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Association of Maternal Anemia and Risk of Preterm Birth in Pregnant Women at Dr Ruth KM Pfau Civil Hospital Karachi

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ABSTRACT

Background: Anemia is a major public health problem in low- and middle-income countries, including pregnant women. It is linked to poor maternal and infant health outcomes, including preterm birth - a major cause of perinatal morbidity and death. But the link between maternal anemia and preterm birth is conflicting in various populations. **Objective:** To determine the association between maternal anemia and the risk of preterm birth in pregnant women. **Methods:** This prospective cohort study was conducted at the Department of Obstetrics and Gynaecology, Dr. Ruth K. M. Pfau Civil Hospital, Karachi from March 2025 to June 2025. A convenience sample of 94 pregnant women were recruited and assigned into anemic (n=47) and non-anemic (n=47) groups. Anemia was defined as hemoglobin levels <11 g/dL in first and third trimesters and <10.5 g/dL in the second trimester. The women were monitored until they gave birth, and preterm birth (<37 weeks) was recorded. SPSS 21 was used to perform the analyses. Chi-square test, relative risk (RR) with 95% confidence interval were computed. P-value ≤0.05 was statistically significant. **Results:** The mean maternal age was 28.4 ± 5.3 years. Preterm birth occurred in 42.6% of participants. A significantly higher proportion of preterm births was observed in the anemic group (55.3%) compared to the non-anemic group (29.8%) (p = 0.012). The relative risk was 1.86 (95% CI: 1.12–3.08). Stratified analysis showed increased risk in the presence of hypertension, urinary tract infection, iron deficiency, and previous preterm labor. **Conclusion:** Maternal anemia is significantly associated with an increased risk of preterm birth. Early screening and appropriate management of anemia during pregnancy may help reduce adverse outcomes.

INTRODUCTION

Anemia is a condition where the blood's oxygen-carrying capacity is diminished due to low hemoglobin concentration and/or red blood cell count, which impairs the transfer of oxygen to tissues. Pregnancy-related maternal anemia is a common health problem, with 25% of pregnant women worldwide suffering from it, and much greater prevalence in low- and middle-income countries (LMICs), especially in South Asia. The World Health Organization (WHO) defines anemia as a hemoglobin concentration less than 11 g/dL, at any time during pregnancy (1-3).

Preterm birth (before 37 completed weeks of gestation) is a leading cause of infant death and disability. Preterm birth rates vary between 7% and 12% in developing countries and pose a major public health concern. Many maternal, fetal and environmental factors play a role in its development, including maternal anemia (4-6).

The link between anemia and preterm delivery is still unclear. Although some studies have found a strong link, others have been inconclusive. Some studies have proposed that the duration and severity of anemia during pregnancy could affect the chances of preterm birth. The study conducted by Kabir MA found preterm birth rate was higher in anemic pregnancies compared to non-anemic pregnancies, with a significant adjusted odds ratio (7), suggesting a causal link. However, the results are still conflicting (8, 9).

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The objective of this study was to determine the association between maternal anemia and the risk of preterm birth in pregnant women.

METHODOLOGY

This prospective cohort study was conducted in the

Department of Obstetrics and Gynaecology Unit at Dr. Ruth K. M. Pfau Civil Hospital Karachi over a period of one year, from March 2025 to June 2025 and after the approval of REU CPSP and the institutional ethical review committee.

The sample size was calculated using the OpenEpi online calculator for cohort studies, based on a previously published study reporting a preterm birth proportion of 29.6% in the non-exposed group and an adjusted relative risk of 2.03 (95% CI: 1.01–4.25). With a power of 80% and a level of significance of 5%, the total sample size was calculated to be 94 participants, with 47 in each group. A non-probability consecutive sampling technique was used. This study included pregnant women aged 16-45 years with singleton pregnancies who attended their booking appointment. We included both primiparous and multiparous women. The study group comprised of pregnant women with anemia (hemoglobin <11 g/dL in the first and third trimesters, <10.5 g/dL in the second trimester by complete blood count (CBC). The control group consisted of pregnant women with hemoglobin ≥11 g/dL in the first and third trimesters and ≥10.5 g/dL in the second trimester.

Women with multiple pregnancies, chronic kidney diseases, systemic lupus erythematosus, polycythemia, sickle cell disease, HIV infection, and women already on iron or vitamin B12 supplementation, as well as those with disseminated intravascular coagulation (DIC) or bleeding disorders or on anticoagulant treatment were excluded.

Following informed written consent, women were recruited and data were obtained in a proforma. Demographic (age, place of residence), obstetric (parity, gestational age, antenatal booking) and anthropometric parameters (weight, height, BMI) were noted. The outcome of preterm birth was defined as delivery prior to 37 completed weeks of gestation (calculated from last menstrual period), and was assessed until the delivery of the infant.

Other possible confounding factors such as diabetes mellitus, hypertension, urinary tract infection, short inter-pregnancy interval, previous preterm labor, polyhydramnios, iron deficiency and body mass index were also noted and stratified.

Data were entered and analysed using the Statistical Package for Social Sciences (SPSS) version 21 (IBM Corp., Armonk, NY, USA). Means and standard deviations were used to describe continuous variables and frequencies and percentages were used for categorical variables. The Shapiro-Wilk test was used to test for normality. Testing of the association between maternal anemia and preterm birth was done using the chi-square test or Fisher's exact test. Relative risk (RR) and 95% confidence intervals were reported. We used stratified analysis to examine confounding factors, and statistical significance was set at p-value ≤0.05.

RESULTS

A total of 94 pregnant women were included, with 47 anemic and 47 non-anemic participants. The average age of the participants was 28.4 ± 5.3 years and the average gestational age at the time of enrolment was 34.1 ± 2.7 weeks. The majority of women were multipara, from urban areas and had booked antenatal care.

Table 1

Baseline Demographic and Obstetric Profile

Variable		Frequency (%) / Mean ± SD
Maternal age (years)		28.4 ± 5.3
Gestational age (weeks)		34.1 ± 2.7
Weight (kg)		68.2 ± 8.4
Height (cm)		160.1 ± 6.2
BMI (kg/m^2)		26.5 ± 3.7
Parity	Primiparous	39 (41.5%)
	Multiparous	55 (58.5%)
Residence	Urban	57 (60.6%)
	Rural	37 (39.4%)
Antenatal Status	Booked	64 (68.1%)
	Unbooked	30 (31.9%)

The average hemoglobin level was 10.4 ± 1.3 g/dL. In this case-control study, 50% of the women were anemic while 50% were non-anemic. Of the anemic women, the most common anemia was moderate, followed by mild.

Table 2

Hemoglobin Status and Anemia Pattern

Variable		Frequency (%) / Mean ± SD
Hemoglobin level (g/dL)		10.4 ± 1.3
Study group	Anemic / Exposure group	47 (50.0%)
	Non-anemic / Non-exposure group	47 (50.0%)
Severity of anemia among total participants	Mild anemia	18 (19.1%)
	Moderate anemia	25 (26.6%)
	Severe anemia	4 (4.3%)
	Non-anemic	47 (50.0%)
Trimester at assessment	First trimester	18 (19.1%)
	Second trimester	34 (36.2%)
	Third trimester	42 (44.7%)

Iron deficiency was the most frequent risk factor and occurred in 32.0% of women, followed by urinary tract infection (29.8%). A significantly high number of women also had preterm labor in previous pregnancy and short inter-pregnancy interval.

Table 3

Maternal Risk Factors and Confounding Variables

Risk factor	Frequency (%)
Diabetes mellitus	18 (19.1%)
Hypertension	20 (21.3%)
Urinary tract infection	28 (29.8%)
Short interval pregnancy	22 (23.4%)
Previous preterm labor	18 (19.1%)
Polyhydramnios	12 (12.8%)
Iron deficiency	30 (32.0%)

The incidence of preterm birth was higher in anemic women, with 26 out of 47 cases (55.3%) in the anemic group and 14 out of 47 cases (29.8%) in the non-anemic group. This association was significant (p = 0.012). The relative risk was 1.86, and pregnant women with anemia were nearly twice as likely to experience preterm birth compared to non-anemic women.

Table 4

Association Between Maternal Anemia and Preterm Birth

Maternal anemia status	Preterm birth Yes	Preterm birth No	Total
Anemic / Exposure group	26 (55.3%)	21 (44.7%)	47 (100%)
Non-anemic / Non-exposure group	14 (29.8%)	33 (70.2%)	47 (100%)
Total	40 (42.6%)	54 (57.4%)	94 (100%)

Chi-square = 6.25, p-value = 0.012, Relative Risk = 1.86, 95% CI = 1.12–3.08

On stratified analysis, preterm delivery was relatively more prevalent among women with previously preterm labor, iron deficiency, urinary tract infection, polyhydramnios, and hypertension. This suggests that anemia may play a more significant role in preterm birth when combined with other maternal risk factors.

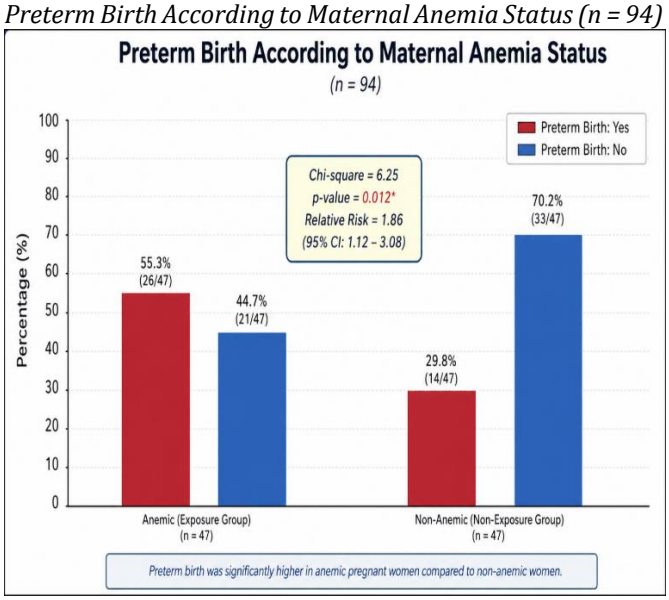
Table 5

Stratified Analysis of Preterm Birth by Maternal Risk Factors

Variable	Preterm birth n (%)	p-value
Diabetes mellitus	10 (55.6%)	0.082
Hypertension	12 (60.0%)	0.041
Urinary tract infection	16 (57.1%)	0.034
Short interval pregnancy	13 (59.1%)	0.048
Previous preterm labor	13 (72.2%)	0.010
Polyhydramnios	8 (66.7%)	0.037
Iron deficiency	19 (63.3%)	0.020

Figure 1

Preterm Birth According to Maternal Anemia Status (n = 94)



Bar chart illustrating the distribution of preterm birth among anemic and non-anemic pregnant women. The proportion of preterm birth was higher in the anemic group (55.3%) compared to the non-anemic group (29.8%). This difference was statistically significant (χ^2 = 6.25, p = 0.012), indicating a strong association between maternal anemia and increased risk of preterm delivery.

DISCUSSION

This study evaluated the association between maternal anemia and the risk of preterm birth among pregnant women. The findings demonstrated a significant relationship between anemia and preterm delivery, with anemic women showing a markedly higher proportion of preterm births compared to non-anemic women. The calculated relative risk further supports that maternal anemia nearly doubles the likelihood of preterm birth, highlighting its clinical importance as a modifiable risk factor (10-12).

The prevalence of preterm birth in our study (42.6%) is high compared to the global estimates in low- and middle-income countries. This could be due to the design of the study, which was conducted in a hospital, and the inclusion of several high-risk pregnancies. These findings are also consistent with recent studies in which anemia has been associated with poor pregnancy outcomes, including preterm birth. In a recent large-scale study, Kabir MA found that women with anemia were more likely to have preterm delivery, with an adjusted odds ratio of 2.03, which is in line with our results (7). Moderate anemia was the most common type of anemia in this study. Our observation is in agreement with recent studies, which suggest that moderate anemia is more likely to be observed in pregnant women from South Asia. It is suggested that even mild to moderate decreases of hemoglobin level can reduce oxygen delivery to the placenta causing placental insufficiency and subsequently, preterm labor. Research has demonstrated a higher risk of adverse maternal and fetal outcomes, including preterm birth, with higher severity of anemia (13-15).

The biological plausibility of the effect of maternal anemia on preterm birth is long known. Low hemoglobin concentration and oxygen-carrying capacity result in fetal hypoxia, which results in activation of stress pathways that may initiate preterm labor. Furthermore, anemia is frequently accompanied by malnutrition and inflammation, which also play a role in pregnancy complications. These pathways are corroborated in recent research that shows that maternal anemia changes placental vascularity and predisposes to intrauterine stress (16, 17).

Stratified analyses in this study also showed that preterm birth risk was further exacerbated in women with other maternal complications such as hypertension, urinary tract infection, iron deficiency and previous preterm labor. This highlights that maternal anemia does not operate in a vacuum, but in combination with other risk factors, to elevate the risk of poor outcomes. Such findings have also been made in recent cohort studies, where multiple maternal morbidities considerably elevated the risk of preterm delivery, compared to individual risk factors. (18-20)

The findings of this study are particularly relevant in the context of developing countries like Pakistan, where maternal anemia remains highly prevalent. Limited access to antenatal care, poor nutritional status, and delayed diagnosis contribute to the persistence of anemia during pregnancy. Early identification and management of anemia, along with proper antenatal monitoring, may significantly reduce the burden of preterm birth in such settings.

Despite its strengths, this study has certain limitations. Being a single-center study, the findings may not be generalizable to the broader population. The use of non-

probability consecutive sampling may also introduce selection bias. Additionally, although stratification was performed, residual confounding cannot be entirely excluded. Future multicenter studies with larger sample sizes and randomized designs are recommended to further validate these findings.

CONCLUSION

Maternal anemia is significantly associated with an increased risk of preterm birth. Pregnant women with anemia were found to have nearly twice the risk of delivering preterm compared to non-anemic women. The presence of additional maternal risk factors further amplifies this risk.

Early screening, timely diagnosis, and effective management of anemia during pregnancy are essential to reduce the incidence of preterm birth. Strengthening antenatal care services and implementing targeted nutritional interventions can play a crucial role in improving maternal and neonatal outcomes.

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