potential long-term neurodevelopmental consequences.

The requirement for neonatal intensive care unit admission increased significantly with maternal anemia severity, affecting 63.6% of babies born to severely anemic mothers compared to only 6.5% of those born to non-anemic mothers ($p<0.001$). This finding has important implications for neonatal care resource allocation and highlights the cascade of consequences that maternal anemia triggers. Stevens et al. (2013) emphasized in their global analysis that maternal anemia remains a significant contributor to neonatal morbidity and mortality, particularly in resource-limited settings where neonatal intensive care availability is already constrained.

Perinatal mortality in our study showed a concerning trend, increasing from 0% in non-anemic mothers to 27.3% in severely anemic mothers ($p=0.001$). This finding underscores the life-threatening nature of severe maternal anemia for the fetus and is consistent with global estimates suggesting that maternal anemia contributes substantially to perinatal mortality in developing countries. The mechanisms contributing to perinatal death in the context of maternal anemia are multifactorial and include intrauterine growth restriction, preterm birth, birth asphyxia, and increased susceptibility to infections.

Our analysis of sociodemographic characteristics revealed important patterns that help explain the high anemia prevalence. Lower education levels and socioeconomic status were overrepresented among anemic women, consistent with the findings of Bharati et al. (2008), who identified poverty and low literacy as key determinants of anemia vulnerability. The multigravida population in our study (57.9%) represents a particularly high-risk group, as repeated pregnancies with inadequate inter-pregnancy intervals deplete maternal iron stores. Gautam et al. (2002) highlighted that frequent pregnancies without adequate birth spacing significantly increase anemia risk due to insufficient time for recovery of iron stores between pregnancies.

The poor iron-folic acid supplementation compliance observed in our study reflects a broader implementation challenge facing anemia control programs in India. Despite the availability of free iron supplements through national programs, Reveiz et al. (2011) noted that compliance remains suboptimal due to side effects, inadequate counseling, and limited awareness about the importance of supplementation. This gap between program availability and actual utilization represents a critical area for intervention to improve anemia outcomes.

The findings of this study have significant implications for clinical practice and public health policy. The strong associations demonstrated between anemia severity and adverse outcomes emphasize the critical importance of early detection through routine antenatal screening and aggressive management of anemia during pregnancy. The data suggest that preventing and treating anemia could substantially reduce cesarean section rates, postpartum hemorrhage, neonatal intensive care admissions, and perinatal mortality, representing major improvements in both clinical outcomes and healthcare costs.

The high prevalence of moderate and severe anemia despite existing national programs indicates that current strategies are insufficient and require strengthening. Toteja et al. (2006) recommended a multi-pronged approach including dietary diversification, food fortification, supplementation, and control of infectious diseases to achieve meaningful reductions in anemia prevalence. Our findings support this comprehensive approach, as supplementation alone appears inadequate given the poor compliance rates observed.

CONCLUSION

This observational study demonstrated an alarmingly high prevalence of anemia (78.6%) among pregnant women, with significant associations between anemia severity and adverse maternal and fetal outcomes. Moderate to severe anemia was associated with increased rates of cesarean section, postpartum hemorrhage, preeclampsia, puerperal sepsis, prolonged hospital stay, low birth weight, preterm delivery, low Apgar scores, increased neonatal intensive care unit admissions, and perinatal mortality. These findings underscore the critical need for strengthened anemia prevention and management strategies during pregnancy to improve maternal and fetal health outcomes in this population.

RECOMMENDATIONS

Early antenatal registration and regular antenatal checkups should be promoted through community awareness programs. Universal hemoglobin screening at first antenatal visit and repeated testing in each trimester is essential. Strategies to improve iron-folic acid supplementation compliance through better counseling and side-effect management should be implemented. High-risk women including multigravidas and those with low socioeconomic status require intensive monitoring and targeted interventions to prevent severe anemia and its complications.

REFERENCES

1. Bharati, P., Pal, M., Bandyopadhyay, M., & Bhattacharya, B. N. (2008). Prevalence and causes of anemia in different vulnerable groups. *The Indian Journal of Medical Research*, 128(6), 753-759. <https://www.ijmr.org.in/article.asp?issn=0971-5916>
2. Drukker, L., Hants, Y., Farkash, R., Ruchlemer, R., Samueloff, A., & Grisaru-Granovsky, S. (2015). Iron deficiency anemia at admission for labor and delivery is associated with an increased risk for Cesarean section and adverse maternal and neonatal outcomes. *Transfusion*, 55(12), 2799-2806. <https://doi.org/10.1111/trf.13252>
3. Gautam, C. S., Saha, L., Sekhri, K., & Saha, P. K. (2002). Iron deficiency in pregnancy and the rationality of iron supplements prescribed during pregnancy. *Medscape General Medicine*, 10(3), 283-289.
4. Georgieff, M. K. (2020). Iron deficiency in pregnancy. *American Journal of Obstetrics and Gynecology*, 223(4), 516-524. <https://doi.org/10.1016/j.ajog.2020.03.006>

5. Haider, B. A., Olofin, I., Wang, M., Spiegelman, D., Ezzati, M., & Fawzi, W. W. (2013). Anaemia, prenatal iron use, and risk of adverse pregnancy outcomes: systematic review and meta-analysis. *BMJ*, 346, f3443. <https://doi.org/10.1136/bmj.f3443>
6. International Institute for Population Sciences (IIPS). (2017). *National Family Health Survey (NFHS-4), 2015-16: India*. IIPS.
7. Kalaivani, K. (2009). Prevalence & consequences of anaemia in pregnancy. *Indian Journal of Medical Research*, 130(5), 627-633. <https://www.ijmr.org.in/article.asp?issn=0971-5916>
8. Khan, K. S., Wojdyla, D., Say, L., Gülmezoglu, A. M., & Van Look, P. F. (2006). WHO analysis of causes of maternal death: a systematic review. *The Lancet*, 367(9516), 1066-1074. [https://doi.org/10.1016/S0140-6736\(06\)68397-9](https://doi.org/10.1016/S0140-6736(06)68397-9)
9. Kumar, K. J., Asha, N., Murthy, D. S., Sujatha, M. S., & Manjunath, V. G. (2013). Maternal anemia in various trimesters and its effect on newborn weight and maturity: an observational study. *International Journal of Preventive Medicine*, 4(2), 193-199.
10. Lone, F. W., Qureshi, R. N., & Emmanuel, F. (2004). Maternal anaemia and its impact on perinatal outcome. *Tropical Medicine & International Health*, 9(4), 486-490. <https://doi.org/10.1111/j.1365-3156.2004.01222.x>
11. Malhotra, M., Sharma, J. B., Batra, S., Sharma, S., Murthy, N. S., & Arora, R. (2002). Maternal and perinatal outcome in varying degrees of anemia. *International Journal of Gynecology & Obstetrics*, 79(2), 93-100. [https://doi.org/10.1016/S0020-7292\(02\)00229-3](https://doi.org/10.1016/S0020-7292(02)00229-3)
12. Milman, N. (2011). Anemia—still a major health problem in many parts of the world! *Annals of Hematology*, 90(4), 369-377. <https://doi.org/10.1007/s00277-010-1144-5>
13. Rahmati, S., Delpishe, A., Azami, M., Hafezi Ahmadi, M. R., & Sayehmiri, K. (2017). Maternal anemia during pregnancy and infant low birth weight: a systematic review and meta-analysis. *International Journal of Reproductive BioMedicine*, 15(3), 125-134. <https://doi.org/10.29252/ijrm.15.3.125>
14. Rao, S., Joshi, S., & Kanade, A. (2012). Pregnancy outcomes following anemia in early, mid and late pregnancy in rural Indian women. *Nutrition Research*, 32(10), 764-770. <https://doi.org/10.1016/j.nutres.2012.08.005>
15. Reveiz, L., Gyte, G. M., Cuervo, L. G., & Casasbuenas, A. (2011). Treatments for iron-deficiency anaemia in pregnancy. *Cochrane Database of Systematic Reviews*, (10), CD003094. <https://doi.org/10.1002/14651858.CD003094.pub3>
16. Rukuni, R., Bhattacharya, S., Murphy, M. F., Roberts, D., Stanworth, S. J., & Knight, M. (2015). Maternal and neonatal outcomes of antenatal anemia in a Scottish population: a retrospective cohort study. *Acta Obstetrica et Gynecologica Scandinavica*, 94(10), 1141-1147. <https://doi.org/10.1111/aogs.12686>
17. Sarin, A. R. (1995). Severe anemia of pregnancy, recent experience. *International Journal of Gynecology & Obstetrics*, 50(Suppl 2), S45-S49. [https://doi.org/10.1016/0020-7292\(95\)02478-8](https://doi.org/10.1016/0020-7292(95)02478-8)
18. Scholl, T. O., & Reilly, T. (2000). Anemia, iron and pregnancy outcome. *The Journal of Nutrition*, 130(2), 443S-447S. <https://doi.org/10.1093/jn/130.2.443S>
19. Sharma, J. B., & Shankar, M. (2010). Anemia in pregnancy. *JIMSA*, 23(4), 253-260.
20. Singla, P. N., Tyagi, M., Kumar, A., Dash, D., & Shankar, R. (1997). Fetal growth in maternal anaemia. *Journal of Tropical Pediatrics*, 43(2), 89-92. <https://doi.org/10.1093/tropej/43.2.89>
21. Stevens, G. A., Finucane, M. M., De-Regil, L. M., Paciorek, C. J., Flaxman, S. R., Branca, F., ... & Nutrition Impact Model Study Group. (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. *The Lancet Global Health*, 1(1), e16-e25. [https://doi.org/10.1016/S2214-109X\(13\)70001-9](https://doi.org/10.1016/S2214-109X(13)70001-9)
22. Toteja, G. S., Singh, P., Dhillon, B. S., Saxena, B. N., Ahmed, F. U., Singh, R. P., ... & Sarma, U. C. (2006). Prevalence of anemia among pregnant women and adolescent girls in 16 districts

- of India. *Food and Nutrition Bulletin*, 27(4), 311-315.
<https://doi.org/10.1177/156482650602700405>.
23. World Health Organization. (2011). *Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity*. World Health Organization.
<https://apps.who.int/iris/handle/10665/85839>.