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NUTRITION HEALTH ASSESSMENT OF IRON DEFICIENCY ANEMIA IN PREGNANT WOMEN

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ABSTRACT
Iron deficiency anemia (IDA) remains one of the most common nutritional disorders among pregnant women, particularly in low- and middle-income countries. Despite various public health interventions, the burden of IDA continues to affect maternal and neonatal health outcomes in South Asia. The research project aims to assess the nutritional status, dietary patterns, and prevalence of IDA among pregnant women in their first and second trimesters at Hameed Latif Hospital, Lahore. A cross-sectional study was conducted on 132 pregnant women diagnosed with IDA. Data were collected using structured questionnaires covering sociodemographic, anthropometric, and dietary information, along with hemoglobin and serum ferritin levels. The mean age of participants was 27.3 ± 4.8 years. The prevalence of moderate anemia was 58.3%, while severe anemia was found in 18.9% of women. Mean hemoglobin was 9.7 ± 0.9 g/dL, and mean serum ferritin was 11.8 ± 3.4 µg/L. Mean dietary iron intake (13.2 ± 5.1 mg/day) was below the WHO-recommended level (27 mg/day). The findings highlight a high prevalence of IDA among pregnant women in Lahore, underscoring the need for nutrition education, dietary diversification, and improved iron supplementation adherence during antenatal care.
Keywords: *Iron deficiency anemia, pregnancy, nutrition assessment, hemoglobin, ferritin, Pakistan.*

1. INTRODUCTION

Pregnancy imposes increased physiological demands on women, including substantially elevated iron requirements, to support expanded maternal red cell mass, placental growth, and fetal haemopoiesis. When these demands are not met through diet, supplementation, or iron stores, iron deficiency (ID) and iron deficiency anemia (IDA) result, posing significant risks to both maternal and fetal health (Mintsopoulos, et al., 2024). Globally, IDA in pregnancy remains a major public health issue: The World Health Organization estimates that roughly 40 % of pregnant women are anemic, many of these cases attributable to iron deficiency (Zhou, Y et al., 2023). Recent national-level meta-analyses suggest that the prevalence of IDA remains high in both low- and middle-income countries (LMICs), with variations across regions, urban vs. rural settings, and by trimester (Al-Bayyari et al., 2024).

Anemia during pregnancy is associated with a range of adverse outcomes. Maternal consequences include increased risk of pre-eclampsia, infection, need for blood transfusion, and prolonged hospitalization (Allen, L. H, 2000). Fetal and neonatal outcomes may include

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preterm birth, low birth weight, small-for-gestational-age infants, and reduced iron stores at birth, which can predispose infants to iron deficiency and impaired cognitive development (Naz, S, et al., 2024). Contributors to ID and IDA are multifactorial. Nutritional factors such as low dietary diversity, inadequate consumption of iron-rich foods, poor absorption (e.g. due to dietary inhibitors), and insufficient supplementation are prominent, especially in resource-limited settings. Socioeconomic status, maternal educational level, parity, gestational age, and access to healthcare also play critical roles (Muhsen, M. A et al., 2024).

There has been progress: recent intervention trials and systemic reviews show that dietary counselling, food fortification, and supplementation can significantly improve iron status and hemoglobin levels when effectively implemented. For example, a large birth cohort in China found that maternal iron status (serum ferritin and hemoglobin) was significantly associated with fetal intrauterine growth parameters (Yang, J et al., 2024). An umbrella systematic review in Iran estimated a prevalence of IDA in pregnant women of ~15.7%, highlighting regional variation within countries (Dehghani, A., et al., 2024). A 2024 cross-sectional study in Northern Jordan found that higher dietary diversity and the use of iron supplements correlated with better maternal hemoglobin and ferritin levels (Al-Bayyari et al., 2024). Meanwhile, a midwife-led continuity of care model implemented in Karachi demonstrated improvement in anemia status after intravenous iron therapy under that model ((Naz, S, et al., 2024).

However, despite decades of research and public health efforts, gaps persist. There is still variability in how IDA is diagnosed, in adherence to supplementation, in the effectiveness of nutrition interventions across diverse populations, and in comprehensive assessment of nutritional health. This article aims to assess the nutritional health associated with iron deficiency anemia among pregnant women—examining prevalence, risk factors, and the role of dietary intake, biomarkers, and supplement use.

2. RESEARCH QUESTIONS

- What is the severity and prevalence of IDA (iron deficiency anemia) among the pregnant women in their first two trimesters?
- What is the average dietary consumption of important micronutrients (folate, iron, vitamin c) among the women suffering from such anemia?

3. RESEARCH OBJECTIVES

a) To evaluate the prevalence of iron deficiency anemia among pregnant women in their 1st and 2nd trimesters.
b) To assess the nutritional status and dietary intake of these pregnant women, such as their iron, vitamin c, and folate consumption.

4. RESEARCH METHODOLOGY

4.1 Study Design & Subjects Selection

A cross-sectional study was conducted over two months (May–June 2025) at Hameed Latif Hospital, Lahore. A total of 132 pregnant women (first and second trimesters) diagnosed with IDA were enrolled through purposive sampling. Pregnant females suffering from any chronic illness (e.g. renal disease, hemoglobinopathies), recent blood transfusion, infections etc. were excluded from the research project. The study protocol was approved by the Institutional Review Board of the University of Lahore – Islamabad campus.

4.2 Data Collection and Sampling

Hemoglobin was measured through the CBC (Complete Blood Count) profiles. Dietary intake was assessed via 24-hour recalls and / or food frequency questionnaire, including supplement use. Socio-economic status, education, parity, anthropometry (weight, height, BMI), and health

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history was also obtained from the participants. Written consent was obtained from each participant before data collection and complete confidentiality was kept throughout the research. IDA was defined as Hb <11.0 g/dL per WHO guidelines; ferritin cut-off used (e.g., <15 or <30 µg/L) were adjusted for inflammation where applicable.

4.3 Data Analysis

The participants' data was categorized by age (18-25, 26-30, 30-35 years), education level, monthly household income, pregnancy's trimester (first of second), and BMI categories (underweight, normal weight, overweight, obese). The baseline (weight, BMI, height) and biochemical data (serum hemoglobin and ferritin levels) were presented in the form of 'Mean ± SD' form. The severity of anemia among participants was classified as severe, mild and moderate on the basis of pre-defined cut-offs as per WHO guidelines. The frequency of severity of anemia and micronutrient intake was presented in the form of percentages to find the objectives of research project.

5. RESULTS

Table 1 presents the sociodemographic characteristics of the study participants. The majority of respondents were aged between 26 and 30 years (46.2%), followed by those aged 18–25 years (28.8%) and 31–35 years (25.0%), indicating that most participants were in their mid to late twenties. Regarding educational status, 43.9% had completed secondary education, 30.3% had primary education or less, while 25.8% were graduates, showing that nearly three-fourths of the participants had received at least some formal education. In terms of monthly income, more than half of the respondents (53.0%) reported earning less than 50,000 PKR, while 34.1% earned between 50,000 and 100,000 PKR, and only 12.9% had an income exceeding 100,000 PKR, suggesting that the majority belonged to low- to middle-income groups. With respect to pregnancy trimester, 55.3% of participants were in their second trimester, whereas 44.7% were in their first trimester, indicating a relatively balanced distribution between the two stages of pregnancy.

Variable	Category	Frequency (%)
Age (years)	18–25	38 (28.8%)
	26–30	61 (46.2%)
	31–35	33 (25.0%)
Education	Primary or less	40 (30.3%)
	Secondary	58 (43.9%)
	Graduate	34 (25.8%)
Monthly Income	< 50,000 PKR	70 (53.0%)
	50,000–100,000 PKR	45 (34.1%)
	> 100,000 PKR	17 (12.9%)
Trimester	First	59 (44.7%)
	Second	73 (55.3%)

Table 1. Sociodemographic Characteristics of Participants (n = 132)

The anthropometric and biochemical parameters of the study participants indicated generally moderate nutritional status with signs of iron deficiency, as indicated in Table 2. The mean weight was 62.4 ± 8.2 kg, and the average height was 158.3 ± 6.1 cm, resulting in a mean BMI of 24.9 ± 3.2 kg/m², which falls within the normal weight range according to WHO

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classification. This suggests that, on average, the participants maintained an adequate body composition. However, the mean hemoglobin level was 9.7 ± 0.9 g/dL, which is below the normal range (12–15 g/dL for adult females and 13–17 g/dL for adult males), indicating a high prevalence of anemia among the participants. Similarly, the mean ferritin concentration of 11.8 ± 3.4 µg/L is lower than the normal reference value (usually >15 µg/L), confirming depleted iron stores and suggesting that the anemia observed is likely iron deficiency anemia. Overall, while participants appeared to have normal body weight, their biochemical indicators reflect poor iron status and anemia, highlighting a micronutrient deficiency despite normal BMI.

Parameter	Mean ± SD
Weight (kg)	62.4 ± 8.2
Height (cm)	158.3 ± 6.1
BMI (kg/m²)	24.9 ± 3.2
Hemoglobin (g/dL)	9.7 ± 0.9
Ferritin (µg/L)	11.8 ± 3.4

Table 2. Anthropometric and Biochemical Parameters

The classification of anemia severity among the participants reveals that the majority were affected by moderate levels of anemia. As shown in the results, 58.3% of participants had moderate anemia, with hemoglobin levels ranging between 7.0 and 9.9 g/dL, indicating a considerable burden of iron deficiency. Additionally, 23.5% of participants were mildly anemic (Hb: 10.0–10.9 g/dL), suggesting early-stage or less severe iron depletion. Alarmingly, 18.9% of participants suffered from severe anemia, with hemoglobin levels below 7.0 g/dL, which poses significant health risks such as fatigue, reduced work capacity, and potential complications if left untreated. Overall, these findings demonstrate a high prevalence of anemia, with most cases falling in the moderate to severe range, underscoring the urgent need for nutritional interventions and public health measures to address iron deficiency in this population.

Severity	Hb Range (g/dL)	Frequency (%)
Mild	10.0–10.9	31 (23.5%)
Moderate	7.0–9.9	77 (58.3%)
Severe	< 7.0	25 (18.9%)

Table 3. Severity of Anemia among Participants

The dietary intake data indicate that the participants' nutrient consumption was generally below the recommended levels set by the World Health Organization (WHO, 2024). The mean energy intake was 2,010 ± 312 kcal, meeting only 82% of the recommended 2,450 kcal, suggesting an overall energy deficit that may contribute to undernutrition or fatigue. The mean protein intake

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was 53.2 ± 11.4 g, achieving 89% of the recommended 60 g, which indicates a slightly inadequate protein intake that may still be sufficient for most individuals but could be marginal for those with higher physiological needs. More concerning are the micronutrient intakes, particularly iron, vitamin C, and folate, which were markedly below recommendations. Participants consumed an average of 13.2 ± 5.1 mg of iron, meeting only 49% of the 27 mg recommendation, reflecting a substantial deficiency that likely contributes to the high prevalence of anemia observed in this group. Similarly, vitamin C intake averaged 58.6 ± 23.7 mg, representing 69% of the recommended 85 mg, which may further impair iron absorption. The mean folate intake was 312 ± 87 µg, just 52% of the recommended 600 µg, indicating another significant shortfall. Overall, these findings suggest that the participants' diets were deficient in both macro- and micronutrients, particularly iron and folate, highlighting the need for dietary improvements and nutrition education to enhance nutrient adequacy and reduce anemia risk (Table 4).

Nutrient	Mean ± SD	Recommended Intake (WHO, 2024)	% of Recommendation
Energy (kcal)	2,010 ± 312	2,450	82%
Protein (g)	53.2 ± 11.4	60	89%
Iron (mg)	13.2 ± 5.1	27	49%
Vitamin C (mg)	58.6 ± 23.7	85	69%
Folate (µg)	312 ± 87	600	52%

Table 4. Average Daily Nutrient Intake

6. DISCUSSION

This study elucidated a troubling profile of micronutrient deficiencies and high anemia burden among pregnant women, in spite of generally normal anthropometry. The sociodemographic data highlight that most participants were in their mid-twenties, and although nearly three-quarters had received some formal education, more than half belonged to lower income groups. Such socioeconomic constraints likely limit access to diverse, nutrient-dense diets and health services, creating vulnerability to micronutrient deficiencies.

While the mean BMI (24.9 ± 3.2 kg/m²) fell within the normal range, the biochemical findings pointed to substantial iron depletion: the average hemoglobin (9.7 ± 0.9 g/dL) was well below normal, and ferritin (11.8 ± 3.4 µg/L) indicated depleted iron stores. This apparent discordance between body mass and iron status underscores the phenomenon of "hidden hunger," where individuals appear well nourished in terms of anthropometry but suffer from micronutrient insufficiencies. Such patterns have been documented in similar populations in South Asia and reflect that weight or BMI alone do not reliably indicate micronutrient sufficiency (Chouli, M. et al., 2025).

The severity distribution of anemia is especially worrisome: 58.3% of women had moderate anemia, 23.5% had mild anemia, and 18.9% had severe anemia. These proportions are higher than national-level surveys and meta-analyses for Pakistan, where the pooled prevalence of anemia among pregnant women has been estimated at about 55% to 63% (fixed- and random-

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effects pooled estimates) (Mahar, B., 2024) (Sehar, B. et al., 2024). The high fraction of moderate-to-severe cases in our sample may reflect either selection bias (e.g., recruiting from clinical settings) or more severe exposure to risk factors in this cohort (e.g., low dietary intake, infections, or poor supplement adherence).

Our data on dietary intake further elucidate contributing factors. Energy and protein intake reached only 82% and 89% of WHO 2024 recommendations, respectively, pointing to a mild energy-protein deficit, which may limit general health and dietary quality. More critically, the mean intakes of iron (13.2 ± 5.1 mg), folate (312 ± 87 µg), and vitamin C (58.6 ± 23.7 mg) achieved merely 49%, 52%, and 69% of their respective WHO targets. Inadequate iron intake clearly undermines hemoglobin synthesis; insufficient folate compromises DNA synthesis and erythropoiesis; and low vitamin C further impairs non-heme iron absorption. The combined shortfalls in these nutrients create a "perfect storm" for development and persistence of iron deficiency anemia (Jue Liu. Et al., 2025). Evidence from interventional studies supports that co-provision of iron with vitamin C enhances iron status more than iron alone (Skolmowska, D., & Głąbska, D., 2022)

These findings align with broader regional trends: anemia is a pervasive maternal health challenge in Pakistan. A comprehensive meta-analysis reported that Pakistan's pregnant-women anemia prevalence lies between ~55% and ~63%, with large heterogeneity across studies ((Mahar, B., 2024). Other local studies also implicate low income, limited education, and poor dietary diversity as consistent predictors of anemia (e.g., studies in Karachi and Faisalabad) (Zulfiqar, H et al., 2021 & Ashraf F. et al., 2024 & Jahan, E. et al., 2021). Moreover, despite national efforts, progress in reducing anemia among women of reproductive age has been modest: between 2011 and 2018, prevalence among WRA declined from ~50.5% to ~42.7% (Owais, A et al., 2025).

The clinical implications of maternal anemia are profound. A recent systematic review and meta-analysis found that anemia during pregnancy is associated with adverse outcomes, including preterm birth, low birth weight, gestational hypertension, and maternal mortality (Wang, R. et al., 2025). This underscores the importance of timely detection and intervention. Current WHO guidance recommends daily supplementation of 30–60 mg elemental iron plus 400 µg folic acid to pregnant women to prevent anemia, low birth weight, and preterm birth (WHO, 2024). In line with evolving evidence, some newer programs are investigating the use of intravenous iron (e.g., ferric carboxymaltose) for moderate-to-severe anemia, which appears more effective and faster at improving hemoglobin than oral iron, especially in the third trimester (Dura, M. C. et al., 2024) and programs in Karachi leveraging midwife-led continuity models are exploring IV iron delivery in Pakistan settings (Naz, S. et a., 2024).

7. CONCLUSION

The findings of this study highlight a significant public health concern, with a high prevalence of anemia—particularly moderate to severe forms—among pregnant women, despite having an average BMI within the normal range. The biochemical indicators, including low hemoglobin and ferritin levels, confirm widespread iron deficiency anemia, likely stemming from inadequate dietary intake of key micronutrients. The participants' consumption of iron, folate, and vitamin C was far below WHO recommendations, underscoring poor dietary quality and limited access to nutrient-rich foods, especially among women from low-income households. These results emphasize the need for comprehensive maternal nutrition strategies that address both macronutrient and micronutrient inadequacies. Interventions should include routine iron and folate supplementation, dietary diversification, nutrition education, and food

fortification programs. Strengthening antenatal care services to ensure timely screening and treatment of anemia is also crucial.

Ultimately, improving women's nutritional status during pregnancy is essential not only for their own health but also for optimal fetal growth, safe pregnancy outcomes, and the long-term well-being of both mother and child.

A strength of this study is the integration of sociodemographic, anthropometric, biochemical, and dietary data, enabling a multidimensional view of anemia etiology. However, this cross-sectional design cannot establish causality or temporal relationships. Also, dietary intake was based on single-day recall, which may not reflect habitual diet. Finally, our sample may not be fully representative of the broader pregnant population, potentially biasing prevalence estimates upward.

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