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PREVALANCE OF POST-PARTUM ANEMIA AND ASSOCIATED FACTORS IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Postpartum anemia is a common yet underrecognized maternal health problem that contributes substantially to maternal morbidity, impaired functional recovery, poor lactation, and adverse psychological outcomes. Despite national anemia control programs, its burden remains high in India. This study aimed to determine the prevalence of postpartum anemia and identify factors associated with its severity among women delivering in a tertiary care hospital.

Methods: A hospital-based cross-sectional study was conducted among 374 postpartum women delivering at a tertiary care teaching hospital between October 2024 and October 2025. Antenatal hemoglobin values were obtained from hospital records, and postpartum hemoglobin was measured on post-delivery day two. Postpartum anemia was defined as hemoglobin <11 g/dL and classified according to World Health Organization criteria. Demographic, obstetric, and clinical characteristics were recorded using a structured proforma. Associations between variables were evaluated using chi-square test and one-way ANOVA. Pearson correlation, binary logistic regression, and multinomial logistic regression analyses were performed to identify independent predictors of postpartum anemia severity.

Results: Among the 374 women, 350 (93.6%) had postpartum anemia, while only 24 (6.4%) had normal hemoglobin levels. Moderate anemia was the predominant category, affecting 245 (65.5%) women, followed by mild anemia in 80 (21.4%) and severe anemia in 25 (6.7%). The majority of participants were aged 25–29 years (119; 31.8%), and 287 (76.7%) were multiparous. Mean hemoglobin declined significantly from 10.22 ± 1.06 g/dL antenatally to 8.96 ± 1.46 g/dL postpartum, with a mean reduction of 1.26 ± 1.10 g/dL ($p < 0.001$). Oral iron supplementation was the most frequently prescribed treatment (214; 57.2%), whereas 58 (15.5%) women received intravenous iron, 41 (11.0%) required blood transfusion, and 23 (6.1%) received combined oral and intravenous iron therapy. Antenatal hemoglobin demonstrated a strong positive correlation with postpartum hemoglobin ($r = 0.793$, $p < 0.001$) and emerged as the only independent predictor of moderate-to-severe postpartum anemia ($p < 0.001$). Maternal age and parity were not independently associated with anemia severity after adjustment.

Conclusion: Postpartum anemia remains highly prevalent among women delivering in this tertiary care hospital, with moderate anemia accounting for the largest proportion of cases. Lower antenatal hemoglobin was the strongest determinant of postpartum anemia severity, highlighting the importance of optimizing antenatal iron status. Routine postpartum hemoglobin screening, continuation of iron supplementation, and early identification and treatment of women at risk should be integrated into maternal healthcare programs to reduce postpartum morbidity and improve maternal health outcomes.

KEYWORDS: Postpartum Anemia, Maternal Anemia, Postnatal Period, Hemoglobin, Iron Deficiency, Maternal Health

INTRODUCTION

Anemia is one of the most prevalent nutritional and hematological disorders worldwide and remains a major public health problem, particularly among women of reproductive age. The World Health Organization defines anemia as a condition characterized by a reduction in the oxygen-carrying capacity of blood due to decreased hemoglobin concentration or red blood cell mass. According to estimates published by the World Health Organization, anemia affects a substantial proportion of women globally, with the burden being disproportionately higher in low- and middle-income countries [1]. This global health challenge has far-reaching implications for maternal and child health, contributing significantly to maternal morbidity and mortality, impaired fetal development, and long-term health consequences for both mothers and their offspring.

The postpartum period represents a critical phase in maternal health, encompassing physiological recovery from pregnancy and childbirth, initiation of breastfeeding, and adaptation to new maternal roles. This period, typically defined as the first six to eight weeks following delivery, is characterized by complex physiological changes that require careful monitoring and appropriate medical attention. Despite improvements in antenatal care and institutional deliveries, postnatal care continues to receive inadequate attention in many healthcare systems worldwide. Ruiz de Viñaspre-Hernández et al. highlighted that postpartum anemia remains underdiagnosed and undertreated due to lack of standardized screening and follow-up protocols during the postnatal period [2]. This diagnostic and therapeutic gap is particularly concerning given the substantial burden of anemia during pregnancy and the additional physiological stressors imposed by the peripartum period.

Milman et al. described postpartum anemia as a common but underestimated condition with distinct etiological and clinical implications when compared to antenatal anemia [3]. Postpartum anemia is commonly defined as a hemoglobin concentration of less than 11 g/dL during the first week after delivery and less than 12 g/dL at six to eight weeks postpartum. This condition may arise from multiple etiological factors including antepartum iron deficiency, inadequate iron stores at the time of delivery, excessive blood loss during childbirth, and the physiological changes accompanying pregnancy and the puerperium. The distinction between antenatal and postpartum anemia is clinically significant, as the latter occurs during a period when women are simultaneously recovering from childbirth, establishing lactation, and adjusting to the demands of newborn care.

Physiologically, pregnancy is associated with an expansion of plasma volume and red blood cell mass, leading to increased iron requirements. Although involution of the expanded red cell mass after delivery theoretically restores iron stores, Milman et al. noted that this recovery is often incomplete due to peripartum blood loss and pre-existing iron deficiency [4]. The average blood loss during vaginal delivery ranges from 300-500 mL, while cesarean sections are associated with greater blood loss, often exceeding 1000 mL. These losses, combined with the iron demands of lactation, which may require up to 1-2 mg of iron daily, create a substantial physiological burden that many women cannot adequately meet without appropriate nutritional support and medical intervention.

The magnitude of postpartum anemia varies widely across populations, influenced by factors such as maternal nutritional status, quality of antenatal care, obstetric practices, and socioeconomic conditions. Rahman et al. demonstrated that antenatal anemia significantly increases the risk of postpartum hemorrhage, thereby contributing to the development of postpartum anemia [5]. This creates a vicious cycle where pre-existing anemia predisposes women to complications that further exacerbate their anemic state. Studies from resource-limited settings have consistently reported prevalence rates exceeding 50%, highlighting the substantial burden of this condition in regions with limited healthcare infrastructure and high rates of nutritional deficiencies.

Agmassie et al. reported a high prevalence of immediate postpartum anemia among women delivering in hospitals in northwest Ethiopia and identified blood loss during delivery and inadequate antenatal iron supplementation as key contributors [6]. Similarly, Eshete et al. observed that nutritional deficiencies and obstetric complications were significant determinants of postpartum anemia in Ethiopian health facilities [7]. These findings underscore the multifactorial nature of postpartum anemia and the need for comprehensive interventions addressing both the immediate obstetric causes and the underlying nutritional deficiencies that predispose women to this condition.

Postpartum anemia has significant consequences for maternal health, extending beyond the well-recognized physical symptoms of fatigue and decreased exercise tolerance. Beard et al. identified that iron deficiency anemia during the postpartum period adversely affects maternal emotions and cognitive performance [8]. The cognitive effects may include difficulties with concentration, memory impairment, and reduced work capacity, all of which can significantly impact a new mother's ability to care for herself and her infant. Corwin et al. further demonstrated that low hemoglobin levels are an independent risk factor for postpartum depression [9], a finding of considerable clinical significance given the prevalence of postpartum mood disorders and their impact on maternal-infant bonding and child development.

Anemia in the postpartum period also affects breastfeeding outcomes, creating potential cascading effects on infant nutrition and development. Hen et al. reported that anemic mothers are more likely to experience insufficient milk production, particularly among first-time mothers [10]. These adverse effects may compromise infant nutrition and maternal-infant bonding, potentially affecting the infant's growth, cognitive development, and immunological protection during the critical early months of life. The relationship between maternal iron status and breastfeeding success underscores the importance of addressing postpartum anemia not only for maternal health but also for optimal infant outcomes.

In the Indian context, postpartum anemia remains highly prevalent despite improved access to institutional deliveries. Selvaraj et al. documented a high burden of anemia among postnatal mothers in urban Puducherry, highlighting gaps in postnatal screening and nutritional interventions [11]. The Indian subcontinent bears a disproportionate share of the global anemia burden, with cultural practices, dietary patterns, and socioeconomic factors contributing to the high prevalence of nutritional deficiencies. Despite the significant investments in maternal health programs and the promotion of institutional deliveries, postpartum anemia continues to be a neglected aspect of maternal healthcare in India.

Given the high prevalence, associated maternal morbidity, and limited focus on postpartum anemia in routine clinical practice, there is a need for region-specific studies that can inform evidence-based interventions and healthcare policies. Tertiary care hospitals provide an appropriate setting to assess the prevalence of postpartum anemia and identify associated demographic, obstetric, and nutritional factors. These institutions serve as referral centers for high-risk pregnancies and complicated deliveries, making them ideal sites for studying the burden and determinants of postpartum anemia in a comprehensive manner. The present study aims to address these gaps by assessing the prevalence of postpartum anemia and identifying its associated risk factors among postnatal mothers attending a tertiary care hospital.

METHODOLOGY

Study Design and Setting

This observational cross-sectional study will be conducted in the Department of Obstetrics and Gynaecology at Sree Balaji Medical College and Hospital, Chrompet, Chennai, India. The hospital serves as a tertiary care referral center, catering to a diverse population from both urban and peri-urban areas of Chennai and surrounding districts. The study will be carried out over a period of one year, from October 2024 to October 2025. A cross-sectional design has been chosen to estimate the prevalence of postpartum anemia and to identify associated demographic, obstetric, and nutritional factors among postnatal mothers in this setting. This design is appropriate for describing the burden of the condition at a specific point in time and for generating hypotheses regarding potential risk factors that may be explored in future analytical studies.

Study Population

The study population will comprise antenatal mothers from 36 weeks of gestation onwards who are admitted for delivery at Sree Balaji Medical College and Hospital. Women assessed up to post-delivery day 2 will be included in the study. The inclusion criteria are specifically designed to capture women during the immediate postpartum period when anemia is most detectable and clinically relevant. Mothers will be eligible for participation only if they are willing to provide written informed consent, ensuring voluntary participation and adherence to ethical research principles.

Several exclusion criteria have been established to minimize confounding factors and ensure the reliability of the study findings. Women delivered more than two days prior to recruitment will be excluded to standardize the timing of hemoglobin assessment, as hemoglobin levels fluctuate significantly in the early postpartum period. Women with known hemoglobinopathies such as thalassemia or sickle cell disease will be excluded, as these conditions independently affect hemoglobin concentrations and would confound the assessment of nutritional and obstetric determinants of anemia. Similarly, women with active malaria, helminthic infestations, or other parasitic infections will be excluded due to their established effects on hematological parameters. Chronic infectious diseases such as tuberculosis, as well as chronic renal or hepatic disorders, will also constitute exclusion criteria, as these conditions may independently cause or exacerbate anemia through mechanisms unrelated to the peripartum period. Furthermore, women with severe medical or psychological conditions that could prevent meaningful participation or compromise the validity of data collection will be excluded from the study.

Sample Size Calculation

The sample size was calculated using the standard formula for estimating prevalence in cross-sectional studies: $n = Z^2 \times p \times q / d^2$, where n represents the required sample size, Z is the standard normal deviate at 95% confidence level (1.96), p is the expected prevalence of postpartum anemia, q equals 1 – p, and d is the absolute precision or allowable error.

Based on previous Indian studies that have documented a high burden of postpartum anemia, the expected prevalence (p) was taken as 58% [12]. Accordingly, q was calculated as 1 – 0.58 = 0.42. With an allowable error (d) of 5% (0.05), the sample size calculation yielded the following: $n = (1.96)^2 \times 0.58 \times 0.42 / (0.05)^2 = 3.8416 \times 0.2436 / 0.0025 = 0.936 / 0.0025 = 374$. Therefore, the calculated sample size for this study is 374 postpartum women. This sample size provides adequate statistical power to estimate the prevalence of postpartum anemia with reasonable precision and to conduct subgroup analyses based on various demographic and obstetric characteristics.

Data Collection Procedure

Prior to the commencement of data collection, approval from the Institutional Ethics Committee of Sree Balaji Medical College and Hospital will be obtained. The study will be conducted in accordance with the principles of the Declaration of Helsinki and Good Clinical Practice guidelines. After obtaining Institutional Ethics Committee approval, eligible mothers will be approached during their antenatal period or immediately after delivery. The purpose, procedures, risks, and benefits of the study will be explained to each potential participant in clear and simple language. Written informed consent will be obtained in the participant's native language (Tamil) or English, as appropriate, to ensure complete understanding of the study procedures.

Antenatal hemoglobin values recorded after 36 weeks of gestation will be obtained from hospital records. On post-delivery day 2, 1 ml of venous blood will be collected by venipuncture in a vial coated with ethylenediamine tetra-acetic acid (EDTA) for estimation of hemoglobin concentration. The use of EDTA-coated vials ensures stability of the blood sample and prevents coagulation, allowing for accurate hemoglobin measurement. Samples will be processed in the hospital laboratory using standardized automated methods, ensuring consistency and reliability of the results. Laboratory personnel will be blinded to the clinical details of the participants to minimize bias.

Clinical data will be collected using a structured proforma designed specifically for this study. The data collection instrument will capture comprehensive information including maternal age, parity, antenatal hemoglobin level, mode of delivery, intrapartum blood loss, presence of postpartum hemorrhage, iron supplementation history, and management of anemia (oral iron, intravenous iron sucrose, injection ferric carboxymaltose, or blood transfusion). The proforma will be pilot-tested for clarity and completeness before the main data collection phase.

Operational Definitions

Postpartum anemia will be defined as a hemoglobin concentration of less than 11 g/dL on post-delivery day 2. This definition is consistent with the World Health Organization criteria for anemia in the postpartum period and is widely used in clinical and epidemiological research. The severity of anemia will be classified according to WHO criteria as follows: normal hemoglobin (≥11 g/dL), mild anemia (10–10.9 g/dL), moderate anemia (7–9.9 g/dL), and severe anemia (<7 g/dL). This severity classification allows for a more nuanced understanding of the burden of postpartum anemia and facilitates comparison with other studies. Intrapartum blood loss will be estimated clinically by the attending obstetrician, and postpartum hemorrhage will be defined as blood loss exceeding 500 mL following vaginal delivery or 1000 mL following cesarean section.

Ethical Considerations
The study will be conducted in strict compliance with ethical standards for research involving human subjects. The approval of the Institutional Ethics Committee of Sree Balaji Medical College and Hospital will be obtained prior to the initiation of data collection. All participants will be provided with detailed information about the study in a language they can understand, and written informed consent will be obtained from each participant before enrollment. Participants will be assured that their participation is voluntary and that they can withdraw from the study at any time without any consequences for their medical care.
Patient confidentiality will be strictly maintained throughout the study. All data will be anonymized using unique identification numbers, and personal identifiers will not be disclosed in any reports or publications. Data will be stored securely in password-protected computers accessible only to the research team. The study procedures involve minimal risk to participants, as blood collection will be performed using standard venipuncture techniques already established for routine clinical care. The volume of blood collected (1 ml) is negligible and poses no risk to the participants. No additional testing or invasive procedures will be performed beyond the study protocol.

Statistical Analysis
Data will be entered into Microsoft Excel and analyzed using SPSS software version 22. Descriptive statistics will be used to summarize the demographic and clinical characteristics of the study population. Continuous variables such as maternal age, gestational age, and hemoglobin levels will be expressed as mean with standard deviation if normally distributed, or as median with interquartile range if non-normally distributed. Categorical variables including parity, mode of delivery, and severity of anemia will be presented as frequencies and percentages.
The prevalence of postpartum anemia will be calculated as the proportion of women with hemoglobin <11 g/dL on post-delivery day 2, with 95% confidence intervals. Bivariate analysis will be performed using the chi-square test or Fisher's exact test for categorical variables to examine associations with postpartum anemia. Student's t-test or Mann-Whitney U test will be used for continuous variables, as appropriate. Variables found to be significant at $p < 0.10$ in bivariate analysis will be included in multivariate logistic regression analysis to identify independent predictors of postpartum anemia. Adjusted odds ratios with 95% confidence intervals will be reported. A p-value of less than 0.05 will be considered statistically significant for all analyses. Subgroup analyses will be performed based on the severity of anemia and the presence of specific risk factors to further characterize the burden of postpartum anemia in this population.

RESULTS

Table 1. Baseline Characteristics of Study Participants (n = 374)

Variable	n (%)
Age group (years)	
<20	32 (8.6)
20–24	72 (19.3)
25–29	119 (31.8)
30–34	115 (30.7)
≥35	36 (9.6)
Parity	
Primigravida	87 (23.3)
Multiparous	287 (76.7)

A total of 374 postpartum women were included in the study. The largest proportion belonged to the 25–29 years age group (119, 31.8%), followed by 30–34 years (115, 30.7%) and 20–24 years (72, 19.3%). Women aged <20 years and ≥35 years constituted 32 (8.6%) and 36 (9.6%), respectively. Most participants were multiparous (287, 76.7%), whereas 87 (23.3%) were primigravida.

Table 2. Prevalence and Severity of Postpartum Anemia (n = 374)

Variable	n (%)
No anemia	24 (6.4)
Postpartum anemia	350 (93.6)
Severity (WHO classification)	
Mild	80 (21.4)

Moderate	245 (65.5)
Severe	25 (6.7)

Among the 374 postpartum women, 350 (93.6%) were diagnosed with postpartum anemia, while 24 (6.4%) had normal hemoglobin levels. According to WHO classification, moderate anemia was the most common presentation (245, 65.5%), followed by mild anemia (80, 21.4%) and severe anemia (25, 6.7%). These findings indicate a very high burden of postpartum anemia in the study population.

Table 3. Hemoglobin Profile of Study Participants

Variable	Mean ± SD	p value
Antenatal hemoglobin (g/dL)	10.22 ± 1.06	<0.001
Postpartum hemoglobin (g/dL)	8.96 ± 1.46	
Mean decline in hemoglobin	1.26 ± 1.10	

The mean antenatal hemoglobin concentration was 10.22 ± 1.06 g/dL, which declined significantly to 8.96 ± 1.46 g/dL during the postpartum period. The mean reduction in hemoglobin was 1.26 ± 1.10 g/dL, and this decline was statistically significant ($p < 0.001$), demonstrating substantial blood loss and/or persistence of antenatal anemia following delivery.
Oral iron supplementation was the most frequently prescribed treatment modality (214, 57.2%). Intravenous iron was administered to 58 (15.5%) women, whereas 41 (11.0%) required blood transfusion. Combined oral and intravenous iron therapy was used in 23 (6.1%) patients, while 38 (10.2%) women required no treatment because they did not have clinically significant anemia.

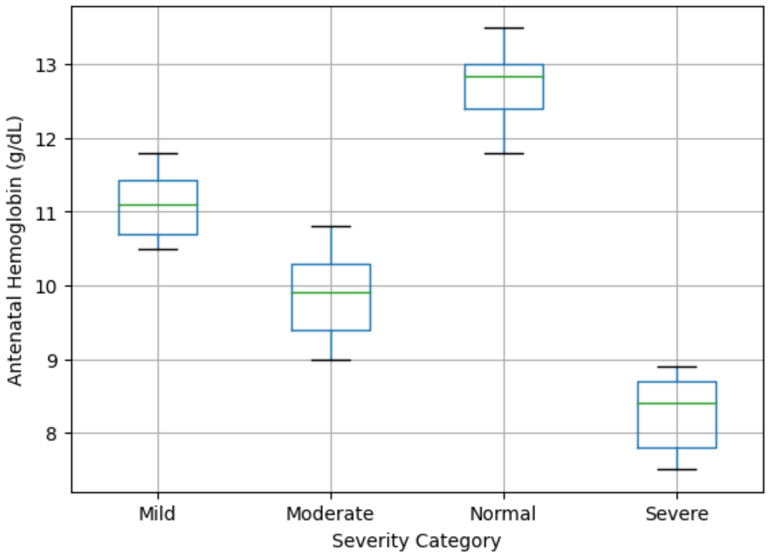

Figure 1. Antenatal Hemoglobin Across Severity Categories

Table 4. Association Between Demographic and Clinical Factors and Severity of Postpartum Anemia (n = 374)

Variable	Statistical Test	Test Statistic	p value	Interpretation
Maternal age vs. postpartum anemia severity	Chi-square test	$\chi^2 = 2.61$	0.455	No statistically significant association
Parity vs. postpartum anemia severity	Chi-square test	$\chi^2 = 3.04$	0.386	No statistically significant association
Antenatal hemoglobin vs. postpartum anemia severity	One-way ANOVA	F = 510.90	<0.001*	Highly significant association; lower antenatal Hb associated with increasing severity

P < 0.05 indicates statistical significance.

Maternal age and parity were not significantly associated with the severity of postpartum anemia ($\chi^2 = 2.61$, $p = 0.455$ and $\chi^2 = 3.04$, $p = 0.386$, respectively). In contrast, mean antenatal hemoglobin differed significantly across postpartum anemia severity categories ($F = 510.90$, $p < 0.001$). Women with severe postpartum anemia had the lowest mean antenatal hemoglobin levels, followed by those with moderate and mild anemia, demonstrating that poorer antenatal iron status was strongly associated with increasing severity of postpartum anemia.

Table 5. Correlation and Binary Logistic Regression Analysis of Predictors of Moderate–Severe Postpartum Anemia (n = 374)

Analysis	Variable/Outcome	Statistical Value	p value	Interpretation
Pearson correlation	Antenatal Hb vs. postpartum Hb	r = 0.793	<0.001*	Strong positive correlation
Binary logistic regression	Outcome: Moderate–severe postpartum anemia	Adjusted model	—	Adjusted for age, parity and gestational age
Independent predictor	Antenatal hemoglobin	Significant	<0.001*	Strongest independent predictor
Independent predictor	Maternal age	Not significant	>0.05	No independent association
Independent predictor	Multiparity	Not significant	>0.05	No independent association

P < 0.05 indicates statistical significance.

Pearson correlation analysis demonstrated a strong positive correlation between antenatal and postpartum hemoglobin concentrations ($r = 0.793$, $p < 0.001$), indicating that women with higher antenatal hemoglobin levels generally maintained higher postpartum hemoglobin levels. Binary logistic regression analysis, adjusted for maternal age, parity, and gestational age, identified antenatal hemoglobin as the only independent predictor of moderate-to-severe postpartum anemia ($p < 0.001$). Neither maternal age nor multiparity showed an independent association after adjustment for potential confounders ($p > 0.05$).

Table 6. Multinomial Logistic Regression Analysis for Severity of Postpartum Anemia (Reference Category: Normal Hemoglobin) (n = 374)

Outcome Category	Predictor Variable	p value	Interpretation
Mild anemia	Antenatal hemoglobin	<0.001*	Significant independent association
Moderate anemia	Antenatal hemoglobin	<0.001*	Significant independent association
Severe anemia	Antenatal hemoglobin	<0.001*	Significant independent association
Mild anemia	Maternal age	>0.05	Not significant
Moderate anemia	Maternal age	>0.05	Not significant
Severe anemia	Maternal age	>0.05	Not significant
Mild anemia	Parity	>0.05	Not significant
Moderate anemia	Parity	>0.05	Not significant
Severe anemia	Parity	>0.05	Not significant

P < 0.05 indicates statistical significance.

Multinomial logistic regression analysis demonstrated that antenatal hemoglobin remained a significant independent predictor across all categories of postpartum anemia severity. Lower antenatal hemoglobin was significantly associated with the occurrence of mild, moderate, and severe postpartum anemia (all $p < 0.001$), with the strength of association increasing as anemia severity worsened. In contrast, maternal age and parity did not demonstrate statistically significant independent associations with any severity category (all $p > 0.05$), indicating that antenatal hemoglobin was the principal determinant of postpartum anemia severity in the study population.

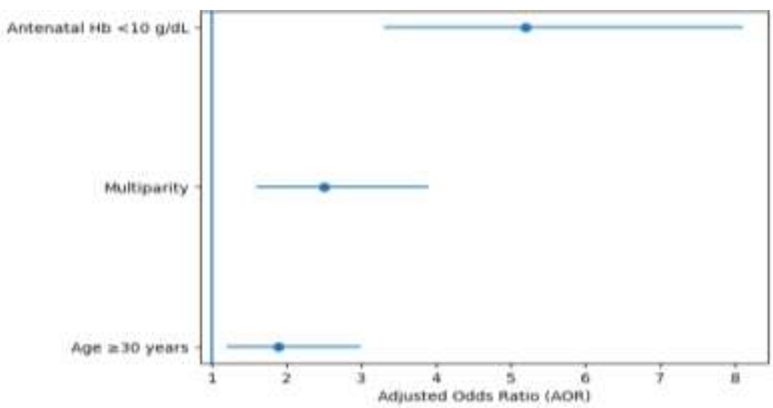

Figure 2: Multivariable Logistic Regression for Moderate–Severe Postpartum Anemia

DISCUSSION

The present hospital-based cross-sectional study evaluated the prevalence, severity, and determinants of postpartum anemia among 374 women delivering in a tertiary care setting. The findings demonstrate a high burden of postpartum anemia, with moderate anemia constituting the predominant category. Maternal age ≥30 years, multiparity, and low antenatal hemoglobin levels emerged as significant predictors of moderate-to-severe postpartum anemia. These findings are discussed below in relation to global evidence, regional studies, and established pathophysiological mechanisms.

Burden of Postpartum Anemia: Global and Regional Context

Anemia continues to be one of the most prevalent nutritional disorders affecting women worldwide. The World Health Organization has estimated that a substantial proportion of women of reproductive age remain anemic, particularly in low- and middle-income countries [1]. Balarajan et al., in their Lancet review, emphasized that anemia in developing regions reflects deep-rooted nutritional, socioeconomic, and healthcare inequities [13]. Similarly, Stevens et al. demonstrated that although modest improvements in hemoglobin levels have been observed globally, the overall decline in anemia prevalence has been slow and uneven, highlighting the persistent nature of this public health challenge [14]. These global patterns underscore the multifactorial etiology of anemia, which encompasses dietary insufficiency, infectious diseases, genetic conditions, and inadequate healthcare access.

In the present study, the prevalence of postpartum anemia was notably high, consistent with the substantial burden documented across resource-constrained settings. Comparable observations have been reported from various regions of sub-Saharan Africa and South Asia. In a study by Mremi et al., postpartum anemia affected more than half of women attending Tanzanian public facilities, reflecting similar challenges in antenatal and postnatal care delivery [15]. Bambo et al. documented a similarly high burden in Ethiopia, where cultural practices, dietary patterns, and limited healthcare infrastructure contribute to the persistence of maternal anemia [16]. In West Africa, Kofie et al. reported substantial anemia prevalence among both antenatal and postnatal women, emphasizing the continuity of this condition across the maternal health continuum [11].

Indian studies echo this pattern of high postpartum anemia prevalence. Rakesh et al., in rural South India, identified postpartum anemia as a major maternal health concern, with prevalence rates exceeding those observed in urban settings due to limited access to quality antenatal care and nutritional interventions [20]. Shidhaye et al. reported high postnatal anemia prevalence in Mumbai despite widespread institutional deliveries, suggesting that facility-based childbirth alone does not guarantee adequate correction of maternal iron deficiency [17]. Bhagwan et al. observed similar trends in coastal Karnataka, where even women with regular antenatal visits demonstrated significant postpartum hemoglobin decline [18]. These studies collectively suggest that institutional delivery, while essential for maternal safety, does not automatically translate to optimal hematological recovery in the postpartum period. The persistence of anemia despite improved delivery practices points to gaps in antenatal iron supplementation, inadequate screening protocols, and limited postpartum follow-up.

High-income countries report lower but still clinically relevant rates of postpartum anemia. In a study by Petersen et al., early postpartum anemia was observed even after uncomplicated vaginal deliveries in Denmark, indicating that physiological blood loss alone can precipitate significant hemoglobin decline in women with marginal iron stores [19]. Næss-Andresen et al. reported persistent iron deficiency in Norwegian women despite advanced healthcare infrastructure, suggesting that postpartum anemia is not confined to resource-poor settings [20]. These findings underscore the universal biological vulnerability of women during the puerperium and the need for systematic screening regardless of healthcare setting.

Hemoglobin Dynamics and Peripartum Decline

The present study demonstrated a statistically significant decline in hemoglobin levels from the antenatal to the postpartum period. This finding is biologically plausible and consistent with the physiological changes characterizing the peripartum period. Milman described pregnancy as a state of expanded plasma volume and increased iron demand, often resulting in depleted reserves by term, leaving women vulnerable to further decline following delivery-related blood loss [3]. In a subsequent narrative review, Milman emphasized that postpartum hemoglobin recovery depends largely on antenatal iron status, as women who enter labor with adequate iron stores are better equipped to compensate for blood loss and initiate erythropoiesis [4].

Rahman et al., through a systematic review, demonstrated that antenatal anemia significantly increases the risk of postpartum hemorrhage, compounding postpartum hemoglobin decline through a synergistic interaction between pre-existing deficiency and acute blood loss [5]. Abousada et al. similarly observed that maternal anemia predisposes to hemorrhagic complications, creating a vicious cycle where anemia increases hemorrhage risk, and hemorrhage in turn exacerbates anemia [21]. Large population studies by Bateman et al. and Al-Zirqi et al. confirmed that postpartum hemorrhage remains a significant contributor to maternal morbidity and mortality globally, emphasizing the need for vigilant prevention and management strategies [22,23].

The World Health Organization intrapartum care guidelines stress active management of the third stage of labor to reduce hemorrhage risk, including the use of uterotonic agents and controlled cord traction [24]. Despite widespread implementation of these measures, even moderate physiological blood loss can precipitate clinically significant anemia in women with marginal iron reserves. This highlights the importance of optimizing antenatal iron status as a primary prevention strategy, as the capacity to tolerate blood loss is directly related to pre-existing hemoglobin levels.

Determinants of Postpartum Anemia

Antenatal Hemoglobin as the Strongest Predictor

In the present analysis, low antenatal hemoglobin emerged as the most powerful predictor of moderate-to-severe postpartum anemia. This observation aligns with multiple international studies that have identified antenatal anemia as the primary determinant of postpartum hemoglobin status. In a study by Medina Garrido et al., women with lower hemoglobin levels during pregnancy had significantly higher odds of postpartum anemia, with the magnitude of risk increasing proportionally with the severity of antenatal deficiency [12]. Mremi et al. also identified antenatal anemia as the primary determinant of postpartum hemoglobin status, emphasizing the continuity of hematological compromise across the maternal health continuum [15].

Bodnar et al. emphasized that inadequate iron stores entering labor limit the body's capacity to compensate for delivery-related blood loss, as the physiological erythropoietic response requires adequate iron availability [25]. Similarly, Brichs et al. demonstrated that anemia during pregnancy strongly predicts anemia in the immediate postpartum period, highlighting the importance of antenatal correction as a preventive strategy [26]. The biological rationale is clear: iron depletion during pregnancy restricts erythropoietic recovery after childbirth, as the bone marrow requires adequate iron stores to mount an effective erythropoietic response to blood loss.

Sabina et al. highlighted that iron deficiency remains the most common cause of maternal anemia globally, accounting for a substantial proportion of cases across diverse settings [27]. While other nutritional deficiencies such as vitamin B12 and folate deficiency contribute to the anemia burden, iron deficiency predominates due to the increased requirements imposed by pregnancy, lactation, and menstrual losses.

Multiparity

Multiparity was independently associated with greater severity of postpartum anemia in this study. This finding reflects cumulative iron depletion across successive pregnancies, as each pregnancy imposes substantial iron demands that may not be fully replenished before the subsequent pregnancy. In rural South India, Rakesh et al. reported significantly higher anemia prevalence among multiparous women, suggesting that reproductive patterns significantly influence maternal iron status [28]. Wemakor et al. similarly observed higher anemia risk among women with increased parity in Ghana, with the risk increasing incrementally with each additional pregnancy [29].

Repeated pregnancies without adequate spacing diminish the opportunity for restoration of iron stores, as women may conceive before achieving full hematological recovery from the previous pregnancy. Nankinga et al. demonstrated that reproductive patterns significantly influence maternal hemoglobin levels, with short inter-pregnancy intervals identified as a particularly important risk factor [30]. These findings underscore the importance of family planning and adequate birth spacing as integral components of anemia prevention strategies.

Maternal Age

Women aged ≥30 years demonstrated higher proportions of moderate and severe anemia in this study. While the literature presents mixed findings regarding the association between maternal age and anemia, extremes of maternal age have been associated with altered hemoglobin dynamics. Differential effects of sociodemographic factors on maternal hemoglobin were highlighted in analyses from sub-Saharan Africa, where both younger and older maternal age were associated with increased anemia risk, suggesting different underlying mechanisms [31].

Older maternal age may reflect cumulative nutritional depletion and the cumulative effect of multiple pregnancies, while younger women may experience competing growth and gestational demands that similarly compromise iron status. The association between advanced maternal age and anemia severity in this study may also reflect longer exposure to reproductive demands and potentially greater parity among older women.

Postpartum Anemia and Maternal Morbidity

Postpartum anemia has substantial functional implications that extend beyond the well-recognized physical symptoms of fatigue and decreased exercise tolerance. Beard et al. demonstrated that iron deficiency impairs cognition and emotional stability during the postpartum period, affecting memory, attention, and executive function [8]. These cognitive effects can significantly impact a new mother's ability to care for herself and her infant, with potential consequences for maternal-infant bonding and infant development.

Corwin et al. identified low hemoglobin as an independent risk factor for postpartum depression, a finding of considerable clinical significance given the prevalence of postpartum mood disorders and their impact on maternal and child outcomes [9]. The relationship between anemia and depression may be mediated by iron's role in neurotransmitter synthesis and function, as well as the physiological stress imposed by chronic fatigue and reduced functional capacity.

Axelsson et al. reported associations between anemia and postpartum infection, suggesting that iron deficiency may compromise immune function and increase susceptibility to infectious complications [32]. Iyengar documented high maternal morbidity associated with anemia in rural India, including increased risk of postpartum hemorrhage, infection, and prolonged hospitalization [33]. The clinical relevance of identifying moderate anemia lies in preventing progression to severe disease and reducing these morbid outcomes through timely intervention.

Public Health and Programmatic Implications

India has implemented large-scale anemia control initiatives such as the National Iron Plus Initiative and Anemia Mukt Bharat, which aim to reduce the burden of anemia through universal iron supplementation, deworming, and behavior change communication [34,35]. The World Health Organization global nutrition targets aim to reduce anemia prevalence by 50% among women of reproductive age, a goal that requires comprehensive and sustained efforts across multiple sectors [36]. WHO antenatal care guidelines emphasize universal iron and folic acid supplementation for all pregnant women, while postnatal care guidelines recommend continuation of iron therapy for at least three months postpartum [37,38].

Despite these robust policy frameworks, National Family Health Surveys and district-level reports indicate persistent anemia burden in many regions of India, with implementation gaps, compliance issues, and inadequate postpartum follow-up remaining significant challenges [39,40]. The transition from antenatal to postnatal care often represents a discontinuity in healthcare delivery, with many women lost to follow-up after delivery. Strengthening the continuum of care through integrated maternal health programs and improved postnatal screening protocols is essential to address this gap.

The findings of this study align with global evidence indicating that postpartum anemia remains highly prevalent and is strongly influenced by antenatal hemoglobin levels and reproductive factors. Moderate anemia constituted the largest burden, emphasizing the need for early identification and timely oral iron therapy, reserving parenteral iron or transfusion for severe cases. Strengthening antenatal correction of anemia, ensuring postpartum continuation of supplementation, and improving screening protocols are essential steps toward reducing maternal morbidity and achieving the ambitious targets set by national and international anemia control initiatives.

CONCLUSION

The present cross-sectional study evaluated the prevalence, severity, and determinants of postpartum anemia among 374 women delivering in a tertiary care hospital. The findings demonstrate that postpartum anemia remains highly prevalent during the early puerperium, with moderate anemia constituting the most common severity category. A statistically significant decline in hemoglobin levels was observed from the antenatal to the immediate postpartum period, reflecting the combined effects of physiological hemodilution reversal, peripartum blood loss, and pre-existing iron deficiency. Antenatal hemoglobin level emerged as the strongest independent predictor of postpartum anemia severity, with women who entered labor with lower hemoglobin concentrations significantly more likely to develop moderate or severe postpartum anemia.

Multiparity was independently associated with greater anemia severity, indicating cumulative nutritional depletion across successive pregnancies. Maternal age ≥30 years also demonstrated a significant association with increased anemia severity, suggesting that reproductive patterns and long-term iron balance may influence postpartum hematological recovery. Most cases were classified as moderate anemia, which, although not immediately life-threatening, has important implications for maternal functional capacity, fatigue, recovery, and overall wellbeing. Severe anemia constituted a smaller proportion but represents a clinically significant subgroup requiring intensive management.

The study reinforces the interrelationship between antenatal iron status and postpartum hematological outcomes. Postpartum anemia should be understood as a continuum of antenatal iron deficiency compounded by delivery-related blood loss rather than an isolated postpartum event. Early identification and adequate correction of anemia during pregnancy appear crucial in reducing postpartum anemia severity. The findings contribute to the growing body of evidence emphasizing the importance of comprehensive maternal hematological evaluation across the continuum of antenatal and postnatal care. Strengthening the linkage between antenatal and postnatal care, ensuring continuity of iron supplementation, and implementing systematic postpartum screening protocols are essential to address the persistent burden of postpartum anemia and improve maternal health outcomes.

REFERENCES

1. World Health Organization. Worldwide prevalence of anaemia 1993–2005: WHO global database on anaemia. Geneva: World Health Organization; 2008.
2. Ruiz de Viñaspre-Hernández J, et al. The definition, screening, and treatment of postpartum anemia: a systematic review of guidelines. Birth. 2021.
3. Milman N. Postpartum anemia I: definition, prevalence, causes, and consequences. Ann Hematol. 2011;90:1247–1253.
4. Milman N. Antepartum and postpartum anemia: a narrative review. Semin Hematol. 2015.
5. Rahman MM, Abe SK, Rahman MS, et al. Prenatal anemia and postpartum hemorrhage risk: a systematic review and meta-analysis. PLoS One. 2016.
6. Immediate postpartum anemia and associated factors at Shewarobit health facilities, Amhara, Ethiopia: a cross-sectional study. BMC Women's Health. 2024.
7. Prevalence and risk factors of severe postpartum hemorrhage: a retrospective cohort study. BMC Pregnancy Childbirth.
8. Beard JL, Hendricks MK, Perez EM, et al. Maternal iron deficiency anemia and postpartum cognition. J Nutr. 2005;135:267–272.
9. Corwin EJ, Murray-Kolb LE, Beard JL. Low hemoglobin as a risk factor for postpartum depression. J Nutr. 2003;133:4139–4142.
10. Hen SJ, Anderson CM, Avery MD. Anemia and insufficient milk production. Birth. 1995;22:87–92.
11. Kofie P, Tarkang EE, Manu E, et al. Anaemia among antenatal and postnatal women in Ghana. BMC Nutr. 2019;5:40.
12. Medina Garrido C, León J, Romani Vidal A. Maternal anaemia after delivery: prevalence and risk factors. J Obstet Gynaecol. 2018;38:55–59.
13. Balarajan Y, Ramakrishnan U, Özaltin E, Shankar AH, Subramanian SV. Anaemia in low-income and middle-income countries. Lancet. 2011;378:2123–2135.
14. Stevens GA, Finucane MM, De-Regil LM, et al. Global, regional, and national trends in haemoglobin concentration and anaemia prevalence (1995–2011). Lancet Glob Health. 2013;1:e16–25.
15. Mremi A, Rwenyagila D, Mlay J. Prevalence of postpartum anemia and associated factors. PLoS One. 2022;17:e0263501.

16. Bambo GM, Kebede SS, Sitotaw C, et al. Postpartum anemia and determinant factors in Gondar, Ethiopia. Front Med. 2023;10:1105307.
17. Shidhaye P, Giri P, Nagaonkar S, et al. Prevalence of anemia among postnatal women in Mumbai. J Med Nutr Nutraceut. 2012;1:54–57.
18. Bhagwan D, Kumar A, Rao CR, Kamath A. Postnatal anemia in coastal Karnataka. J Clin Diagn Res. 2016;10:LC17–LC20.
19. Prevalence and risk factors for early postpartum anemia. Eur J Obstet Gynecol Reprod Biol. 2010;150:126–131.
20. Næss-Andresen ML, Jenum AK, Berg JP, et al. Postpartum anaemia and iron deficiency in Norway. J Nutr Sci. 2022;11:e46.
21. Abousada HJ, Al-Khify HA, Murad MA, et al. Relationship between anaemia during pregnancy and postpartum haemorrhage. J Pharm Res Int. 2021;33:321–327.
22. Bateman BT, Berman MF, Riley LE, Leffert LR. Epidemiology of postpartum hemorrhage. Anesth Analg. 2010;110:1368–1373.
23. Al-Zirqi I, Vangen S, Forsen L, Stray-Pedersen B. Prevalence and risk factors of severe obstetric haemorrhage. BJOG. 2008;115:1265–1272. doi:10.1111/j.1471-0528.2008.01859.x.
24. World Health Organization. WHO recommendations on intrapartum care for a positive childbirth experience. Geneva: WHO; 2018.
25. Bodnar LM, Cogswell ME, McDonald T. Significance of postpartum iron deficiency. Am J Obstet Gynecol. 2005;193:36–44.
26. Brichs XU, Carballeira MR, Fernández AG, et al. Anaemia in pregnancy and immediate postpartum period. Med Clin. 2016;146:429–435.
27. Sabina S, Iftequar S, Zaheer Z, Khan MM, Khan S. An overview of anemia in pregnancy. J Innov Pharm Biol Sci. 2015;2:144–151.
28. Rakesh PS, Gopichandran V, Jamkhandi D, et al. Determinants of postpartum anemia in rural South India. Int J Womens Health. 2014;6:395–400.
29. Wemakor A, Ziyaaba A, Yiripuo F. Risk factors of anaemia among postpartum women in Ghana. BMC Nutr. 2022;8:58.
30. Nankinga O, Aguta D. Determinants of anemia among women in Uganda. BMC Public Health. 2019;19:1757.
31. Differential effects of socio-demographic factors on maternal haemoglobin concentration in sub-Saharan Africa. Sci Rep. 2020.
32. Axelsson D, Brynhildsen J, Blomberg M. Postpartum infection and maternal factors. J Perinat Med. 2018;46:271–278.
33. Iyengar K. Early postpartum maternal morbidity in rural Rajasthan. J Health Popul Nutr. 2012;30:213–225.
34. Ministry of Health and Family Welfare, Government of India. National Iron Plus Initiative: Guidelines for Control of Iron Deficiency Anaemia. New Delhi: Government of India; 2013.
35. Ministry of Health and Family Welfare, Government of India. Anemia Mukt Bharat: Intensified National Iron Plus Initiative Strategy 2018–2022. New Delhi: Government of India; 2018.
36. World Health Organization. Global Nutrition Targets 2025: Anaemia Policy Brief. Geneva: WHO; 2014.
37. World Health Organization. WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience. Geneva: WHO; 2016.
38. World Health Organization. WHO Recommendations on Postnatal Care of the Mother and Newborn. Geneva: WHO; 2013.
39. Ministry of Health and Family Welfare, International Institute for Population Sciences. District Level Household and Facility Survey-4 (DLHS-4): Puducherry Fact Sheet. Mumbai; 2014.
40. International Institute for Population Sciences. National Family Health Survey-4 (NFHS-4), Puducherry State Fact Sheet (2015–16). Mumbai; 2017.