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PREVALENCE OF ANEMIA AND ASSOCIATED DIETARY HABITS AMONG PREGNANT WOMEN IN TERTIARY CARE SETTINGS: A CROSS-SECTIONAL STUDY

Original Article

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ABSTRACT

Background: Anemia in pregnancy is a persistent global health concern, particularly in low- and middle-income countries, where it contributes to maternal and fetal complications. Dietary iron deficiency remains a leading cause, especially in resource-constrained clinical settings.

Objective: To determine the prevalence of anemia and assess dietary patterns linked to iron deficiency among pregnant women in their second and third trimesters attending a tertiary care hospital in Lahore.

Methods: This cross-sectional study was conducted over eight months and included 422 pregnant women selected via consecutive non-probability sampling. Participants in their second and third trimesters were enrolled based on defined inclusion and exclusion criteria. Hemoglobin levels were measured using automated hematology analyzers. Dietary intake patterns were assessed through a structured, culturally adapted questionnaire. Statistical analysis was performed using SPSS version 26. Logistic regression was applied to identify predictors of anemia. Ethical approval was granted by the Institutional Review Board (IRB).

Results: Anemia prevalence was 63.0%, with 33.6% mild, 24.4% moderate, and 5.0% severe cases. Significant dietary associations included low intake of red meat ($p=0.002$) and citrus fruits ($p=0.001$), and high consumption of tea/coffee with meals ($p<0.001$). Logistic regression revealed tea/coffee consumption with meals (OR 3.15), no citrus fruit intake (OR 2.07), and low meat intake (OR 1.82) as significant predictors of anemia. Third-trimester status and low income also emerged as contributory factors.

Conclusion: Anemia remains highly prevalent in pregnant women attending tertiary care, driven by poor dietary patterns and socioeconomic constraints. Targeted nutritional interventions and individualized dietary counseling should be integrated into antenatal care to address this preventable health issue.

Keywords: Anemia, Dietary habits, Iron-deficiency, Pregnancy, Prevalence, Red meat, Socioeconomic factors.

INTRODUCTION

Anemia during pregnancy is a significant public health concern, particularly in low- and middle-income countries, where nutritional deficiencies and limited access to antenatal care can exacerbate maternal health challenges. Defined by a decrease in the oxygen-carrying capacity of the blood, anemia in pregnancy is most often due to iron deficiency and is associated with numerous adverse maternal and neonatal outcomes, including increased risk of preterm birth, low birth weight, postpartum hemorrhage, and maternal mortality. Globally, it is estimated that over 40% of pregnant women are affected by anemia, with much higher prevalence rates reported in regions with inadequate dietary iron intake and healthcare infrastructure (1,2). Despite public health efforts and policy-level interventions aimed at improving iron supplementation and nutrition during pregnancy, anemia remains pervasive, particularly in resource-limited clinical settings. Physiological changes in pregnancy, especially in the second and third trimesters, contribute to increased iron requirements. The expanding maternal blood volume, growing fetal demands, and placental development all necessitate a higher iron intake (3). When dietary intake fails to meet these elevated demands, iron stores become depleted, leading to iron deficiency anemia. Importantly, this condition does not develop in isolation; it is often influenced by various dietary habits, including low consumption of iron-rich foods, poor dietary diversity, and intake of iron inhibitors such as phytates, tannins, and calcium. On the other hand, enhancing iron absorption through ascorbic acid-rich foods and adopting balanced dietary patterns has been shown to reduce anemia risk significantly. However, knowledge gaps remain regarding how dietary behaviors directly correlate with anemia prevalence among pregnant women attending tertiary care facilities, particularly in settings where comprehensive dietary counseling is not routinely implemented (4,5).

In recent years, there has been a growing emphasis on nutritional interventions and behavior change communication within maternal health programs. While iron supplementation remains a cornerstone of anemia prevention and treatment, long-term success relies heavily on sustainable dietary changes (6). However, translating global nutritional recommendations into local contexts remains a challenge due to cultural food practices, socioeconomic constraints, and varying levels of awareness among pregnant women. Several studies have explored the effectiveness of dietary counseling and iron-fortified foods, yet few have systematically examined how everyday eating habits influence anemia status in tertiary healthcare settings—where women may be more health-conscious and have greater access to medical care, yet still face nutritional inadequacies (7,8). This gap becomes particularly relevant when considering that antenatal clinics in tertiary hospitals often serve as referral centers for high-risk pregnancies. These settings thus offer a unique opportunity to observe anemia prevalence among women who may have already been screened and offered standard care, and whose dietary patterns might reflect both urban influences and traditional practices (9). Assessing dietary habits in such populations can yield critical insights into the real-world effectiveness of dietary guidelines and the role of nutrition education during pregnancy. Furthermore, understanding the interplay between cultural food choices, supplement adherence, and anemia outcomes could support more nuanced public health strategies and individualized care models (10).

Despite existing literature identifying common dietary risk factors for anemia—such as insufficient intake of heme iron, poor consumption of vitamin C-rich fruits, and excessive intake of tea or coffee around mealtimes—there is limited data from cross-sectional studies that simultaneously measure anemia prevalence and detailed dietary patterns among pregnant women in clinical settings (11). Most existing studies either focus solely on biochemical markers or fail to capture comprehensive dietary information, leading to an incomplete understanding of the nutritional drivers of maternal anemia (12,13). Given the multifactorial nature of anemia and the critical importance of maternal nutrition, this study aims to address the identified gaps by evaluating both the prevalence of anemia and the associated dietary habits among pregnant women in their second and third trimesters attending tertiary care facilities. The research is grounded in the hypothesis that suboptimal dietary patterns—characterized by low intake of bioavailable iron and iron absorption enhancers—are significantly associated with higher anemia rates in this population. By bridging clinical observations with nutritional assessments, the study seeks to inform targeted dietary interventions that can be integrated into routine antenatal care. Ultimately, the objective is to determine the prevalence of anemia and evaluate dietary patterns linked to iron deficiency among pregnant women in their second and third trimesters, providing a foundation for tailored nutritional counseling and policy development.

METHODS

This cross-sectional study was conducted over a period of eight months at a tertiary care hospital in Lahore, aiming to determine the prevalence of anemia and evaluate dietary patterns linked to iron deficiency among pregnant women in their second and third trimesters. The research followed a quantitative observational design, chosen for its capacity to assess the magnitude and pattern of anemia in a defined population at a single point in time. A hospital-based setting was deemed appropriate due to its accessibility to a diverse

population of pregnant women receiving routine antenatal care and its ability to facilitate systematic data collection within a clinical framework. The sample size was calculated using the World Health Organization (WHO) formula for prevalence studies, taking into account a 95% confidence level, a 5% margin of error, and an expected prevalence of anemia of approximately 50% based on regional literature. This yielded a required minimum sample of 384 participants. To account for possible non-responses or incomplete data, a 10% contingency was added, resulting in a final target sample size of 422 pregnant women. Participants were selected using a non-probability consecutive sampling technique, allowing inclusion of all eligible women who met the criteria during the study period (14).

The study population included pregnant women aged 18–40 years in their second (13–27 weeks) and third trimesters (28 weeks onward) attending the outpatient antenatal clinic. Inclusion criteria required participants to have a singleton pregnancy and willingness to provide informed consent. Exclusion criteria included known hematologic disorders unrelated to iron deficiency (e.g., thalassemia, sickle cell disease), chronic illnesses that could independently influence anemia (e.g., chronic kidney disease, HIV, tuberculosis), use of iron supplements prior to the current pregnancy, and any history of recent blood transfusion. These criteria ensured that the observed anemia status could be attributed primarily to dietary patterns and physiological demands of pregnancy. Data collection was carried out by trained research assistants under close supervision. Sociodemographic data, obstetric history, and dietary habits were recorded using a structured questionnaire developed based on previously validated tools and adapted to local dietary contexts. Dietary data focused on frequency and type of iron-rich foods (heme and non-heme sources), consumption of iron absorption enhancers (e.g., citrus fruits), and inhibitors (e.g., tea, coffee, calcium-rich foods) in relation to meals. Participants were interviewed in the local language to ensure clarity and accuracy.

Hemoglobin levels were measured through a venous blood sample collected under aseptic conditions. Samples were analyzed at the hospital's accredited central laboratory using an automated hematology analyzer. Anemia was classified according to the World Health Organization guidelines: hemoglobin <11 g/dL for pregnant women. Severity was further categorized as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL), or severe (<7.0 g/dL). These cutoff points allowed for consistent stratification and interpretation across study groups. To ensure the integrity of the data and its relevance to the study's objective, several quality control measures were implemented. The dietary questionnaire was pilot-tested on a subset of 20 participants to ensure cultural appropriateness and ease of understanding. Any ambiguous items were revised accordingly. Hemoglobin measurement procedures adhered to standard operating protocols and were verified periodically for consistency.

Statistical analysis was performed using IBM SPSS version 26.0. Descriptive statistics were used to summarize participant characteristics and anemia prevalence. Means and standard deviations were calculated for continuous variables, while frequencies and percentages were used for categorical data. The normality of data distribution was assessed using the Shapiro-Wilk test, and results indicated that the data were normally distributed. To evaluate the association between dietary patterns and anemia status, independent sample t-tests and one-way ANOVA were employed for continuous variables, while chi-square tests were used for categorical variables. Logistic regression analysis was conducted to determine predictors of anemia, adjusting for potential confounders such as maternal age, parity, and gestational age. Ethical approval for the study was obtained from the Institutional Review Board of the hosting tertiary care hospital in Lahore, ensuring adherence to ethical standards for research involving human subjects. Informed written consent was obtained from all participants after providing a clear explanation of the study's purpose, procedures, potential risks, and confidentiality safeguards. Participants were informed of their right to withdraw at any time without any impact on their medical care. Anemic participants were counseled on dietary modifications and referred to the obstetrician for appropriate supplementation and follow-up. By adhering to rigorous methodology, this study ensured the reliability and reproducibility of findings regarding anemia prevalence and its dietary correlates in a clinically relevant population. The transparent design, objective measurement of hemoglobin levels, and culturally adapted dietary assessment collectively strengthened the study's potential to inform future nutritional interventions in antenatal care settings.

RESULTS

Out of the 422 pregnant women enrolled in the study, the mean age was 27.8 ± 4.5 years and the mean gestational age at presentation was 28.9 ± 5.1 weeks. The average gravida was 2.6 ± 1.1. In terms of education, 68.7% of participants had attained at least secondary education, while 26.1% were employed at the time of the study. About 42.7% reported a monthly household income above 50,000 PKR. Anemia was prevalent in 266 participants (63.0%), with varying severity: 33.6% had mild anemia, 24.4% had moderate anemia, and 5.0% had severe anemia. The remaining 36.9% of participants had hemoglobin levels within the normal range (≥11 g/dL). These findings

indicated a substantial burden of anemia among pregnant women attending tertiary care antenatal services. A comparison of dietary patterns revealed significant differences between anemic and non-anemic groups. Among the anemic participants, only 38.3% reported consuming red meat three or more times a week, compared to 57.1% of non-anemic women (p=0.002). Similarly, daily intake of citrus fruits was significantly lower among anemic participants (29.7%) compared to non-anemic counterparts (56.4%) (p=0.001). Tea or coffee consumption with meals—a known inhibitor of iron absorption—was markedly more common among anemic women (71.8%) compared to the non-anemic group (28.8%) (p<0.001). Intake of green leafy vegetables three or more times per week was more frequent in non-anemic women, though the difference was not statistically significant (p=0.095).

Logistic regression analysis identified key predictors of anemia. Red meat intake fewer than three times a week was associated with nearly double the odds of anemia (OR 1.82, 95% CI: 1.21–2.74, p=0.004). Absence of daily citrus fruit intake significantly increased the likelihood of anemia (OR 2.07, 95% CI: 1.33–3.22, p=0.002). Tea or coffee consumption with meals emerged as the strongest predictor (OR 3.15, 95% CI: 2.02–4.92, p<0.001). Additionally, lower household income (≤50,000 PKR) and being in the third trimester were also significantly associated with higher odds of anemia (OR 1.64 and 1.57, respectively). The results clearly indicated that dietary behaviors play a critical role in the presence and severity of anemia among pregnant women in this clinical setting. Two figures have been created to visually represent these findings: one pie chart illustrating the prevalence and severity of anemia, and one bar chart comparing dietary habits between anemic and non-anemic groups.

Table 1: Demographic Characteristics of Participants (n = 422)

Variable	Mean ± SD / n (%)
Age (years)	27.8 ± 4.5
Gestational Age (weeks)	28.9 ± 5.1
Gravida	2.6 ± 1.1
Education (secondary or above)	290 (68.7%)
Employment (employed)	110 (26.1%)
Monthly Household Income (PKR > 50,000)	180 (42.7%)

Table 2: Anemia Prevalence and Severity

Anemia Status	n (%)
Non-anemic (Hb ≥ 11 g/dL)	156 (36.9%)
Mild (10–10.9 g/dL)	142 (33.6%)
Moderate (7–9.9 g/dL)	103 (24.4%)
Severe (< 7 g/dL)	21 (5.0%)

Table 3: Dietary Habits and Anemia Association

Dietary Variable	Anemic (n = 266)	Non-anemic (n = 156)	p-value
Red meat intake (≥3 times/week)	102 (38.3%)	89 (57.1%)	0.002
Citrus fruit intake (≥1 serving/day)	79 (29.7%)	88 (56.4%)	0.001
Tea/Coffee with meals	191 (71.8%)	45 (28.8%)	<0.001
Green leafy vegetable intake (≥3/wk)	144 (54.1%)	98 (62.8%)	0.095

Table 4: Logistic Regression for Predictors of Anemia

Variable	Adjusted OR (95% CI)	p-value
Red meat intake <3 times/week	1.82 (1.21–2.74)	0.004
No citrus fruit intake	2.07 (1.33–3.22)	0.002
Tea/Coffee with meals	3.15 (2.02–4.92)	<0.001
Low income (≤50,000 PKR)	1.64 (1.08–2.50)	0.020
Gestational age (3rd trimester)	1.57 (1.01–2.45)	0.046

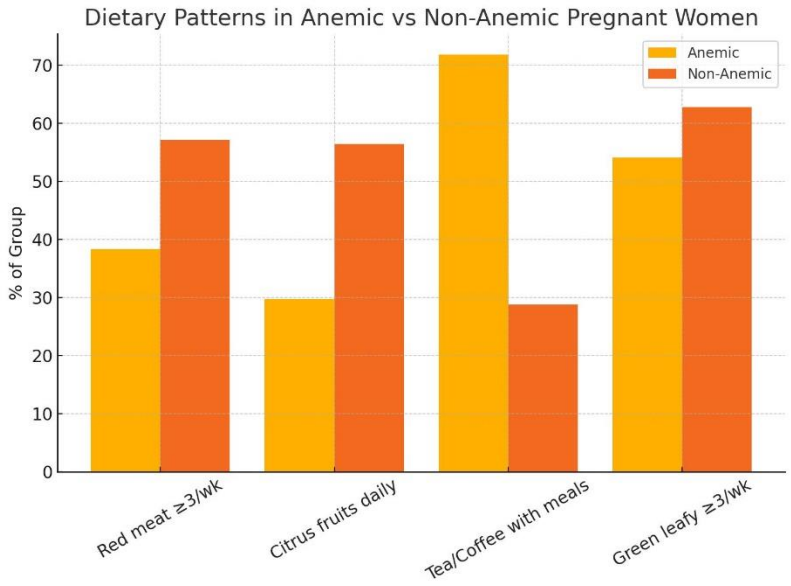

Figure 1 Dietary Patterns in Anemic vs Non-Anemic Pregnant Women

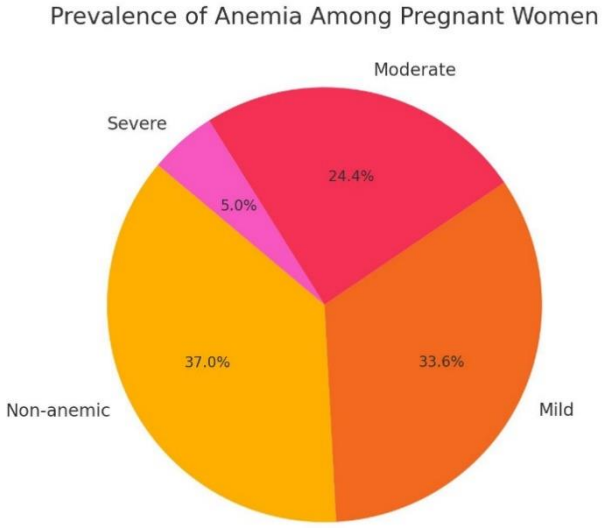

Figure 2 Prevalence of Anemia Among Pregnant Women

DISCUSSION

The findings of this study underscore a persistently high prevalence of anemia among pregnant women, with nearly two-thirds of the cohort presenting with hemoglobin levels below the WHO threshold. This result aligns closely with recent studies conducted across South Asia and sub-Saharan Africa, where anemia remains a severe public health challenge in pregnancy despite years of nutritional interventions and antenatal screening programs (15,16). This study's observed association between dietary behavior and anemia is consistent with previous literature that identifies nutritional inadequacies—specifically iron and vitamin C deficiency—as major contributors to maternal anemia. The high prevalence of tea or coffee consumption with meals and low intake of red meat and citrus fruits reported here echoes patterns reported in similar studies across India, Pakistan, and Saudi Arabia, all of which highlighted these habits as primary risk factors for anemia due to their impact on iron bioavailability (17,18). These dietary patterns are often influenced by cultural norms, low health literacy, and economic barriers that limit access to high-quality protein and fresh produce.

Low household income also emerged as a significant predictor of anemia in this study. This economic constraint affects dietary diversity, meal frequency, and overall nutritional status, which has been corroborated in broader national-level surveys such as the India National Family Health Survey, where anemia prevalence reached up to 61.9% among the lowest income groups (19,20). Logistic regression in this study affirmed the compounded effect of dietary and socioeconomic factors, with tea/coffee consumption during meals tripling the odds of anemia—an association that mirrors findings from both community- and hospital-based cohorts across Africa and South Asia (21). The clinical implications are significant. With a large proportion of participants already receiving antenatal care in a tertiary setting, the findings suggest that dietary counseling during pregnancy may not be adequately emphasized or personalized. The third trimester, in particular, showed higher rates of anemia, reinforcing global meta-analyses that show worsening hemoglobin levels as pregnancy progresses due to increased physiological demand (22,23). Hence, there is an urgent need to embed nutritional assessments and tailored dietary education into antenatal protocols, especially for women at greater gestational age or socioeconomic disadvantage.

This study's strengths include its robust sample size, the inclusion of trimester-specific data, and the simultaneous analysis of clinical, nutritional, and socioeconomic variables. The setting in a tertiary care hospital enabled standardized blood testing and reliable data collection procedures, enhancing the internal validity of the results. However, the study is not without limitations. Being cross-sectional, causality between dietary factors and anemia cannot be definitively established. Self-reported dietary data may be subject to recall bias, and the frequency-based approach to dietary assessment may not fully capture micronutrient density or bioavailability. Furthermore, confounding factors such as parasitic infections, genetic hemoglobinopathies, and compliance with iron supplementation were not

evaluated, which could affect hemoglobin levels independently of diet. Future studies would benefit from a longitudinal design to track changes in hemoglobin levels and dietary behaviors over the course of pregnancy. Including biomarkers such as serum ferritin and transferrin saturation could provide a more comprehensive understanding of iron status. Additionally, integrating qualitative methods could help explore the underlying beliefs and barriers influencing dietary choices among pregnant women. In conclusion, the findings reiterate that anemia in pregnancy remains a multifactorial challenge deeply intertwined with dietary practices and socioeconomic context. Effective interventions must go beyond supplementation to include context-sensitive, culturally tailored dietary education embedded into routine antenatal care services.

CONCLUSION

This study highlights a high prevalence of anemia among pregnant women in tertiary care, strongly linked to modifiable dietary habits such as low intake of iron-rich foods and frequent consumption of iron absorption inhibitors. These findings underscore the urgent need to integrate targeted nutritional counseling into antenatal care protocols to improve maternal health outcomes and reduce anemia-related risks in pregnancy.

AUTHOR CONTRIBUTION

Author	Contribution
Mahboob Rahman Siddeiqe	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Kashaf Qayyum	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Taj Muhammad Khan*	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Ayaz Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sibtain Nawaz	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Maryam Raza	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Muhammad Naeem	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Ghulam Abbas	Writing - Review & Editing, Assistance with Data Curation

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