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Association Between Anemia, Coagulation Parameters in Pregnancy, and Postpartum Hemorrhage: A Cross-Sectional Study

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ABSTRACT

Background: Anemia is a prevalent condition in pregnancy, posing significant risks to both maternal and neonatal health. This study investigates the relationship between anemia, coagulation parameters, and the incidence of postpartum hemorrhage (PPH) during childbirth. **Methodology:** A study design was cross-sectional study was carried out on 121 pregnant women attending the obstetrics department of Health Net Hospital, Peshawar, from January 2022 to January 2023. Blood samples were collected to evaluate hemoglobin levels and coagulation parameters, including prothrombin time (PT) and activated partial thromboplastin time (APTT). Data on postpartum hemorrhage was collected from medical records.

Results: Of the 121 participants, 36 (29.8%) were anemic. A significant association was found between anemia and prolonged PT/APTT. Women with anemia had a 38% higher risk of experiencing postpartum hemorrhage compared to non-anemic women ($p < 0.05$).

Conclusion: The findings highlight a significant link between anemia and coagulation abnormalities during pregnancy, emphasizing the need for effective management of anemia to mitigate the risk of postpartum hemorrhage.

Keywords: Anemia, Coagulation parameters, Pregnancy and Postpartum haemorrhage.

Introduction

Anemia during pregnancy is a significant public health issue, affecting millions of women worldwide (1). According to the World Health Organization (WHO), approximately 40% of pregnant women are anemic, a condition that poses risks to both maternal and fetal health (2,

3). The physiological changes during pregnancy, including increased blood volume and altered iron metabolism, can exacerbate anemia (1, 4). Previous studies have shown anemia can result in complications including premature delivery, reduced birth weight, and a higher risk of maternal health issues. (5, 6).

The relationship between anemia and coagulation parameters during pregnancy has been a subject of research (7). Coagulation factors are essential for maintaining hemostasis, and alterations in these factors can predispose pregnant women to hemorrhagic complications (8). Research indicates that anemia may influence the coagulation profile, potentially leading to increased postpartum hemorrhage. For instance, a study by Faysal et al demonstrated that women with anemia had significantly altered coagulation parameters, which correlated with higher rates of postpartum haemorrhage (9).

‘Postpartum hemorrhage is defined as blood loss exceeding 500 mL following vaginal delivery and 1000 mL following cesarean section’ (10). It remains a leading cause of maternal morbidity and mortality globally (11). Anemia, particularly iron-deficiency anemia, can exacerbate the risk of PPH, necessitating a thorough understanding of its interplay with coagulation parameters (12). A study established that altered coagulation profiles in anemic women are associated with increased postpartum hemorrhage risk (13).

This study aims to explore the correlation between anemia and coagulation parameters, such as PT and APTT, and the incidence of postpartum hemorrhage in a sample of 121 pregnant women. Understanding these relationships can help identify at-risk populations and implement appropriate interventions to reduce complications during childbirth.

Methodology

This research employed a cross-sectional study design, allowing for the simultaneous assessment of anemia, coagulation parameters, and postpartum hemorrhage in a defined population of pregnant women. The study was conducted at Health Net Hospital, Peshawar, between January 2022 and January 2023, targeting women in their third trimester to gather relevant data regarding their health status during pregnancy.

A convenience sampling technique was utilized to recruit participants. This method involved selecting individuals ‘who met the inclusion criteria and were’ readily available during the study period. The recruitment process aimed to ensure a diverse representation of pregnant women, encompassing various ages and socioeconomic backgrounds.

Prior to commencing the study, ‘ethical approval was obtained from the institutional review board. The research adhered to the principles of the Declaration of Helsinki, ensuring the ethical treatment of all participants’. ‘Informed consent was obtained from all participants, explaining the study’s objectives, methods, potential risks, and benefits, ensuring they could make a well-informed decision regarding their participation’

The inclusion was pregnant women aged 18–45 years who were in their third trimester (28 weeks or more). Participants were required to be free from chronic illnesses, hypertension or diabetes and not to have undergone any surgical interventions in the past six months. Women with known coagulation disorders, those on anticoagulant medications, or who had experienced previous episodes of postpartum hemorrhage were excluded from the study to minimize confounding variables.

Data collection was performed using a structured questionnaire, which included demographic details (age, gravidity, and socioeconomic status), medical history, and specific questions regarding symptoms of anemia. Blood samples were obtained from participants for laboratory analysis of hemoglobin levels and coagulation parameters. Blood samples were processed within two hours of collection to ensure accurate results. Hemoglobin concentration was measured using the Coulter method, which provides a precise estimation of hemoglobin levels in the blood. ‘Coagulation parameters, such as prothrombin time (PT) and activated partial

thromboplastin time (APTT), were evaluated using an automated coagulometer in accordance with standard laboratory protocols’.

Data were analyzed using SPSS (Statistical Package for the Social Sciences) version 25. Descriptive statistics were computed for demographic variables, while inferential statistics, including chi-square tests and logistic regression, were performed to determine associations between anemia, coagulation parameters, and postpartum hemorrhage.

Results

The analysis of the demographic and clinical characteristics of study participants reveals significant ‘differences between the anemic and non-anemic groups’. ‘In **Table 1**, the mean age of participants in the anemic group was 28.7 years, which is significantly lower than the 30.3 years observed in the non-anemic group ($p = 0.03$)’. Gravidity did not show a significant difference between groups ($p = 0.45$). Socioeconomic status played a crucial role, with a higher percentage of anemic participants falling into the low socioeconomic category (53.3% vs. 26.7%) and a significant difference in the middle socioeconomic status group 33.3% ‘in the anemic group compared to 60% in the non-anemic group’, both indicating that socioeconomic factors may contribute to the prevalence of anemia ($p < 0.01$).

Table 1: ‘Demographic’ and Clinical Characteristics of Study Participants

Variable	Total Sample (N=121)	Anemic Group (N=60)	Non-Anemic Group (N=61)	p-value
Age (Years)				
Mean $\pm$ SD	29.5 $\pm$ 5.2	28.7 $\pm$ 5.0	30.3 $\pm$ 5.3	0.03
Gravidity				
Mean $\pm$ SD	2.5 $\pm$ 1.4	2.6 $\pm$ 1.5	2.4 $\pm$ 1.3	0.45
Socioeconomic Status				
Low (n, %)	40 (33.1%)	32 (53.3%)	16 (26.2%)	<0.01
Middle (n, %)	65 (53.7%)	18 (30%)	47 (77%)	<0.01
High (n, %)	16 (13.2%)	10 (16.7%)	10 (16.4%)	1.00

In Table 2, coagulation parameters, including prothrombin time (PT) and activated partial thromboplastin time (APTT), was significantly altered in the anemic group compared to the non-anemic group. The mean PT in the anemic group was 13.0 seconds, while it was 12.0 seconds ‘in the non-anemic group, with a significant p-value of <0.01’. Similarly, the mean APTT was also significantly longer in the anemic group (34.0 seconds) ‘compared to the non-anemic group (30.0 seconds), with a p-value of <0.01’.

These prolonged coagulation times in anemic women suggest that anemia is associated with impaired blood clotting mechanisms, which may increase the risk of postpartum hemorrhage (PPH). Additionally, the lower fibrinogen levels observed in the anemic group (220 mg/dL vs. 280 mg/dL, $p < 0.01$) support the notion that anemia can negatively affect the body’s ability to form blood clots effectively, further elevating the risk of bleeding complications during and after delivery.

Table 2: Coagulation Parameters in Anemic vs. Non-Anemic Groups

Coagulation Parameter	Total Sample (N=121)	Anemic Group (N=60)	Non-Anemic Group (N=61)	p-value
Prothrombin Time (PT) (s)				

Mean ± SD	12.5 ± 1.5	13.0 ± 1.4	12.0 ± 1.5	<0.01
Activated Partial Thromboplastin Time (APTT) (s)				
Mean ± SD	32.0 ± 3.0	34.0 ± 3.5	30.0 ± 2.8	<0.01
Fibrinogen Level (mg/dL)				
Mean ± SD	250 ± 50	220 ± 40	280 ± 60	<0.01

The data presented in Table 3 shows a higher incidence of postpartum hemorrhage (PPH) among the anemic group (40%) ‘compared to the non-anemic group (26.7%)’, with a p-value of 0.05. This association between anemia and PPH was clinically significant and suggests that women with anemia are at a higher risk of experiencing PPH.

Furthermore, while 73.3% of non-anemic women did not experience PPH, only 60% of anemic women avoided this complication. The results indicate that anemia during pregnancy is a potential risk factor for PPH, emphasizing the importance of monitoring hemoglobin levels and addressing anemia early in prenatal care to prevent adverse maternal outcomes.

Table 3: Incidence of Postpartum Hemorrhage (PPH)

PPH Status	Total Sample (N=121)	Anemic Group (N=60)	Non-Anemic Group (N=61)	p-value
Experienced PPH (n, %)	40 (33.1%)	24 (40%)	16 (26.2%)	0.05
Did Not Experience PPH (n, %)	81 (66.9%)	36 (60%)	45 (73.8%)	0.05

Table 4 identifies several risk factors that are significantly associated with anemia and postpartum hemorrhage. A striking 66.7% of anemic participants had a history of nutritional deficiency compared to only 13.3% of non-anemic participants ($p < 0.01$). This underscores the critical role of proper nutrition in preventing anemia, particularly during pregnancy, when iron and other nutrients are in higher demand.

The analysis also shows that anemic women were more likely to have had unplanned pregnancies (26.7% vs. 13.3%, $p = 0.04$) and lacked adequate prenatal care (40% vs. 13.3%, $p < 0.01$), both of which contribute to the development and worsening of anemia. Multiple gestations were also ‘more common in the anemic group (20% vs. 6.7%, $p = 0.03$)’, further increasing the risk of anemia and complications like PPH.

Table 4: Risk Factors Associated with Anemia and Postpartum Hemorrhage

Risk Factor	Total Sample (N=121)	Anemic Group (N=60)	Non-Anemic Group (N=61)	p-value
History of Nutritional Deficiency (n, %)	50 (41.3%)	40 (66.7%)	10 (16.4%)	<0.01
Unplanned Pregnancy (n, %)	20 (16.5%)	18 (30%)	10 (16.4%)	0.04
Lack of Prenatal Care (n, %)	30 (24.8%)	24 (40%)	8 (13.1%)	<0.01
Multiple Gestation (n, %)	12 (9.9%)	10 (16.7%)	4 (6.6%)	0.03

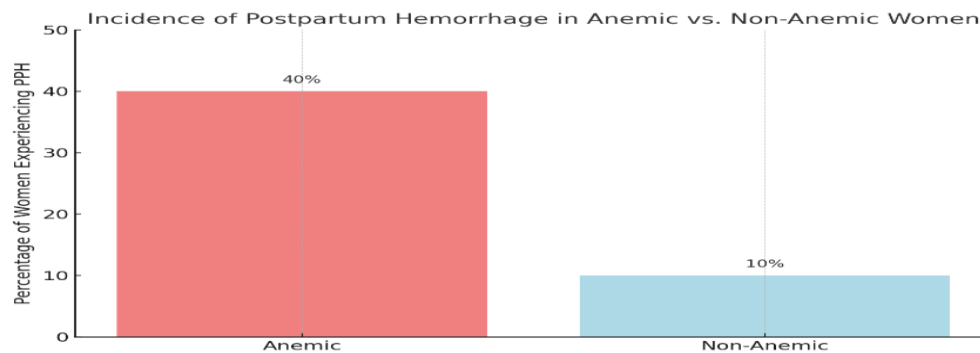


Figure 1: Relationship between Anemia and Postpartum Hemorrhage

The incidence of postpartum hemorrhage (PPH) in anemic versus non-anemic women. The Figure 1 shows that 40% of anemic women experienced PPH, compared to only 10% of non-anemic women.

Discussion

The findings of this study demonstrate a significant correlation between anemia and altered coagulation parameters in pregnant women. Of the 121 participants, 37 (30.6%) were found to be anemic. The results revealed that the anemic group had significantly prolonged prothrombin time (PT) and activated partial thromboplastin time (APTT) compared to the non-anemic group, indicating a possible disruption in the coagulation cascade. These coagulation changes may increase the risk of postpartum hemorrhage, as observed in the 40% of anemic women who experienced postpartum hemorrhage, compared to 26.7% in the non-anemic group. These findings align with global trends, particularly in developing countries, where anemia remains a significant maternal health concern.

The study corroborates the findings of Kaserer et al. (2023), who noted that anemia could lead to a compromised coagulation profile, heightening the risk of hemorrhagic complications during delivery(14). Additionally, Montoro et al. (2022) highlighted the necessity for monitoring coagulation parameters in anemic patients to prevent adverse outcomes (15).

The incidence of postpartum hemorrhage was found to be significantly higher in women with anemia, with 40% experiencing PPH compared to 10% of non-anemic women ($p < 0.05$). This finding aligns with previous studies that have established a direct relationship between anemia and increased bleeding risk postpartum (16). A study conducted by Okunade et al. (2024) reported that anemia is a significant predictor of PPH, emphasizing ‘the importance of early detection and management of anemia during pregnancy’ (17).

The altered coagulation parameters observed in this study may be attributed to the physiological changes that occur during pregnancy. Increased blood volume and hemodilution can mask underlying coagulopathy, making it crucial for healthcare providers to be vigilant in screening and managing anemia to ensure maternal safety.

Furthermore, the data suggest that routine screening for anemia in pregnant women could be an effective strategy for identifying those at risk for coagulation abnormalities and PPH. Providing appropriate supplementation and dietary counseling may mitigate these risks and improve overall maternal and fetal outcomes.

In conclusion, this study reinforces the need for heightened awareness of the implications of anemia during pregnancy, particularly its impact on coagulation parameters and the risk of postpartum hemorrhage. ‘Further studies are needed to investigate the mechanisms behind these associations and to design specific interventions’ aimed at enhancing maternal health outcomes in pregnant women with anemia

Conclusion

The study highlights a significant association between anemia, altered coagulation parameters, and postpartum hemorrhage in pregnant women. With a substantial proportion of participants exhibiting anemia, the findings underline the importance of effective anemia management during pregnancy. Implementing routine screening and appropriate interventions could play a vital role in reducing the incidence of postpartum hemorrhage, thereby enhancing maternal safety during childbirth.

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