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IMPACT OF ANEMIA ON MATERNAL AND FETAL HEALTH OUTCOMES IN LAHORE, PAKISTAN

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Abstract

Background: Maternal anemia is a major public health problem in Pakistan, with estimated prevalence of 50–75% among pregnant women. Despite its recognized clinical significance, evidence on the specific magnitude of its association with adverse fetal outcomes in urban Pakistani settings remains limited. Methods: A hospital-based cross-sectional study was conducted in Lahore, Pakistan. One hundred (100) pregnant women were enrolled from a specialized gynecology unit. Anemia was defined as hemoglobin (Hb) <11.0 g/dL. Fetal outcomes preterm birth (<37 weeks gestation) and low birth weight (LBW; <2.5 kg) and maternal complications were assessed. Chi-square tests, Spearman rank correlations, binary logistic regression, and multiple linear regression were performed using SPSS v27. Results: Anemia prevalence was 65% (mean Hb = 10.18 g/dL). All 42 preterm births (100%) occurred exclusively in anemic women ($\chi^2 = 38.992$, $p < .001$; Cramer's $V = .624$). Similarly, all 52 LBW cases (100%) were confined to the anemic group ($\chi^2 = 58.333$, $p < .001$; Cramer's $V = .764$). Hemoglobin was positively correlated with birth weight ($r_s = .651$, $p < .001$) and gestational age ($r_s = .575$, $p < .001$). Anemia status was the strongest predictor of birth weight ($\beta = .749$, $p < .001$; $R^2 = .639$). No significant association was found between anemia and maternal complications ($p = .928$). Conclusion: Maternal anemia demonstrates a powerful, near-exclusive association with preterm birth and low birth weight in this Lahore cohort. These findings underline the urgent need for universal antenatal hemoglobin screening, iron supplementation, and nutritional counselling as cornerstones of maternal care in Pakistan.

1. INTRODUCTION

Anemia in pregnancy defined by the World Health Organization (WHO) as a hemoglobin concentration below 11.0 g/dL in the first trimester and below 10.5 g/dL in the second and third trimesters remains one of the most prevalent nutritional disorders globally, affecting an estimated 40% of pregnant women worldwide (WHO, 2023). The burden is disproportionately concentrated in low- and middle-income countries (LMICs), with South Asia and sub-Saharan Africa bearing the highest prevalence. In Pakistan, estimates range from 50% to 75% among pregnant women, driven by iron deficiency, poor dietary diversity, closely-spaced pregnancies, limited antenatal care access, and widespread socioeconomic deprivation (Kamran et al., 2019; NIPS, 2019).

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During pregnancy, plasma volume expands by 40–50% while red cell mass increases by only 30%, producing a relative hemodilution that lowers hemoglobin concentration. This physiological adaptation, when compounded by insufficient iron or folate intake, results in true anemia that impairs oxygen delivery to both maternal tissues and the developing fetus. Pathophysiologically, reduced uteroplacental perfusion triggers fetal hypoxia, intrauterine growth restriction (IUGR), and activation of the hypothalamic-pituitary-adrenal axis mechanisms collectively linked to preterm labour and reduced fetal growth (Levy et al., 2005; Nair et al., 2016). Despite a robust global literature, evidence on the precise magnitude of anemia's impact on fetal outcomes in urban Pakistani populations remains sparse. The present study was therefore designed to quantify the associations between maternal anemia and adverse pregnancy outcomes specifically preterm birth (PTB), low birth weight (LBW), and maternal complications—in a hospital-based cohort in Lahore, Pakistan.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

A hospital-based cross-sectional study was conducted at a specialized gynecology unit in Lahore, Pakistan, equipped with iron supplementation, dietary counselling, blood transfusion capacity, and folate and vitamin B12 therapy. Data were collected over a three-month period following institutional approval.

2.2 Participants

Eligible participants were pregnant women aged 18–45 years with singleton pregnancies presenting with clinical signs of reduced hemoglobin. Women with chronic systemic diseases (renal, hepatic, or cardiac) or multiple gestations were excluded. The required sample size was calculated as $N \approx 87$ using the formula $N = [Z^2 \times p(1-p)] / E^2$, assuming 35% anemia prevalence (p), 95% confidence ($Z = 1.96$), and 10% margin of error; 100 participants were ultimately enrolled to account for attrition.

2.4 Statistical Analysis

All analyses were performed in SPSS v27. Categorical associations were examined using chi-square tests with Cramer's V effect sizes. Normality was assessed via the Shapiro-Wilk test; non-parametric Spearman's rho correlations were applied given confirmed non-normality across all continuous variables ($p < .05$). Binary logistic regression (Enter method) and multiple linear regression were used to examine predictors of fetal outcomes. A significance threshold of $\alpha = .05$ was applied throughout.

3. RESULTS

3.1 Descriptive analysis

Table 3.1

Descriptive statistics are presented in Table 1.

Variable	Mean	SD	Minimum	Maximum
Maternal Age (years)	28.66	6.39	18	39
Hemoglobin (g/dL)	10.18	1.77	7.00	13.50
Gestational Age (weeks)	36.79	1.94	34	40
Birth Weight (kg)	2.57	0.51	1.82	3.76

Descriptive statistics for continuous variables (N = 100).

The study included 100 pregnant women with a mean age of 28.66 years (SD = 6.39). The average hemoglobin concentration was 10.18 g/dL, which falls below the WHO threshold of 11 g/dL for pregnancy, indicating a high burden of anemia among participants.

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Table 3.2

Frequency Distribution of Maternal and Fetal Outcomes

Variable	Category	n	%
Anemia Status	Anemic	65	65.0
	Non-anemic	35	35.0
Preterm Birth	Yes	42	42.0
	No	58	58.0
Low Birth Weight	Yes	52	52.0
	No	48	48.0
Maternal Complications	Yes	32	32.0
	No	68	68.0

Note. Percentages are based on N = 100.

Hemoglobin as a Continuous Predictor

Table 3.3

Spearman Correlation Matrix for Hemoglobin, Birth Weight, and Gestational Age

Variable	1	2	3
1. Hemoglobin (g/dL)	—	.651**	.575**
2. Birth Weight (kg)	.651**	—	.608**
3. Gestational Age (weeks)	.575**	.608**	—

Note. $p < .01$.

Maternal hemoglobin level showed a significant positive correlation with birth weight ($r_s = .651$, $p < .001$) and gestational age ($r_s = .575$, $p < .001$). These findings indicate that higher maternal hemoglobin levels are associated with heavier newborns and longer gestational duration. Birth weight was also positively correlated with gestational age ($r_s = .608$, $p < .001$).

3.4 Anemia and Low Birth Weight

Table 3.4

Outcome	Anemic n=65	Non-Anemic n=35	χ^2	p-value	Cramer's V
Preterm Birth	42 (64.6%)	0 (0.0%)	38.992	< .001***	.624
Low Birth Weight	52 (80.0%)	0 (0.0%)	58.333	< .001***	.764
Maternal Complications	21 (32.3%)	11 (31.4%)	.008	.928 (ns)	.009

*Table 2. Chi-square results for anemia status by outcome variable. *** $p < .001$; ns = not significant.*

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Table 3.5

Multiple Linear Regression Predicting Birth Weight

Predictor	B	SE	β	t	P
Hemoglobin (g/dL)	.005	.032	.017	0.154	.878
Gestational Age (weeks)	.013	.024	.049	0.546	.586
Anemia Status	.796	.140	.749	5.685	< .001

Note: $R^2 = .639$, *Adjusted* $R^2 = .627$, $F(3, 96) = 56.58$, $p < .001$.

4. DISCUSSION

This study documents a strikingly high anemia prevalence (65%) among pregnant women in Lahore consistent with national estimates of 50–75% and reveals a powerful, near-exclusive association between anemia and the two most clinically consequential fetal outcomes: preterm birth and low birth weight. The magnitude of association, characterized by complete absence of PTB and LBW in non- anemic women and effect sizes of Cramer's V = .624 and .764 respectively, places this study among the more compelling single-site demonstrations of anemia's fetal consequences in South Asia.

The biological plausibility of these associations is well-established. Maternal anemia impairs placental oxygen transfer, triggering fetal hypoxia, IUGR, and activation of stress hormones that precipitate preterm labour (Levy et al., 2005). Iron deficiency further reduces oxygen-carrying capacity of maternal blood, limiting glucose and amino acid delivery to the fetus, manifesting as reduced neonatal birth weight (Steer, 2000; Brabin et al., 2001). Our Spearman correlation findings (rs = .651 for Hb–birth weight) support a dose-response relationship, suggesting that hemoglobin level should be considered not merely as a binary screening threshold but as a continuous marker of fetal risk. The null association between anemia and composite maternal complications is consistent with prior reports (Scholl, 2005) and likely reflects the heterogeneous, multi-aetiology nature of the composite variable used. Anemia's maternal effects such as postpartum hemorrhage or peripartum cardiomyopathy are more reliably detected when outcomes are disaggregated by specific condition rather than pooled (van den Broek, 2003).

The cross-sectional design limits causal inference, and the complete predictor-outcome separation while clinically meaningful constrained logistic regression convergence. Larger prospective studies with repeated hemoglobin measurements and disaggregated outcome variables are warranted. Nonetheless, the consistency of our findings with existing Pakistani (Ahmad et al., 2021; Lone et al., 2004) and international evidence strengthens confidence in the observed associations.

5. CONCLUSION

Maternal anemia is highly prevalent and powerfully associated with preterm birth and low birth weight among pregnant women in Lahore. These findings provide compelling evidence for universal antenatal hemoglobin screening, early and sustained iron supplementation, and structured nutritional counselling as essential components of maternal care in Pakistan. Health policy must prioritize integrated, community-level anemia prevention programs especially targeting adolescent girls and women of reproductive age to reduce the burden of adverse birth outcomes in this high-risk population.

Limitations

- The cross-sectional study design limits the ability to establish causal relationships between maternal anemia and adverse pregnancy outcomes.
- The relatively small sample size (N = 100) may have reduced statistical power and limited adjustment for important confounding variables such as socioeconomic status, dietary intake, parity, and antenatal care utilization.
- Complete separation in the logistic regression models for preterm birth and low birth weight prevented stable parameter estimation, although

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chi-square analyses provided strong evidence of significant associations.

Suggestions

- Public health awareness campaigns should be implemented to educate women about the risks of anemia during pregnancy and the importance of early antenatal care.
- Healthcare providers should establish targeted monitoring and follow-up strategies for anemic mothers to reduce adverse fetal outcomes.
- Government and healthcare authorities should improve access to maternal nutrition programs, particularly among low-income and high-risk populations

REFERENCES

Ahmad, M. O., Luqman, M., Shafique, S., & Pasha, A. (2021). Prevalence of iron deficiency anemia and its association with adverse birth outcomes in Karachi. Pakistan Journal of Medical and Health Sciences, 15(4), 912–917.

Brabin, B. J., Hakimi, M., & Pelletier, D. (2001). An analysis of anemia and pregnancy-related maternal mortality. Journal of Nutrition, 131(2 Suppl.), 604S–615S.

Harrison, R. K., et al. (2021). Maternal anemia and severe maternal morbidity in a US cohort. American Journal of Obstetrics & Gynecology MFM, 3(5), 100395.

Kamran, S., Khan, M. A., & Rasool, S. (2019). Maternal anemia and its determinants among pregnant women in Lahore, Punjab. Journal of Ayub Medical College Abbottabad, 31(2), 214–218.

Levy, A., Fraser, D., Katz, M., Mazor, M., & Sheiner, E. (2005). Maternal anemia during pregnancy is an independent risk factor for low birthweight and preterm delivery. European Journal of Obstetrics & Gynecology and Reproductive Biology, 122(2), 182–186.

Lone, F. W., Qureshi, R. N., & Emanuel, F. (2004). Maternal anemia and its impact on perinatal outcome in a tertiary care hospital in Pakistan. Eastern Mediterranean Health Journal, 10(6), 801–807.