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Association between Iron Supplementation and Anemia among Pregnant and Postpartum Women in Pakistan: A Secondary Analysis of PDHS 2017–18

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ABSTRACT

IDA and VAD during pregnancy and postpartum are important public health problems contributing to maternal and neonatal morbidity in LMICs. Coverage of supplementation is not consistent, and monitoring of uptake remains limited in developing countries despite WHO recommendations. **Objectives:** To determine the prevalence of anemia and its association with iron supplementation. **Methods:** A cross-sectional study was conducted on 100 pregnant and postpartum women using PDHS 2017–18 data. Anemia was considered hemoglobin < 11.0 g/dL. Iron supplementation uptake, postpartum Vitamin A supplementation, and 24-hour dietary recall data were obtained. Chi-square tests, independent-samples t-tests, and multivariate logistic regression were performed, with reporting of risk ratios (RR) and odds ratios (OR) with 95% confidence intervals. **Results:** The prevalence of anemia was 46%. Iron supplementation was received by 53% of women, and anemia was considerably higher among non-users (88.9%) compared with users (7.8%), with a significant association observed ($p<0.001$). Dietary diversity was also low, with only 31% consuming dark leafy green vegetables and 33% consuming Vitamin A-rich foods within the previous 24 hours. Iron supplementation remained significantly associated with lower odds of anemia in multivariate regression (OR = 0.03 $p=0.015$). **Conclusions:** Maternal anemia remains common despite the observed association between iron supplementation and lower anemia frequency. Strengthening supplementation delivery monitoring systems and community nutrition education may help address micronutrient deficiencies among pregnant and postpartum women.

INTRODUCTION

In low- and middle-income countries (LMICs), iron deficiency anemia (IDA) and Vitamin A deficiency (VAD) remain important causes of maternal and newborn morbidity during pregnancy and the postpartum period. In 2019, anemia was estimated to affect 47.4% of pregnant women in sub-Saharan Africa and 35.7% in South Asia [1]. Iron deficiency during pregnancy has been associated with low birth weight, adverse pregnancy outcomes, and maternal morbidity [2]. VAD further contributes to these risks because of its effects on immune function, night blindness in pregnant women, and reduced transfer of retinol to the fetus and breastfeeding infant [3]. WHO recommends high-dose Vitamin A supplementation (200,000 IU) after delivery and oral iron and folic acid supplementation (IFAS) during pregnancy to address these deficiencies [4]. The benefits of these interventions are well supported. Daily iron supplementation has been shown to reduce the incidence of anemia at term compared with no iron supplementation, while nutrition education delivered alongside IFAS has been associated with

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improved compliance, hemoglobin levels, and reduced risk of anemia [1, 2]. Despite this evidence, supplementation coverage in real-world settings remains inconsistent. Previous studies have reported that only 28.7% of pregnant women followed IFAS for the recommended period of 90 days [5], while population-level data on postpartum Vitamin A supplementation coverage among mothers in developing countries remain limited and are not regularly monitored [3, 6]. In addition to supplementation gaps, poor dietary diversity further contributes to this problem, with less than half of pregnant women in high-burden areas consuming iron-rich and Vitamin A-rich foods [4, 7].

Despite increasing interest in maternal nutrition, important research gaps remain at the programmatic level. Previous studies have mainly focused on supplementation coverage or dietary intake separately, while limited evidence is available regarding the association between iron supplementation, anemia outcomes, and postpartum Vitamin A coverage within the same population. In many resource-constrained settings, multivariate analysis controlling for potential confounding factors such as age, wealth, and diet also remains limited. This study therefore addresses the issue of iron deficiency anemia (IDA) and Vitamin A deficiency (VAD) during pregnancy and postpartum, which continue to be inadequately monitored in developing countries. To address this gap, the present study aimed to determine the frequency of anemia and its association with uptake of iron supplementation, assess postpartum Vitamin A supplementation coverage, assess dietary intake of iron- and Vitamin A-rich food groups, and identify independent predictors of anemia through multivariate logistic regression to generate evidence for policy and programmatic improvements

METHODS

This cross-sectional analytical study used secondary data obtained from the Pakistan Demographic and Health Survey (PDHS) 2017–18, a nationally representative household survey conducted by the National Institute of Population Studies (NIPS), Islamabad, in collaboration with ICF International. The analysis of data was done from December 2025 to February 2026. The study was conducted in all four provinces of Pakistan (Punjab, Sindh, Khyber Pakhtunkhwa, and Balochistan) as well as Islamabad Capital Territory (ICT) from November 2017 to April 2018. The PDHS used a two-stage cluster sampling design with probability proportional to size (PPS) sampling of enumeration areas followed by systematic sampling of households within each cluster. A subsample of 100 women aged 15–49 years who had a live birth within five years before the survey and had complete data on study variables was included in the present analysis. Using the national estimate of anemia frequency (41%), 95% confidence level, and a margin of error of 10%, the minimum required sample size was calculated to be 92. Women with complete hemoglobin data, supplementation data, and dietary data were included, while women with missing or inconsistent hemoglobin data were excluded. Data were obtained from the standardized PDHS Women's Questionnaire adapted for Pakistan by NIPS technical experts. Sociodemographic characteristics, antenatal care utilization, receipt of iron and folic acid supplementation, postpartum Vitamin A supplementation, hemoglobin measurement using a HemoCue 301 device, and 24-hour dietary recall information were extracted for analysis. Data collection in PDHS was carried out by trained female field interviewers using standardized procedures, translated questionnaires, and quality control measures to ensure data consistency and cultural appropriateness. Written and verbal informed consent had been obtained from participants by the original PDHS survey team before interviews and biological sample collection.

Data were extracted, cleaned, and analyzed using R (version 4.5.1). Means with standard deviations (SD) were used for continuous variables, while frequencies and percentages were used for categorical variables. Normality was assessed using the Shapiro–Wilk test. Although hemoglobin and age were not normally distributed, independent-samples t-tests were used because of their relative robustness to moderate non-normality. Bivariate analyses included Pearson's chi-square test with risk ratios (RR) to assess the association between iron supplementation and anemia, and independent-samples t-tests to compare mean hemoglobin levels between iron supplementation groups. Independent predictors of anemia were identified using multivariate binary logistic regression after adjustment for age, wealth, and meat intake. Education was excluded from the final regression model because of complete separation. Model fit was evaluated using Nagelkerke R^2 and Hosmer–Lemeshow goodness-of-fit tests. A p-value < 0.005 was considered statistically significant throughout the analysis.

RESULTS

The study shows the distribution of categorical variables in the study sample. Just over half of the women (53%) received iron supplementation during pregnancy, while 46% were found to be anemic. Only 13% of women received postpartum Vitamin A supplementation. Dietary intake patterns also showed that only 31% consumed dark leafy green vegetables and 33% consumed Vitamin A-rich fruits or vegetables within the previous 24 hours (Table 1).

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Table 1: Descriptive Statistics – Categorical Variables

Variables	Category	n (%)
Iron Supplementation During Pregnancy	Yes	53 (53.0%)
	No	47 (47.0%)
Anemia	Yes	46 (46.0%)
	No	54 (54.0%)
Received Vitamin A Dose Postpartum*	Yes	13 (13.0%)
	No	87 (87.0%)
Ate Bread/Rice/Noodles (24h)	Yes	81 (81.0%)
	No	19 (19.0%)
Ate Meat (24h)	Yes	53 (53.0%)
	No	47 (47.0%)
Ate Eggs (24h)	Yes	45 (45.0%)
	No	55 (55.0%)
Ate Dark Leafy Greens (24h)	Yes	31 (31.0%)
	No	69 (69.0%)
Ate Vitamin A-Rich Fruits/ Vegetables (24h)	Yes	33 (33.0%)
	No	67 (67.0%)

Overall, the mean hemoglobin level was 11.7 g/dL (SD = 1.54), which was slightly above the anemia threshold of 11.0 g/dL. The average age of participants was 28.9 years (SD = 6.38), reflecting a predominantly reproductive-age female population. The results present the results of the Shapiro–Wilk normality tests. Both hemoglobin (W = 0.965, p=0.011) and age (W = 0.966, p=0.014) were found to be significantly non-normal. However, independent-samples t-tests were used for group comparisons because of their relative robustness to moderate non-normality at the obtained sample size (Table 2).

Table 2: Normality Tests (Shapiro-Wilk)

Variables	W	p-value
Hemoglobin (g/dL)	0.965	0.011
Age	0.966	0.014

A positive relationship between age and hemoglobin levels in the study sample was represented. Most non-anemic women had relatively higher hemoglobin levels compared with anemic women across different age groups. Anemic women were more frequently clustered below the hemoglobin threshold of 11.0 g/dL. The dashed regression line indicates an overall increasing trend of hemoglobin levels with increasing age (Figure 1).

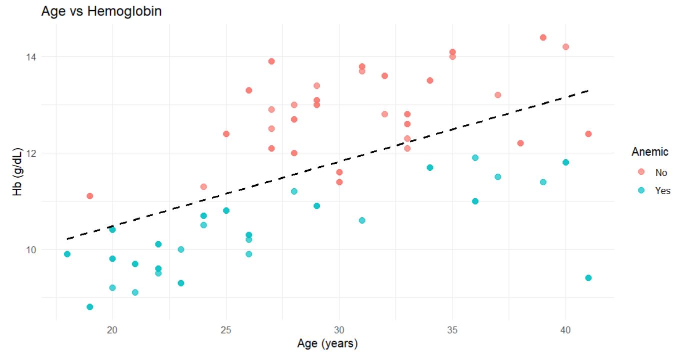

Figure 1: Relationship between Age and Hemoglobin Levels by Anemia Status

The women who did not receive iron supplementation had an 11.34-fold higher risk of anemia compared to users (p<0.001). Additionally, iron users had a mean hemoglobin level 2.30 g/dL higher than non-users (t(98) = 8.45, p<0.001). These findings indicate a strong, statistically significant protective association between iron supplementation and both anemia prevalence and hemoglobin concentration (Table 3).

Table 3: Association of Iron Supplementation with Anemia and Hemoglobin Levels

Outcomes	Comparison	Measure	Value (95% CI)	Test statistic	p-value
Anemia, n (%)	Non-users vs. Users	Risk Ratio	11.34	$\chi^2(1) = 63.31$	<0.001
Hemoglobin, g/dL	Users vs. Non-Users	Mean Difference	2.30 (1.89, 2.71)	t(98) = 8.45*	<0.001

The study presents the multivariate logistic regression analysis for independent predictors of anemia. After adjustment for wealth, meat consumption, and age, iron supplementation during pregnancy remained significantly associated with lower odds of anemia (OR = 0.03, 95% CI: 0.0008–0.34, p = 0.015). Older age was associated with higher odds of anemia (OR = 1.35 per year, 95% CI: 1.12–1.77, p=0.008). Wealth (OR = 1.30, p=0.517) and meat intake (OR = 0.33, p=0.355) were not statistically significant predictors. Education was excluded from the final model because of complete separation. Model fit showed a Nagelkerke R^2 of 0.82 and Hosmer–Lemeshow p = 0.98. The findings suggest a significant association between iron supplementation and lower frequency of anemia, while the relationship between age and anemia may require further investigation (Table 4).

Table 4: Multivariate Logistic Regression – Independent Predictors of Anemia

Predictors	Odds ratio	95% CI	p-value
Iron supplementation (Yes vs No)	0.03	(0.0008 – 0.34)	0.015
Wealth (Continuous)	1.30	(0.59 – 3.01)	0.517
Meat Intake (Yes vs No)	0.33	(0.03 – 3.62)	0.355
Age (per year)	1.35	(1.12 – 1.77)	0.008

Note: Education was excluded from the final model due to

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complete separation (zero anemic cases in higher education groups). Model fit: Nagelkerke R^2 = 0.82; Hosmer-Lemeshow p = 0.98

DISCUSSION

The most remarkable finding of this study was the significant association between iron supplementation and anemia. Women who were not offered iron supplementation during pregnancy had an RR of >7 times of being anemic compared to those who were offered iron (p<0.001), and their mean hemoglobin was 2.30 g/dL lower (95% CI: 1.89—2.71). The results of this research are **consistent with** evidence reported internationally. A recent systematic review and meta-analysis published in eClinical Medicine of the effects of daily versus intermittent iron supplementation in pregnancy supports the WHO's updated guidelines of 30-60 mg elemental iron daily during pregnancy; it found significant evidence suggesting that daily iron supplementation during pregnancy was associated with lower risk of anemia at term compared with intermittent supplementation [8]. Likewise, another Cochrane review revealed a 73% reduction in anemia at term when IFAS was given daily versus no intervention [2]. More recently, implementation research has also pointed to the importance of behavior change strategies, adherence support, and supply chain systems in influencing the effectiveness of iron supplementation [9]. The multivariate logistic regression showed that after adjustment for age, wealth, and diet, iron supplementation remained the **strongest factor associated with lower odds of anemia (OR = 0.03, 95% CI: 0.0008—0.34, p=0.015). Notwithstanding this, only 53% of women in the current sample had received iron supplementation, a pattern that has also been observed throughout LMICs. In sub-Saharan Africa, only 28.7% of pregnant women followed IFAS as recommended for at least 90 days [5], suggesting that the gap between policy and practice remains an important public health issue. The finding that only 13% of postpartum women received a Vitamin A dose in this study was similar to documented programmatic gaps in South Asia. In Pakistan, VAD remains an important public health problem, with an estimated 70% of pregnant and lactating women at risk of VAD [6]. A meta-analysis of randomized trials found that Vitamin A supplementation during the postpartum period was associated with reduced maternal night blindness and increased breast milk retinol concentrations, particularly when coverage was adequate [10]. High-dose postpartum Vitamin A supplementation (200,000 IU) has been recommended by WHO to replenish maternal stores and improve retinol content in breast milk, but coverage remains poorly monitored in many health systems, especially among postpartum women [3]. According to a study published in Maternal and Child Nutrition in 2024, there are substantial gaps in survey-based coverage monitoring of key maternal nutrition interventions such as postpartum Vitamin A supplementation in several countries, including Pakistan [11]. The 2024 Nutrition International declaration to accelerate implementation of the Pakistan Maternal Nutrition Strategy 2022-2027 further reinforces the importance of integrating postpartum supplementation into a continuum of maternal nutrition care [12]. In the present study, based on PDHS 2017-18 data, the 13% coverage indicates that postpartum Vitamin A supplementation remains low. The dietary intake patterns observed in this study also highlight possible nutritional gaps in this population. The majority of women (81%) consumed basic carbohydrate food groups such as bread, rice, or noodles within the previous 24 hours, but only 31% consumed dark leafy greens and 33% consumed Vitamin A-rich fruits or vegetables, food groups important for iron and Vitamin A intake. Only 53% of participants reported consuming meat, which is a major dietary source of haem iron. These findings are similar to those reported in a 2024 cross-sectional study among pregnant women in Jordan [13] and a 2023 systematic review and meta-analysis conducted in Africa [14], which reported high intake of staple carbohydrates and lower intake of animal-based foods, dark vegetables, and Vitamin A-rich foods among pregnant women in LMICs. A recent study from rural Pakistan also reported that less than 30% of pregnant women consumed iron- or Vitamin A-rich foods, which is comparable to the findings of the present study [15]. Meat consumption and wealth were not statistically significant predictors of anemia in the multivariate model, although this may be related to the relatively small sample size and the strong association observed with iron supplementation. A 2022 meta-analysis of nutritional risk factors for pregnancy anemia found that low meat intake, low vegetable intake, and multiparty were independently associated with pregnancy anemia [16]. Similarly, a review on maternal undernutrition concluded that dietary diversification remains an important component of sustainable anemia prevention strategies [17]. The finding that older age was associated with higher odds of anemia (OR = 1.35 per year, p = 0.008) should be interpreted cautiously [18]. Older reproductive-age women may have greater cumulative parity burden and gradual depletion of iron stores over repeated pregnancies in LMIC settings. In a population-based study of women of reproductive age in LMICs, parity emerged as one of the most consistent factors associated with anemia along with education, iron intake, and VAD [19]. A multi-level study of 28 DHS datasets also showed that women in low-income countries were more likely to be anemic with increasing parity [20]. These

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findings may indicate the importance of strengthening maternal nutrition interventions across the reproductive life course rather than focusing only on early pregnancies.
This study has some limitations that should be considered while interpreting the findings. The analysis was based on a relatively small subsample from PDHS 2017–18 data, which may limit the generalizability of the findings. The cross-sectional design also limits the ability to establish causal relationships between iron supplementation and anemia. Dietary intake data were based on 24-hour recall and may be subject to recall bias. In addition, important factors such as parity, gestational age, infection status, and other nutritional deficiencies were not included in the analysis because of limited availability of variables in the selected dataset. Despite these limitations, the study has important public health implications. The findings highlight the low coverage of iron and postpartum Vitamin A supplementation among pregnant and postpartum women and emphasize the need for strengthening maternal nutrition programs. Improving supplementation coverage, routine monitoring, dietary counselling, and community-based nutrition education may help reduce the burden of maternal micronutrient deficiencies in resource-limited settings.

CONCLUSIONS

Maternal anemia remained common in the present study population. Iron supplementation was associated with lower odds of anemia, although supplementation coverage remained low among pregnant women. Postpartum Vitamin A supplementation coverage was also low. These findings highlight the importance of improving maternal nutrition programs, strengthening supplementation delivery and monitoring systems, and promoting dietary diversity through community nutrition education to help address micronutrient deficiencies among pregnant and postpartum women.

Authors' Contribution

Conceptualization: MI, SAK
Methodology: IF, NS
Formal analysis: MI, AB[1]
Writing and Drafting: SAK, AB[1], AB2
Review and Editing: MI, SAK, IF, AB[1], NS, AB[2], MFG

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

The authors declare no conflict of interest.

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