

FREQUENCY OF ANEMIA AMONG PREGNANT WOMEN AND ITS IMPACT ON MATERNAL AND FETAL HEALTH

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ABSTRACT

Objective: To determine the frequency of anemia among pregnant women presenting at a tertiary care hospital and to assess its association with fetomaternal outcomes. **Study Design:** Descriptive, Cross-sectional study. **Setting:** Department of Obstetrics & Gynaecology, Jinnah Post-graduate Medical Center, Karachi. **Period:** Four months from January 2026 to April 2026. **Methods:** A sample of 237 pregnant patients aged between 15 and 49 years with a gestational age of 28 weeks or more and admitted for labor and delivery was obtained through a consecutive sampling technique. Women with a history of multiple gestation pregnancies, chronic diabetes and/or hypertension, chronic liver and/or renal disease, and chronic thyroid disease were excluded from the study. The admission hemoglobin was checked, and anemia was labeled with hemoglobin less than 11 g/dL based on WHO criteria. Each participant of the study was followed till discharge for the outcomes of preterm birth, postpartum hemorrhage, perineal rupture, low birth weight, a poor APGAR score, NICU admission, stillbirth, neonatal death, and maternal death. The data was analyzed using SPSS version 26. For categorical comparisons, the Chi-square or the Fisher's Exact Test was used, while the Mann-Whitney U test was used for continuous variables. To obtain the odds ratios with 95% confidence intervals, the binary logistic regression was used. A p-value less than or equal to 0.05 was considered statistically significant. **Results:** The mean age of participants was 28.91 ± 6.61 years and mean hemoglobin was 10.33 ± 1.21 g/dL. Anemia was identified in 160 (67.5%) women. Anemic women had significantly higher odds of NICU admission (OR 6.54, 95% CI 3.14–13.60, $p < 0.001$), poor APGAR score (OR 5.05, 95% CI 2.58–9.88, $p < 0.001$), postpartum hemorrhage (OR 3.54, 95% CI 1.64–7.64, $p = 0.001$), preterm birth (OR 2.82, 95% CI 1.50–5.31, $p = 0.001$) and perineal tear (OR 2.24, 95% CI 1.21–4.15, $p = 0.010$). No statistically significant association was observed for low birth weight, stillbirth or neonatal mortality, and there were no maternal deaths. **Conclusion:** Anemia during pregnancy was very common in this sample and was significantly associated with poor outcomes for both the mother and fetus. In particular, NICU admission, lower APGAR score, postpartum hemorrhage, preterm birth, and perineal tear were all common in this group. A better iron-rich diet during pregnancy.

KEYWORDS: Anemia, Feto-maternal Outcome, Hemoglobin, Iron Deficiency, Pregnancy.

INTRODUCTION

Anemia during pregnancy represents a troubling lack of sufficient nutrition for pregnant women and leads to a high incidence of morbidity and mortality among women and babies in low and middle-income countries. The World Health Organization sets the threshold for the diagnosis of pregnancy anemia at a hemoglobin concentration of less than 11 g/dL.¹ The WHO's global estimates on anemia, in 2025, predicted that 35.5% of women in the 15 - 49 year demographic were anemic, with the highest concentrations found in South Asia and sub-Saharan Africa.^{2,3} The primary cause is a lack of iron. In low-resource settings, the contribution of folate, vitamin B12, malaria, and other chronic diseases and hemoglobinopathies cannot be underestimated.

As the baby grows, so does the mass of the mother's placental and fetal structures and red blood cells. If this increase in demand is not fulfilled with dietary or supplemental iron, anemia will be the consequence.⁴ The most recent systematic review and meta-analysis estimated the substantial impacts of maternal anemia on pregnancy and infant outcomes: postpartum hemorrhage (RR 2.76), preterm birth (RR 1.51), low birth weight (RR 1.40), and increased risk of cesarean section delivery (RR 1.33) and gestational hypertension and neonatal asphyxia.⁵ Other studies in Nigeria, Somalia, Ethiopia, and India have shown that pregnancy anemia is a risk factor for hemorrhage in the peripartum period and adverse neonatal outcomes with a need for NICU care.⁶⁻⁹ Within Pakistan, studies from hospitals have shown pregnant women presenting with anemia from 70.9% to 91.4% of the cases,¹⁰⁻¹² and document the unabated severity in low-resource countries, with the highest severity of anemia among low socioeconomic, multigravida, and un-booked populations.

Although this gives a general overview, information specific to Balochistan is often lacking. The population served by Jinnah Post-graduate Medical Center, Karachi is characterized by a unique combination of extreme poverty, illiteracy, and inadequate provision of antenatal care. Most of the literature that is available is limited to estimating the prevalence of a condition and is not thorough in the assessment of feto-maternal outcomes. This study was designed to determine the prevalence of anemia in pregnant women who attended our tertiary care hospital and the association between maternal anemia and fetal-maternal outcomes. It was hoped that this would generate some evidence that would help to design more appropriate antenatal care to reduce the prevalence of anemia and improve maternal and fetal outcomes in the region.

METHODS

Study Design: Descriptive, cross-sectional study.

Setting: Department of Obstetrics & Gynaecology, Jinnah Post-graduate Medical Center, Karachi.

Duration: Four months from January 2026 to April 2026

Sample Size: A sample size of 237 was calculated using the WHO sample size calculator, with an expected frequency of anemia among pregnant women of 19%,¹³ margin of error 5% and confidence level 95%.

Sampling Technique: Non-probability consecutive sampling.

Inclusion Criteria: Pregnant women aged 15–49 years with gestational age greater than 28 weeks admitted for delivery in the labor room, both booked and un-booked.

Exclusion Criteria: Women with multiple gestation (because of higher physiological demand on iron stores and inherent obstetric risk), thyroid dysfunction, chronic liver or renal disease, and known chronic diabetes or hypertension were excluded, as these conditions could independently confound anemia status and pregnancy outcomes.

Data Collection Procedure: After obtaining ethical approval from the institutional ethical review committee and acquiring written consent from participants, demographic and clinical details were recorded using a structured pro-forma. This included age, residence, education, family monthly income, height and weight (from which BMI was calculated), parity, gravidity, gestational age, and booking status. Upon admission, five milliliters of blood were drawn for hemoglobin estimation. Following the WHO criteria, the assessment of anemia is considered present when hemoglobin is less than 11 g/dL.¹ All participants were followed from admission until delivery and discharge to capture feto-maternal outcomes which included the incidence of: preterm birth (defined as delivery before 37 completed weeks); postpartum hemorrhage (PHH; defined as a total blood loss of 500 mL after a vaginal delivery, and a total blood loss of 1,000 mL after a cesarean section, within 24 hours); and perineal tear; as well as the assessment of maternal mortality, low birth weight (LBW) (which was defined as a weight of less than 2.5 kg), a poor APGAR score (which was defined as a score of less than 7 at 5 minutes), NICU admission, stillbirth, and neonatal mortality which was assessed within a timeframe of 28 days or discharge, whichever was earlier.

Data / Statistical Analysis: Data collection and preliminary analysis were conducted using SPSS version 26. Neonatal variables were analyzed according to categories, i.e., mean $\pm$ SD for continuous variables and frequency and percentage for categorical variables. Proportions for anemic and non-anemic women were compared using the Chi-square test (or Fisher's exact test if expected counts were < 5). The Mann–Whitney U test was used to compare continuous neonatal variables. An association between anemia and each of the lethal and non-lethal feto-maternal outcomes was evaluated by estimating the odds and performing binary logistic regression for outcomes, with 95% confidence intervals (CI). The threshold for statistical significance was defined as a P-value ≤ 0.05 .

Ethical Approval: Approval was obtained from the Institutional Ethical Review Committee of Jinnah Post-graduate Medical Center, Karachi. The synopsis was also approved by the Research Evaluation Unit of the College of Physicians and Surgeons Pakistan (RTMC No. OBG-2022-001-11899).

RESULTS

A total of 237 pregnant women fulfilling the inclusion criteria were enrolled during the study period. The mean age of the study population was 28.91 ± 6.61 years (range 17–45 years) and the mean family monthly income was $38,329 \pm 17,148$ PKR. More than half of the participants (53.6%) belonged to a rural background, 19.4% were illiterate, and 55.7% were un-booked. The mean gestational age at admission was 36.54 ± 2.84 weeks. Normal vaginal delivery, instrumental delivery and caesarean section were performed in 109 (46.0%), 22 (9.3%) and 106 (44.7%) women respectively. The baseline demographic and clinical characteristics of the study population are summarized in Table-I.

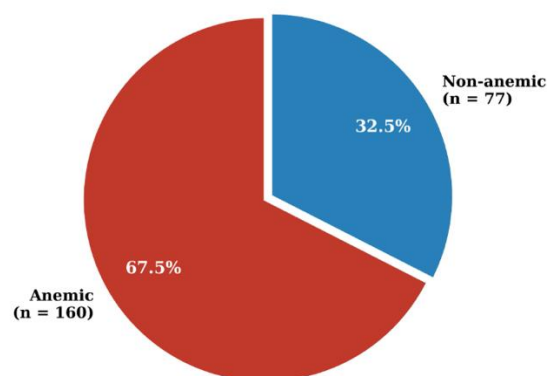
Table-I: Baseline demographic and clinical characteristics of the study population (n = 237).

Variable	Category / Statistic	Value (n = 237)
Age (years)	Mean $\pm$ SD	28.91 ± 6.61
Residence	Urban	110 (46.4%)
	Rural	127 (53.6%)

Variable	Category / Statistic	Value (n = 237)
Education	Illiterate	46 (19.4%)
	Primary	43 (18.1%)
	Secondary	41 (17.3%)
	Matric	40 (16.9%)
	Intermediate	42 (17.7%)
	Graduate / Higher	25 (10.5%)
Family income (PKR/month)	Mean $\pm$ SD	38,329 $\pm$ 17,148
Booking status	Booked	105 (44.3%)
	Un-booked	132 (55.7%)
Gestational age (weeks)	Mean $\pm$ SD	36.54 $\pm$ 2.84
Gravidity	Mean $\pm$ SD	3.39 $\pm$ 1.54
Parity	Mean $\pm$ SD	2.00 $\pm$ 1.36
Height (cm)	Mean $\pm$ SD	158.47 $\pm$ 6.92
Weight (kg)	Mean $\pm$ SD	60.17 $\pm$ 10.66
BMI (kg/m ²)	Mean $\pm$ SD	23.96 $\pm$ 4.00
Hemoglobin (g/dL)	Mean $\pm$ SD	10.33 $\pm$ 1.21
Mode of delivery	Normal vaginal	109 (46.0%)
	Instrumental	22 (9.3%)
	Caesarean section	106 (44.7%)

The mean hemoglobin level was 10.33 $\pm$ 1.21 g/dL (range 8.0 – 12.4 g/dL). Anemia (Hb < 11 g/dL) was identified in 160 (67.5%) of 237 pregnant women, while 77 (32.5%) had a normal hemoglobin concentration (Figure-1).

Figure-1: Distribution of anemia status among pregnant women (n = 237).



Bivariate analysis demonstrated that anemia was significantly associated with preterm birth (42.5% vs 20.8%, $\chi^2 = 10.72$, $p = 0.001$), postpartum hemorrhage (31.9% vs 11.7%, $\chi^2 = 11.20$, $p = 0.001$), perineal tear (40.6% vs 23.4%, $\chi^2 = 6.80$, $p = 0.009$), poor APGAR score at 5 minutes (50.6% vs 16.9%, $\chi^2 = 24.73$, $p < 0.001$) and NICU admission (49.4% vs 13.0%, $\chi^2 = 29.35$, $p < 0.001$). Low birth weight (43.8% vs 35.1%, $p = 0.203$), stillbirth (0.6% vs 3.9%, Fisher $p = 0.102$) and neonatal mortality (1.9% vs 2.6%, Fisher $p = 0.661$) did not differ significantly between the two groups, and there were no maternal deaths in either group (Table-II). The frequency of anemia did not differ significantly across modes of delivery (NVD 63.3%, instrumental 68.2%, caesarean 71.7%; $\chi^2 = 1.73$, $p = 0.421$).

Table-II: Feto-maternal outcomes by anemia status (n = 237).

Outcome	Anemic (n = 160)	Non-anemic (n = 77)	χ^2	p-value
Preterm birth	68 (42.5%)	16 (20.8%)	10.72	0.001
Postpartum hemorrhage	51 (31.9%)	9 (11.7%)	11.20	0.001
Perineal tear	65 (40.6%)	18 (23.4%)	6.80	0.009
Low birth weight	70 (43.8%)	27 (35.1%)	1.62	0.203
Poor APGAR (<7)	81 (50.6%)	13 (16.9%)	24.73	<0.001
NICU admission	79 (49.4%)	10 (13.0%)	29.35	<0.001
Stillbirth	1 (0.6%)	3 (3.9%)	Fisher	0.102
Neonatal mortality	3 (1.9%)	2 (2.6%)	Fisher	0.661
Maternal mortality	0 (0%)	0 (0%)	—	—

χ^2 = Pearson Chi-square; Fisher = Fisher exact test (used when expected cell counts < 5).

Mann–Whitney U analysis of continuous neonatal outcomes showed that mean birth weight did not differ significantly between the groups (2.52 ± 0.42 kg in anemic vs 2.58 ± 0.41 kg in non-anemic women; $p = 0.252$). However, both APGAR scores at 1 minute (6.18 ± 1.49 vs 7.21 ± 1.45 ; $p < 0.001$) and at 5 minutes (7.34 ± 1.47 vs 8.35 ± 1.27 ; $p < 0.001$) were significantly lower among neonates of anemic mothers (Table-III).

Table-III: Continuous neonatal outcomes by anemia status (Mann–Whitney U test).

Variable	Anemic (Mean $\pm$ SD)	Non-anemic (Mean $\pm$ SD)	Mann–Whitney U p-value
Birth weight (kg)	2.52 ± 0.42	2.58 ± 0.41	0.252
APGAR at 1 min	6.18 ± 1.49	7.21 ± 1.45	<0.001
APGAR at 5 min	7.34 ± 1.47	8.35 ± 1.27	<0.001

Binary logistic regression was performed to estimate the magnitude of association between anemia and each binary feto-maternal outcome. The risk of NICU admission was approximately six and a half times higher in anemic women (OR 6.54, 95% CI 3.14 – 13.60, $p < 0.001$), followed by poor APGAR score (OR 5.05, 95% CI 2.58 – 9.88, $p < 0.001$), postpartum hemorrhage (OR 3.54, 95% CI 1.64 – 7.64, $p = 0.001$), preterm birth (OR 2.82, 95% CI 1.50 – 5.31, $p = 0.001$) and perineal tear (OR 2.24, 95% CI 1.21 – 4.15, $p = 0.010$). Low birth weight, stillbirth and neonatal mortality were not significantly associated with anemia (Table-IV).

Table-IV: Binary logistic regression — odds ratios for feto-maternal outcomes associated with anemia.

Outcome	Odds Ratio	95% CI	p-value
Preterm birth	2.82	1.50 – 5.31	0.001
Postpartum hemorrhage	3.54	1.64 – 7.64	0.001

Outcome	Odds Ratio	95% CI	p-value
Perineal tear	2.24	1.21 – 4.15	0.010
Low birth weight	1.44	0.82 – 2.53	0.204
Poor APGAR score (<7)	5.05	2.58 – 9.88	<0.001
NICU admission	6.54	3.14 – 13.60	<0.001
Stillbirth	0.16	0.02 – 1.52	0.109
Neonatal mortality	0.72	0.12 – 4.38	0.717

OR = Odds Ratio; CI = Confidence Interval. Odds ratios calculated with non-anemic as the reference group.

DISCUSSION

Anemia and its effects on maternal and neonatal health remain a prominent concern in both the field of obstetrics and global health. In this study and in the selected population, we identified anemia in 67.5% of women who were about to deliver, and we identified a significant association of anemia with a higher risk of NICU admission, a lower APGAR score, postpartum hemorrhage, preterm labor, and perineal tears.

Our study reported a significantly higher prevalence of anemia than the global prevalence of 35.5% reported in the 2025 WHO Anemia Estimates.² The prevalence of anemia in our study was higher than the reported 42.7% prevalence for the lower and middle-income countries reported by Rahman et al.¹⁴ However, the numbers were consistent with the anemia prevalence reported in other studies conducted in Pakistan. In a 2024 study by Tabassum et al., 91.4% of pregnant women in Hayatabad Medical Complex, Peshawar, were reported to be anemic,¹⁰ while Ashraf et al. (2024) reported anemia in 71.5% of 397 women of reproductive age at Jinnah Postgraduate Medical Centre, Karachi.¹¹ A multicenter study that included Quetta identified a high prevalence of anemia in pregnancy in all four provinces of Pakistan.¹⁵ The combination of a low socioeconomic status, with an average monthly family income of approximately 38,000 PKR, high illiteracy rates, large families with high parity, poor utilization of antenatal care services (un-booked 55.7%), and a culturally low heme iron diet, may explain the high prevalence of anemia in our study.

Compared to non-anemic women, women with anemia in our cohort had 3.5 times the odds of postpartum hemorrhage. This mirrors the findings of the WOMAN-2 trial, where moderate to severe anemia was shown to be an independent risk factor for PPH.¹⁶ This finding was also reported in the Predict-PPH study in Lagos, where prenatal anemia had an odds ratio for the prediction of PPH of 1.37 (adjusted odds ratio).⁷ Prepartum anemia was also shown to be a significant risk factor for PPH in the Glonnegger et al. meta-analysis.¹⁷ Decreased contractility of the uterus and the risk of atonic PPH are due to the anemia's reduced oxygen-carrying capacity and the accompanying tissue hypoxia. Anemic women also require a higher likelihood of blood transfusion and a higher likelihood of being cared for in high-dependency obstetric units.

Anemia and its association with preterm birth are reflected in the international literature. The reported odds ratio of preterm birth in anemic women in the current study was 2.8, and is broadly in keeping with the reported pooled relative risk of 1.51 to 1.63 in recent global and African meta-analyses.^{5,8,14} In a study by Räisänen et al., which included over 18 million pregnancies, moderate to severe anemia was associated with placental-related morbidity, preterm birth, and severe PPH.¹⁸ It has been proposed that placental anemia and the subsequent hypoxia, along with increased secretion of the stress hormone corticotropin-releasing hormone, may induce early labor as a result of an oxidative stress cascade.

While prior literature reports a significant association between maternal anemia and low birth weight, our study found no significant difference (43.8% vs 35.1%, $p = 0.203$; OR 1.44, 95% CI 0.82 – 2.53). One possible explanation is that the LBW rate was overall high in both groups (40.9% of the cohort), likely due to other associated factors of maternal undernutrition, undiagnosed hypertensive disorders, and intrauterine growth restriction. This perhaps decreased the relative difference between the groups. No woman in our sample also had severe anemia (Hb < 7 g/dL). Severe anemia is the most studied and is associated with the strongest links with fetal growth restriction.¹⁹

The strong associations we observed between anemia and poor APGAR score (OR 5.05) and NICU admission (OR 6.54) are particularly noteworthy. In our study, the APGAR scores of newborns who were born to anemic mothers were low at both the 1 and 5 minutes, and showed early adaptive compromise. Considering that low hemoglobin at admission in a recent retrospective cohort from Northwest Women's and Children's Hospital in China predicted NICU admission and poor neonatal outcomes,²⁰ and that second-trimester anemia in a Romanian tertiary-center cohort predicted NICU admission,²¹ these outcomes are in agreement with our study. Maternal anemia leads to poor oxygen delivery from the placenta and fetal hypoxia, low APGAR scores, and a greater need for neonatal resuscitation, which in turn results in a greater rate of NICU admissions.

Zero maternal deaths were observed in our cohort. In comparison, studies on sub-Saharan Africa report maternal deaths caused by anemia.^{14,22} Considering that our subjects had no severe anemia, had relatively short hospital stay periods, and had access to obstetric services at a tertiary care center, this outcome is as expected. The low

total number of stillbirths (n = 4) and neonatal deaths (n = 5) meant that we were unable to sufficiently analyze these outcomes. Therefore, we believe that the stillbirth OR (0.16) represents the small number of observed events and should not be interpreted as an indication of anemia having a protective effect.

The strengths of this study include the consecutive enrollment of 237 women, the application of WHO-defined diagnostic criteria for anemia, and the prospective evaluation of clear fetomaternal outcomes within one obstetric unit, thus reducing information bias. Our results stress that antenatal care should include screening for anemia, and that folic acid and iron should be initiated as early as possible, along with dietary counseling and treatment of the underlying factors, such as malaria and intestinal parasites, as applicable.^{23,24} Some limitations are also present. The first one is the single-center design from a tertiary care unit that may pose a challenge to its applicability to community-based settings. The second one is that hemoglobin estimation upon admission does not differentiate between iron-deficiency anemia and thalassemia trait, which is common in our area, as serum ferritin and peripheral smears were not done routinely. The third one is that stillbirth and neonatal death were too low to estimate any association with anemia. The fourth one is that only unadjusted associations were analyzed, and adjusting for obstetric and socio-demographic covariates is recommended for future studies. The fifth one is the study's cross-sectional design, which does not allow for the establishment of causation. To advance these findings and promote region-specific antenatal care strategies, further multicenter studies with serum iron concentration assessments and prospective studies with a wider range of severity classifications are warranted.

CONCLUSION

Anemia was diagnosed in more than two-thirds of pregnant women who came to our tertiary care hospital. Such patients had a higher risk of NICU admissions along with poor APGAR scores, postpartum hemorrhage, preterm births, and perineal tears. We recommend timely iron-folate supplementation and increased utilization of antenatal care services to reduce the burden of anemia-related fetomaternal morbidity in this population.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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