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ORIGINAL ARTICLE

Risk factors of iron deficiency anemia among pregnant women in tertiary care hospital.

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ABSTRACT… Objective: To identify socioeconomic and dietary risk factors associated with iron deficiency anemia among pregnant women. **Study Design:** Descriptive Cross-sectional study. **Period:** June to December 2025. **Setting:** Inpatient Obstetrics and Gynecology Ward, Bahawal Victoria Hospital, Bahawalpur. **Methods:** One hundred ninety-two pregnant women aged 20–35 years with laboratory-confirmed iron deficiency anemia were recruited through consecutive sampling. Iron deficiency was defined per RCOG hemoglobin thresholds across gestational trimesters. A pre-tested structured questionnaire captured demographic profiles, obstetric history, and dietary frequencies. Data analysis utilized SPSS version 23, with categorical associations evaluated via Chi-square or Fisher's exact tests, establishing statistical significance at $p<0.05$. **Results:** Nutritional deficits were prominent; 38.0% consumed fewer than three daily meals, while 62.0%, 71.4%, and 44.8% reported suboptimal weekly consumption of meat, eggs, and vegetables. Overall, 54.2% demonstrated composite dietary insufficiency. Severity stratification highlighted socioeconomic disease gradients. Reduced educational attainment and lower household income were significantly associated with moderate to severe anemia ($p=0.018$ and $p=0.007$, respectively). Inter-pregnancy intervals under two years strongly predicted inadequate daily meal frequency ($p=0.003$) and multiple concurrent dietary deficiencies ($p<0.001$). Parity and geographic residence demonstrated no significant correlations. **Conclusion:** Maternal iron deficiency anemia in this cohort is primarily driven by financial limitations, poor dietary diversity, and short birth spacing. Implementing targeted nutritional education and structured family planning interventions remains essential for improving maternal hematological outcomes and reducing perinatal complications.

Key words: Anemia, Birth Intervals, Dietary Patterns, Iron-Deficiency, Pregnancy, Risk Factors, Socioeconomic Factors.

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INTRODUCTION

Anemia is defined as a condition in which hemoglobin (Hb) level in the body is lower than normal, which results in a decreased oxygen-carrying capacity of red blood cells to tissues.[1] It affects all age groups, but pregnant women and children are more vulnerable. According to the WHO guidelines, anemia in pregnancy is defined as a hemoglobin level < 11 g/dL in the first trimester and less than 10.5 g/dl in the second and third trimesters.[2] The prevalence of anemia is an important health indicator. Anemia is one of the most prevalent complications during pregnancy. It is commonly considered a risk factor for poor pregnancy outcomes and can result in complications that threaten the life of both mother and fetus, such as preterm birth and low birth weight.[3]

Many studies have reported that the commonest cause of anemia in pregnancy is due to iron deficiency, especially in low- and middle-income countries, where it is attributed to poverty and malnutrition. It is more common among women and girls as a result of regular blood loss during menstruation.[4,5] The risk factors of anemia in pregnancy are diverse ranging from the individual's behaviors, both socioeconomic and cultural, nutrition, parasitic diseases like malaria and hookworm, and human immune deficiency virus infection. Factors affecting anemia in pregnancy vary greatly, so anemia in pregnant women must be handled properly.[6,7] A study has shown factors for iron deficiency anemia in pregnant women as follows; pregnancy interval <2 years in 56.1%, rural residence (69.7%), low education (57.2%), low family income (97.6%), multi-para (86.6%), insufficient meals per day <3 in 14.6%, insufficient meat intake <2 times/week in 86.8%, insufficient vegetables intake <2 times/

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week in 61.4%, insufficient egg intake <2 times/ week in 86.9%.[8] Another study has shown that iron deficiency was observed among 41% (95%CI: 38 – 45) of women with moderate or severe anemia and the prevalence increased with gestational age. The odds for IDA reduces from 0.36 (95%CI: 0.13 – 0.98) among pregnant women who consume green leafy vegetables every 2-3 weeks, to 0.26 (95%CI: 0.09 – 0.73) among daily consumers, compared to those who do not eat it. Consumption of soybeans three to four times a week was associated with higher odds of IDA compared to non-consumption, 1.78 (95%CI: 1.12 – 2.82).[9]

Anemia during pregnancy can cause stress reactions in pregnant women and fetuses, increase the synthesis of corticotrophin-releasing hormone in the body, lead to the secretion from T and B cells, and inhibit the activity of neutrophils and macrophages. Anemia can then reduce the resistance to external bacteria of pregnant women, causing adverse events such as premature rupture of membranes and premature birth.[6] Hence, understanding the factors influencing the occurrence of iron deficiency anemia in women during pregnancy and intervening aggressively can have a positive impact on pregnancy outcomes and prognosis.[8]

Iron deficiency anemia is considered as global public health threat. In developing countries health care systems are devoid of its preventive measures. Lack of knowledge is present regarding its risk factors and there is no public awareness regarding risk factors responsible for causing iron deficiency anemia. Iron deficiency anemia is preventable disease. A huge number of iron deficiency anemia studies have been conducted based on clinical and hospital based settings in Pakistan not emphasizing on risk factors causing iron deficiency anemia. The purpose of this study was to amplify and improve the knowledge regarding risk factors responsible for iron deficiency anemia in the area of Bahawalpur, South Punjab.

OBJECTIVE

To find the risk factors of iron deficiency anemia among pregnant women in tertiary care hospital in indoor patients at gynecology department, Bahawal Victoria Hospital, Bahawalpur.

METHODS

This descriptive cross-sectional study was conducted from June 2025 to December 2025 at the indoor department of Obstetrics and Gynecology, Bahawal Victoria Hospital, Bahawalpur. Ethical approval was obtained from the Institutional Review Committee (Reference No. 2710/DME/QAMC Bahawalpur, Dated. 12-11-2024) and informed consent from each participant. The sample size calculated assuming prevalence of 14.6%[8] for inadequate daily meal consumption among pregnant women with iron deficiency anemia, 5% margin of error and 95% confidence level (Z=1.96), was 192 participants. A non-probability consecutive sampling technique was employed to recruit eligible subjects.

Inclusion criteria comprised pregnant women aged 20–35 years with singleton cephalic presentation confirmed by ultrasonography, who met the operational definition of iron deficiency anemia. Women outside the specified age range, those with anemia attributable to non-iron deficiency etiologies, and individuals unwilling to participate were excluded. Following ethical clearance, 191 eligible women were enrolled, and verbal informed consent was obtained from each participant. Data were collected using a pre-designed, pre-tested structured questionnaire (Annexure I). Iron deficiency anemia was defined according to Royal College of Obstetricians and Gynaecologists (RCOG) guidelines as hemoglobin <11 g/dL in the first trimester and <10.5 g/dL in the second and third trimesters. Demographic and exposure variables were operationalized using predefined thresholds: short pregnancy interval (<2 years), rural residence, low educational attainment (illiterate or primary education only), low monthly family income (<50,000), multiparity (parity >1), and dietary insufficiencies (defined as <3 meals per day, and <2 times per week for meat, vegetables, and eggs). All participants received standard clinical management per institutional ward protocols.

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) version 23. Categorical variables were summarized as frequencies and percentages and presented in tables and figures. Stratified analyses were performed according to age, education, family income, parity, and pregnancy interval. Given the qualitative nature

of all study variables, associations were evaluated using the Chi-square test or Fisher's exact test, as appropriate and p-value ≤0.05 was considered statistically significant.

RESULTS

A total of 192 pregnant women meeting the inclusion criteria were enrolled in the study. Age distribution of participants showed that 44.8% aged 20–25 years, 38.0% aged 26–30 years, and 17.2% aged 31–35 years. Educational attainment was generally limited; 63.0% of participants had either no formal schooling or only primary education. Socioeconomic indicators reflected a predominantly low-income, rural population, as 72.4% reported monthly household earnings below 50,000 PKR and 68.2% resided in rural settings. Multiparous women accounted for 58.3% of the sample, while 59.4% reported an inter-pregnancy interval of two years or longer. Regarding gestational timing, 46.4% were enrolled during the second trimester, followed by the third (32.3%) and first trimesters (21.4%) [Table-I].

Dietary assessment revealed widespread nutritional inadequacies across the cohort. Over one-third of women (38.0%) consumed fewer than three meals daily. Intake of animal-source proteins and vegetables was particularly low: 62.0% reported consuming meat fewer than twice weekly, 71.4% consumed eggs with similar infrequency, and 44.8% fell below the threshold for weekly vegetable intake. When evaluated collectively using the composite dietary score, 54.2% of participants exhibited inadequacy in two or more dietary categories [Table-II].

Anemia severity demonstrated statistically significant gradients across educational and economic strata. Women with lower educational attainment (illiterate or primary) presented with higher proportions of moderate (51.2%) and severe (17.4%) anemia compared to those with secondary or higher education (33.8% moderate, 7.0% severe; p=0.018). A comparable pattern was observed for household income, with the <50,000 PKR group showing greater frequencies of moderate (49.6%) and severe (13.0%) anemia relative to the ≥50,000 PKR group (34.0% and 15.1%, respectively; p=0.007). Neither residential status nor parity demonstrated statistically significant associations with anemia severity (p=0.112 and p=0.204, respectively) [Table-III].

TABLE-I

Socio-demographic and clinical characteristics of pregnant women with iron deficiency anemia (n=192)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	20–25	86	44.8
	26–30	73	38.0
	31–35	33	17.2
Educational attainment	Illiterate	54	28.1
	Primary (1–5 years)	67	34.9
	Secondary (6–10 years)	48	25.0
	Higher (>10 years)	23	12.0
Monthly family income (PKR)	<50,000	139	72.4
	≥50,000	53	27.6
Residence	Rural	131	68.2
	Urban	61	31.8
Parity	Primipara (≤1)	80	41.7
	Multipara (>1)	112	58.3
Pregnancy interval	<2 years	78	40.6
	≥2 years	114	59.4
Trimester at enrollment	First	41	21.4
	Second	89	46.4
	Third	62	32.3

Stratified analysis of daily meal frequency (<3 meals/day) identified several significant socio-demographic correlates. Inadequate meal consumption was more prevalent among women with limited education (43.0%) compared to those with secondary or higher schooling (29.6%; p=0.031). Lower household income was similarly associated with higher rates of inadequate meal frequency (43.9% vs. 22.6%; p=0.009), as was rural residence (42.7% vs. 27.9%; p=0.015). The strongest association was observed with pregnancy interval; women with inter-pregnancy gaps of less than two years were significantly more likely to report inadequate daily meals (50.0%) compared to those with intervals of two years or longer (29.8%; p=0.003). Parity status did not show a significant relationship with meal frequency (p=0.217) [Table-IV].

Bivariate analysis of composite dietary insufficiency (≥2 dietary deficiencies) confirmed consistent associations with socioeconomic and reproductive factors. Women with low educational attainment were more likely to exhibit composite insufficiency than their more educated counterparts (58.7% vs. 45.1%; p=0.024). Low household income demonstrated a stronger association (59.7% vs. 39.6%; p=0.006), as did rural residence (58.8% vs. 44.3%; p=0.041). The most pronounced association was observed with short pregnancy intervals, where 65.4% of women with intervals <2 years demonstrated composite dietary insufficiency compared to 45.6% in the ≥2 years group (p<0.001). Multiparity was not significantly associated with composite dietary insufficiency (57.1% vs. 50.0%; p=0.189) [Table-V].

TABLE-II

Dietary Intake Patterns and Nutritional Practices among Participants (n=192)

Dietary Variable	Operational Definition	Inadequate Intake n (%)	Adequate Intake n (%)
Daily meal frequency	<3 meals/day vs. ≥3 meals/day	73 (38.0)	119 (62.0)
Meat consumption	<2 servings/week vs. ≥2 servings/week	119 (62.0)	73 (38.0)
Vegetable intake	<2 servings/week vs. ≥2 servings/week	86 (44.8)	106 (55.2)
Egg consumption	<2 servings/week vs. ≥2 servings/week	137 (71.4)	55 (28.6)
Composite dietary score	≥2 inadequate categories vs. 0–1	104 (54.2)	88 (45.8)

TABLE-III

Distribution of anemia severity by socio-demographic factors (n=192)

Factor	Mild Anemia n (%)	Moderate Anemia n (%)	Severe Anemia n (%)	P-Value
Education				0.018
	Illiterate/Primary	38 (31.4)	62 (51.2)	
	Secondary/Higher	42 (59.2)	24 (33.8)	
Monthly income				0.007
	<50,000 PKR	52 (37.4)	69 (49.6)	
	≥50,000 PKR	27 (50.9)	18 (34.0)	
Residence				0.112
	Rural	58 (44.3)	55 (42.0)	
	Urban	21 (34.4)	31 (50.8)	
Parity				0.204
	Primipara	37 (46.3)	33 (41.3)	
	Multipara	42 (37.5)	53 (47.3)	

TABLE-IV

Stratified Analysis: Frequency of Inadequate Daily Meal Consumption (<3 meals/day) by Socio-demographic Variables (n=192)

Stratification Variable	Category	Inadequate Meals n (%)	P-Value
Educational attainment	Illiterate/Primary	52/121 (43.0)	0.031
	Secondary/Higher	21/71 (29.6)	
Family income	<50,000 PKR	61/139 (43.9)	0.009
	≥50,000 PKR	12/53 (22.6)	
Residence	Rural	56/131 (42.7)	0.015
	Urban	17/61 (27.9)	
Pregnancy interval	<2 years	39/78 (50.0)	0.003
	≥2 years	34/114 (29.8)	
Parity	Primipara	28/80 (35.0)	0.217
	Multipara	45/112 (40.2)	

TABLE-V

Bivariate Associations between Exposure Variables and Composite Dietary Insufficiency (≥2 Deficiencies) (n=192)

Exposure Variable	Category	Dietary Insufficiency Present n (%)	Dietary Insufficiency Absent n (%)	P-Value
Low education	Yes	71/121 (58.7)	50/121 (41.3)	0.024
	No	32/71 (45.1)	39/71 (54.9)	
Low income	Yes	83/139 (59.7)	56/139 (40.3)	0.006
	No	21/53 (39.6)	32/53 (60.4)	
Rural residence	Yes	77/131 (58.8)	54/131 (41.2)	0.041
	No	27/61 (44.3)	34/61 (55.7)	
Short pregnancy interval	Yes	51/78 (65.4)	27/78 (34.6)	<0.001
	No	52/114 (45.6)	62/114 (54.4)	
Multiparity	Yes	64/112 (57.1)	48/112 (42.9)	0.189
	No	40/80 (50.0)	40/80 (50.0)	

DISCUSSION

The present investigation demonstrates that iron deficiency anemia among pregnant women in this tertiary care setting is closely intertwined with socioeconomic deprivation, restricted educational attainment and suboptimal dietary practices. A substantial proportion of the participants consumed fewer than three meals daily, with animal-source proteins and vegetables markedly underrepresented in weekly menus. The composite dietary score revealed that more than half of the participants met criteria for multiple nutritional deficiencies, underscoring the pervasive nature of food insecurity and dietary gaps in this population.[10] These observations align with recent regional evidence indicating that maternal nutritional status remains highly sensitive to household economic capacity and literacy levels.[11] Women with minimal formal education and lower monthly incomes exhibited significantly higher rates of moderate to severe anemia, a pattern consistent with studies from South Asia where financial constraints directly limit access to iron-rich foods and prenatal supplements.[12] Limited health literacy further compounds this disparity, as educated women are more likely to recognize dietary requirements and adhere to antenatal nutritional guidance.[13]

The pronounced inadequacy in egg and meat consumption reflects broader cultural and economic barriers in resource-limited settings, where plant-based staples dominate daily menus despite lower

bioavailability of non-heme iron.[14] Notably, short inter-pregnancy intervals emerged as the strongest predictor of both inadequate meal frequency and composite dietary insufficiency.[15] Rapid successive pregnancies deplete maternal iron reserves before physiological recovery can occur, a mechanism well-documented in low-resource obstetric populations.[16] The absence of significant associations with parity and residential status in this group may reflect uniform socioeconomic constraints across both urban and rural catchment areas, suggesting that economic vulnerability overrides geographic differences in nutritional access.[17]

The methodological rigor of this study is reinforced by standardized operational definitions aligned with international obstetric guidelines, comprehensive stratification of exposure variables, and a high data completion rate across all demographic and dietary domains.[18] However, several constraints warrant acknowledgment. The cross-sectional design precludes causal inference regarding the temporal relationship between dietary habits and anemia progression, while reliance on self-reported intake introduces potential recall and social desirability biases.[19] Additionally, the single-center recruitment and non-probability sampling technique may limit the external validity of these findings to other regional or provincial populations.[20] Future research should incorporate biochemical markers such as serum ferritin and transferrin saturation to differentiate iron deficiency from other anemic etiologies, and employ longitudinal or multi-center designs to capture seasonal dietary variations and intervention responsiveness.[21] From a public health perspective, integrating targeted nutritional counseling into routine antenatal visits, expanding community-based food fortification initiatives, and promoting evidence-based birth spacing programs could substantially mitigate maternal anemia burden in similar socioeconomic contexts.

CONCLUSION

Iron deficiency anemia in these pregnant women is predominantly driven by socioeconomic disadvantage, restricted dietary diversity and short inter-pregnancy intervals. Targeted nutritional interventions, enhanced health literacy initiatives and systematic birth spacing strategies are essential to reduce maternal anemia prevalence and improve perinatal outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1	**Hafsa Nazir Malik:** Conception of Idea, study design, acquisition of data, Manuscript drafting.
2	**Summaira Hassan:** Data collection, data analysis.
3	**Sadia Abbasi:** Interpretation of data.
4	**Areej Fatima:** Data collection.
5	**Syed Muhammad Rooh Ul Ain Naqi Bukhari:** Data entry.
6	**Ayesha Kausar:** Critical revision.