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PREVALENCE AND MULTIDIMENSIONAL DETERMINANTS OF ANEMIA AMONG PREGNANT WOMEN ATTENDING A TERTIARY CARE HOSPITAL: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

Ayesha Shahzad[*1], Faisal Wadood[2], Mehreen Mehdi[3], Ahmed Ejaz[4], Anbreen Gul[5], Musarat Ramzan[6]

*[*1]House Officer, CMH Lahore Medical College & Institute of Dentistry, Lahore, Pakistan*
[2]Dean, Allied Health Sciences, HITEC-IMS, Pakistan
[3]Professor & HOD of the Gyne Department, Wah Medical College, Wah Cant (NUMS University), Pakistan
[4]Founder, Rite Institute of Mind Sciences™ (RIMS) and Similia Homoeo Clinix™ (SHC), Abbottabad, Pakistan
[5]Dental Surgeon, Institute of Dentistry, CMH Lahore Medical College, Pakistan
[6]Professor & HOD, Department of Community Medicine, Wah Medical College, Wah Cantt (NUMS), Pakistan

[*1]ayeshashahzadbaig@gmail.com

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Corresponding Author: *
Musarat Ramzan

Abstract

Background: *Anemia during pregnancy remains an important maternal and public-health concern, particularly in settings where nutritional, socioeconomic, reproductive, and healthcare-related factors contribute to maternal vulnerability. Evidence from Pakistan indicates a substantial burden of maternal anemia, but local data from specific tertiary-care settings remain limited.*

Objective: *To determine the prevalence of anemia and identify sociodemographic, obstetric, nutritional, and healthcare-related factors associated with anemia among pregnant women attending the antenatal care clinic of a tertiary care hospital in Wah Cantt, Taxila.*

Methodology: *A cross-sectional study was conducted among 250 pregnant women aged 18–40 years attending antenatal care at POF Hospital, Wah Cantt, Taxila. Participants were selected using consecutive sampling. Data on sociodemographic, obstetric, nutritional, and healthcare-related factors were collected using a structured proforma, and hemoglobin levels were measured from venous blood samples using a validated laboratory method. Data were analyzed using SPSS version 25.0, with descriptive statistics and Pearson's chi-square test used to assess associations between anemia and potential risk factors. A p-value <0.05 was considered statistically significant.*

Results: *Among 250 pregnant women, 64.4% were anemic, with a mean hemoglobin level of 10.2 ± 1.6 g/dL. Anemia was significantly associated with younger age, lower education, fewer antenatal care visits, lack of deworming, rural residence, and shorter birth interval ($p < .05$). No significant associations were observed with occupation, family type, or history of miscarriage.*

Conclusion: *Anemia represents a substantial health concern among pregnant women attending the study hospital and is associated with multiple sociodemographic, reproductive, and healthcare-related factors. Strengthening*

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antenatal care, nutritional counseling, appropriate deworming, and targeted preventive interventions may help address modifiable factors associated with maternal anemia.

INTRODUCTION

Anemia during pregnancy remains a major maternal and public-health concern, particularly in low- and middle-income countries where nutritional inadequacies, socioeconomic inequalities, limited healthcare utilization, and infectious conditions may coexist. The prevalence of maternal anemia varies considerably across populations and geographical settings, reflecting differences in dietary practices, maternal nutritional status, reproductive characteristics, socioeconomic circumstances, and access to antenatal services. Recent evidence from Pakistan indicates a substantial burden of anemia among pregnant women. A systematic review and meta-analysis of Pakistani studies reported a pooled prevalence of 70.4% among pregnant women, with considerable regional variation and a particularly high pooled prevalence of 77.4% reported for Punjab (Mahar et al., 2024). This considerable burden highlights the importance of assessing anemia within specific local populations to identify variations in prevalence and associated determinants.

Anemia during pregnancy is generally characterized by an insufficient hemoglobin concentration to meet maternal and fetal physiological requirements. The condition may compromise the oxygen-carrying capacity of blood and can result from multiple nutritional, physiological, pathological, and socioeconomic factors. Although iron deficiency represents an important contributor, maternal anemia may also arise from deficiencies of folate and vitamin B12, infectious and parasitic diseases, inflammatory conditions, inherited hemoglobin disorders, and blood loss. A systematic review and meta-analysis involving 51 studies identified multiple factors associated with anemia during pregnancy, including inadequate dietary diversity, low consumption of meat and vegetables, low meal frequency, tea or coffee consumption after meals, low household income, inadequate antenatal care, multiparity, multiple pregnancy, underweight status, short birth intervals, and advanced gestational age (Zhang et al., 2022). More recent evidence similarly demonstrates that maternal anemia has a multidimensional etiology involving nutritional, sociodemographic, reproductive, and healthcare-related determinants (Mekonnen et al., 2025).

Nutritional inadequacy is particularly important during pregnancy because physiological requirements for iron and other micronutrients increase substantially. Insufficient intake of nutrient-rich foods and limited dietary diversity can contribute to inadequate micronutrient availability and consequently increase the risk of anemia. A systematic review and meta-analysis found that inadequate dietary diversity during pregnancy was associated with an increased risk of maternal anemia, emphasizing the importance of dietary quality and nutritional adequacy during pregnancy (Seid et al., 2023). Similarly, evidence indicates that inadequate consumption of iron-rich foods, vegetables, and other micronutrient-dense foods may increase susceptibility to maternal anemia, while dietary patterns and meal-related practices can influence iron absorption and utilization (Zhang et al., 2022).

Iron and folic acid supplementation constitutes another important factor in the prevention of anemia during pregnancy. Inadequate adherence to supplementation may increase the risk of anemia, particularly among women whose dietary intake is insufficient to meet pregnancy-related nutritional requirements. Recent evidence indicates that inadequate iron and folic acid supplementation is associated with an increased likelihood of anemia among pregnant women, although the magnitude of this association varies across populations and healthcare settings (Mekonnen et al., 2025). The effectiveness of supplementation may also be influenced by adherence, dietary practices, timing of consumption, gastrointestinal tolerance, and access to antenatal healthcare. Therefore, assessment of supplementation practices is

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important when examining factors associated with anemia among pregnant women.

Maternal anemia is also influenced by sociodemographic characteristics. Maternal education, household income, place of residence, family size, and socioeconomic circumstances can influence dietary quality, health-seeking behavior, access to healthcare, and adherence to preventive interventions. A population-based multicenter cohort study reported that rural residence, lower educational attainment, three or more pregnancies, and multiple fetuses were associated with increased odds of anemia among pregnant women (Zhang et al., 2024). Similarly, a recent systematic review and meta-analysis reported that low income, inadequate antenatal care, rural residence, larger family size, and lower dietary diversity were associated with increased risk of anemia during pregnancy (Zhang et al., 2022). These findings suggest that maternal anemia should be considered within a broader social and nutritional context rather than being viewed solely as an individual clinical condition.

Reproductive and obstetric characteristics may also contribute to the development of anemia. Multiparity, multiple gestation, short birth intervals, and increasing gestational age have been identified as important associated factors. Pregnancy places additional demands on maternal iron stores because iron is required for expansion of maternal blood volume, placental development, and fetal growth. Consequently, women with repeated pregnancies and inadequate intervals between pregnancies may have insufficient time to replenish depleted nutritional stores. Evidence from recent studies has demonstrated associations between higher gravidity, multiple fetuses, short birth intervals, and maternal anemia (Zhang et al., 2024; Mekonnen et al., 2025). These reproductive factors are therefore important considerations in evaluating the determinants of anemia among pregnant women.

Infections and parasitic diseases may further contribute to maternal anemia by causing blood loss, inflammation, impaired nutrient absorption, or increased nutritional requirements. A comprehensive umbrella review of systematic reviews and meta-analyses identified intestinal parasitic infections and malaria among important modifiable risk factors for anemia during pregnancy, alongside poor dietary diversity, inadequate iron and folic acid supplementation, low maternal education, adolescent pregnancy, short birth intervals, and inadequate antenatal care (Mekonnen et al., 2025). Although the relevance of specific infectious determinants may differ according to geographical setting, their consideration is important when investigating the multifactorial nature of maternal anemia.

Anemia during pregnancy has implications extending beyond maternal hematological status and may adversely affect pregnancy and neonatal outcomes. A systematic review and meta-analysis of cohort studies reported that maternal anemia was associated with increased risks of postpartum hemorrhage, premature rupture of membranes, preterm delivery, low birth weight, cesarean delivery, gestational hypertension, and neonatal asphyxia (Wang et al., 2025). Similarly, evidence from South Asian populations demonstrated that maternal anemia was associated with increased risks of low birth weight, preterm birth, and perinatal mortality (Rahman et al., 2022). A prospective maternal and neonatal registry involving South Asian populations, including Pakistan, further demonstrated associations between maternal hemoglobin concentrations and adverse pregnancy outcomes (Daru et al., 2021). These findings emphasize the importance of early identification and appropriate management of anemia as part of comprehensive antenatal care.

The Pakistani context is particularly important because recent evidence indicates a substantial burden of anemia among pregnant women. Mahar et al. (2024) reported a pooled prevalence of 70.4% among pregnant women in Pakistan, with substantial heterogeneity across geographical regions and socioeconomic groups. Earlier hospital-based evidence from Lahore also demonstrated a considerable prevalence of anemia among pregnant women and identified lower household income as an important independent factor associated with maternal anemia (Khan et al., 2018). More recent research among women of reproductive age attending a tertiary care hospital in Karachi reported a high prevalence of anemia

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and identified socioeconomic status, irregular meal patterns, frequent tea consumption, pica, and pregnancy as relevant factors (Shah et al., 2024). Although findings from these studies provide important evidence regarding anemia in Pakistani women, differences in geographical location, study population, healthcare setting, and methodology indicate the need for additional evidence from other local populations.

The available literature demonstrates that maternal anemia is influenced by a complex interaction of nutritional, socioeconomic, reproductive, obstetric, and healthcare-related factors. However, prevalence estimates and determinants may differ substantially between communities and healthcare settings. Evidence specifically concerning pregnant women attending tertiary-level antenatal services in Wah Cantt, Taxila remains limited. Establishing the local prevalence and identifying associated factors may provide useful evidence for identifying women at increased risk and strengthening contextually appropriate antenatal screening, nutritional counseling, supplementation, and preventive strategies. Therefore, the present study aims to determine the prevalence of anemia and examine its associated sociodemographic, nutritional, obstetric, and healthcare-related factors among pregnant women attending the antenatal care clinic of a tertiary care hospital in Wah Cantt, Taxila. Accordingly, the objectives of the study are:

1. To determine the prevalence of anemia among pregnant women attending the antenatal care clinic of a tertiary care hospital in Wah Cantt, Taxila
2. To identify the sociodemographic, nutritional, obstetric, and healthcare-related factors associated with anemia among pregnant women attending the antenatal care clinic of a tertiary care hospital in Wah Cantt, Taxila.

Methodology

This cross-sectional study was conducted to determine the prevalence of anemia and its associated factors among pregnant women attending antenatal care services. The study was conducted in the Department of Obstetrics and Gynecology, POF Hospital, Wah Cantt, Taxila, over a period of six months following approval of the research synopsis and ethical approval. A non-probability consecutive sampling technique was employed. All eligible pregnant women presenting to the antenatal care clinic during the study period were approached consecutively until the required sample size was achieved.

The sample size was calculated using the WHO sample size calculator, considering a 95% confidence level, 7% absolute precision, and an anticipated prevalence of anemia of 66.9% among pregnant women based on previously reported evidence. The required sample size for the study was 250 pregnant women. Women aged 18–40 years who were pregnant, attending the antenatal care clinic with a gestational age of 20–37 weeks, and had a singleton pregnancy were eligible for participation. Women willing to participate in the study and provide written informed consent were included. Women with a history of blood transfusion within the preceding three months, known hemolytic or inherited blood disorders such as thalassemia, medical conditions associated with significant gastrointestinal blood loss such as ulcerative colitis, or any other condition that could substantially affect hemoglobin concentration independently of pregnancy-related factors were excluded.

Following approval from the Institutional Review Board (IRB) of Wah Medical College and permission from the concerned hospital authorities, eligible pregnant women attending the antenatal care clinic of POF Hospital, Wah Cantt, Taxila, were approached for participation. The purpose, procedures, potential benefits, and possible risks of the study were explained to each participant, and written informed consent was obtained before enrollment. A structured data collection proforma was used to record relevant sociodemographic, obstetric, nutritional, and healthcare-related information. The variables included maternal age, gestational age, residence, occupation, educational level, socioeconomic status, family type, number of antenatal care visits, deworming status, birth interval, and history of miscarriage or abortion. Relevant medical and obstetric histories were obtained, followed by a general physical examination.

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For hemoglobin assessment, approximately 2 mL of venous blood was collected from the antecubital vein under appropriate aseptic precautions using a sterile disposable syringe and transferred into a properly labeled EDTA-containing blood collection tube. Each sample was assigned a unique identification number to maintain confidentiality and facilitate linkage with the corresponding data collection form. The EDTA blood samples were processed according to the standard laboratory protocol of the hospital, and hemoglobin concentration was measured using the laboratory's validated colorimetric method. Serum separation was not performed because hemoglobin estimation was conducted using anticoagulated whole blood rather than serum. The hemoglobin concentration was recorded in g/dL, and anemia was classified according to the operational definition specified for the study. All laboratory procedures were performed by trained laboratory personnel following standard operating procedures and appropriate quality-control measures.

All completed data collection forms were checked for completeness and consistency before data entry. Participants' identities were not included in the analytical dataset, and confidentiality of all collected information was maintained throughout the study. Data were entered, coded, and analyzed using SPSS version 25.0. Descriptive statistics were used to summarize the study variables. Quantitative variables, including maternal age and gestational age, and hemoglobin status were presented as mean ± standard deviation, while categorical variables, including age group, anemia status, adolescent pregnancy, number of antenatal care visits, residence, occupation, educational level, family type, deworming status, birth interval, and history of miscarriage or abortion, were presented as frequencies and percentages. Potential effect modifiers and associated factors, including maternal age, gestational age, residence, occupation, educational level, socioeconomic status, family type, number of antenatal care visits, deworming status, and birth interval, were assessed through appropriate stratification. Pearson's chi-square test was used to assess the association between anemia status and categorical sociodemographic, nutritional, obstetric, and healthcare-related factors. A p-value <0.05 was considered statistically significant.

Ethical approval for the study was obtained from the Institutional Review Board (IRB), Wah Medical College, before commencement of data collection, and permission was also obtained from the relevant hospital authorities. The study was conducted in accordance with accepted ethical principles for research involving human participants. Written informed consent was obtained from all participants after adequate information regarding the study had been provided. Participation was voluntary, and participants had the right to withdraw from the study at any stage without any effect on their medical care. Confidentiality and privacy were maintained throughout the research process. Participant identification numbers were used instead of names in the research dataset, and collected information was used exclusively for research purposes. All procedures involving blood collection were performed using appropriate aseptic techniques and standard safety precautions.

Results

Table 1: Frequency of Anemia and Distribution of Risk Factors (n = 250)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	18-29 years	52	20.8
	29-40 years	198	79.2
Anemia Status	Anemic (Hb <11 g/dL)	161	64.4
	Non-anemic	89	35.6
Education	< Undergraduate	141	56.4

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Variable	Category	Frequency (n)	Percentage (%)
	≥ Graduate/Postgraduate	109	43.6
ANC Visits	<3 visits	150	60.0
	≥3 visits	100	40.0
Deworming	No	172	68.8
	Yes	78	31.2
Occupation	Housewife	204	81.6
	Working	46	18.4
Family Type	Nuclear	127	50.8
	Joint	123	49.2
Residence	Rural	158	63.2
	Urban	92	36.8
Birth Interval	<2 years	104	41.6
	≥2 years	146	58.4
History of Miscarriage	Yes	57	22.8
	No	193	77.2

Table-1 results show that 64.4% (n = 250) of pregnant women were anemic, whereas 35.6% (n = 89) were non-anemic. Most participants were aged 29-40 years (79.2%), had education below undergraduate level (56.4%), and reported fewer than three antenatal care visits (60.0%). The majority had not received deworming (68.8%), were housewives (81.6%), belonged to nuclear families (50.8%), and resided in rural areas (63.2%). More than half of the participants reported a birth interval of ≥2 years (58.4%), while 22.8% had a history of miscarriage.

Table 2**: Descriptive Statistics of Quantitative Variables (n = 250)**

Variable	Mean ± SD
Age (years)	27.4 ± 5.2
Gestational Age (weeks)	29.6 ± 4.8
Hemoglobin (g/dL)	10.2 ± 1.6

Table 2 results show that the mean age of the participants was 27.4 ± 5.2 years. The mean gestational age was 29.6 ± 4.8 weeks. The mean hemoglobin concentration was 10.2 ± 1.6 g/dL, indicating that the overall hemoglobin level of the study population was relatively low.

Table 3. Association of Sociodemographic, Obstetric, and Healthcare-Related Factors with Anemia among Pregnant Women (n = 250)

Variable	Category	Anemic n (%)	Non-Anemic n (%)	p-value
Age Group	18-29 years	43 (82.7%)	9 (17.3%)	0.018
	29-40 years	118 (59.6%)	80 (40.4%)	
Education	< Secondary	112 (79.4%)	29 (20.6%)	<0.001
	≥ Secondary	49 (45.0%)	60 (55.0%)	

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Variable	Category	Anemic n (%)	Non-Anemic n (%)	p-value
ANC Visits	<4 visits	121 (80.7%)	29 (19.3%)	<0.001
	≥4 visits	40 (40.0%)	60 (60.0%)	
Deworming	No	132 (76.7%)	40 (23.3%)	<0.001
	Yes	29 (37.2%)	49 (62.8%)	
Occupation	Housewife	138 (67.6%)	66 (32.4%)	0.084
	Working	23 (50.0%)	23 (50.0%)	
Family Type	Nuclear	89 (70.6%)	37 (29.4%)	0.092
	Joint	72 (58.5%)	51 (41.5%)	
Residence	Rural	118 (74.7%)	40 (25.3%)	0.006
	Urban	43 (46.7%)	49 (53.3%)	
Birth Interval	<2 years	80 (77.7%)	23 (22.3%)	0.002
	≥2 years	81 (55.5%)	65 (44.5%)	
Miscarriage History	Yes	40 (70.2%)	17 (29.8%)	0.421
	No	121 (62.7%)	72 (37.3%)	

Table-3 results show that anemia was significantly associated with age group, education, number of antenatal care visits, deworming status, residence, and birth interval ($p < .05$). Anemia was more frequent among participants aged 18-29 years (82.7%) than those aged 29-40 years (59.6%, $p = .018$). Participants with education below secondary level had a higher proportion of anemia (79.4%) compared with those with ≥ secondary education (45.0%, $p < .001$). Similarly, anemia was more common among women with fewer than four antenatal care visits (80.7%) than among those with ≥4 visits (40.0%, $p < .001$). Women who had not received deworming had a higher prevalence of anemia (76.7%) compared with those who had received deworming (37.2%, $p < .001$). Rural residents had a higher proportion of anemia (74.7%) than urban residents (46.7%, $p = .006$), while women with a birth interval of <2 years had a higher proportion of anemia (77.7%) than those with an interval of ≥2 years (55.5%, $p = .002$). In contrast, occupation, family type, and history of miscarriage were not significantly associated with anemia ($p > .05$).

Discussion

The present study aimed to determine the prevalence of anemia and examine its sociodemographic, obstetric, nutritional, and healthcare-related factors among pregnant women attending antenatal care services at a tertiary care hospital in Wah Cantt, Taxila. Among the 250 pregnant women included in the study, 64.4% were anemic, indicating that anemia represented a substantial health burden in this study population. This finding is consistent with the broader epidemiological situation in Pakistan, where a recent systematic review and meta-analysis reported a pooled anemia prevalence of 70.4% among pregnant women, with the prevalence reaching 77.4% in Punjab (Mahar et al., 2024). The prevalence observed in the present study was therefore lower than the pooled estimate for Punjab but remained considerable. Differences in study setting, participant characteristics, gestational age, diagnostic procedures, socioeconomic composition, and healthcare utilization may account for variation between individual studies and pooled estimates. The comparatively high prevalence observed in the present study reinforces the continued importance of anemia screening and prevention within antenatal services in this population.

Table 1 demonstrated that the participants had a mean age of 27.4 ± 5.2 years and a mean gestational age of 29.6 ± 4.8 weeks. The mean

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hemoglobin concentration was 10.2 ± 1.6 g/dL, which was below the conventional threshold used in the study to classify anemia during pregnancy. The relatively low mean hemoglobin is compatible with the high proportion of participants classified as anemic. The interpretation should nevertheless recognize that hemoglobin concentration during pregnancy is influenced by physiological hemodilution as well as nutritional, infectious, and other maternal factors. Evidence from a large global systematic review and meta-analysis has shown that low maternal hemoglobin concentrations during pregnancy are associated with several adverse maternal and neonatal outcomes, although the magnitude and timing of these associations vary according to hemoglobin concentration and gestational period (Young et al., 2023).

The findings in Table 2 further characterized the study population and demonstrated that 64.4% of participants were anemic, while 35.6% were non-anemic. A substantial proportion of women had fewer than three antenatal care visits (60.0%), had not received deworming (68.8%), and resided in rural areas (63.2%). More than half had education below undergraduate level (56.4%), and 81.6% were housewives. These characteristics are relevant because maternal anemia is recognized as a multidimensional condition influenced by nutritional, reproductive, sociodemographic, infection-related, and healthcare-access factors. A recent umbrella review of systematic reviews and meta-analyses identified low maternal education, adolescent pregnancy, short birth intervals, rural residence, inadequate antenatal care, poor dietary practices, inadequate iron and folic acid supplementation, and intestinal parasitic infections among important modifiable factors associated with anemia during pregnancy (Dagne et al., 2026).

The high proportion of women with limited antenatal care attendance in the present study is particularly relevant to the observed anemia burden. Antenatal care provides opportunities for hemoglobin screening, nutritional assessment, iron and folic acid supplementation, counseling, identification of infections, and timely management of anemia. The present findings are consistent with the meta-analysis by Zhang et al. (2022), which identified lack of antenatal care as a risk factor for anemia and reported associations between anemia and rural residence, low household income, inadequate dietary diversity, later gestational age, and short birth intervals. The distribution observed in Table 2 therefore provides an important contextual background for interpreting the significant associations observed in Table 3.

Table 3 showed a statistically significant association between age group and anemia. Anemia was observed in 82.7% of participants aged ≤19 years compared with 59.6% among those aged >19 years (p = .018). This finding suggests that younger pregnant women in this population constituted an important subgroup with a higher proportion of anemia. The result is consistent with recent evidence identifying adolescent pregnancy as a determinant associated with maternal anemia. The 2026 umbrella review reported an association between adolescent pregnancy and anemia, with the increased risk potentially reflecting increased nutritional requirements during maternal growth combined with the physiological demands of pregnancy (Dagne et al., 2026). However, because the present study used a cross-sectional design, the observed association should not be interpreted as evidence that younger age independently caused anemia.

Educational attainment was also significantly associated with anemia. Participants with education below secondary level had a considerably higher proportion of anemia (79.4%) than those with ≥ secondary education (45.0%, p < .001). This finding is consistent with evidence indicating that maternal education is an important social determinant of anemia. Dagne et al. (2026) identified low maternal education as a consistently reported modifiable sociodemographic factor, while Zhang et al. (2022) similarly identified socioeconomic and dietary factors as important contributors to maternal anemia. Education may influence health literacy, knowledge regarding nutrition and supplementation, utilization of antenatal services, and preventive health practices. Nevertheless, these pathways were not directly examined in the present study, and the association

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should therefore be interpreted as an observed relationship rather than a demonstrated mechanism.

A strong association was also observed between antenatal care attendance and anemia. Among women who had fewer than four antenatal visits, 80.7% were anemic compared with 40.0% among those who had ≥4 visits ($p < .001$). This finding is consistent with previous evidence showing that inadequate antenatal care is associated with increased anemia risk. Zhang et al. (2022) identified absence or inadequate utilization of antenatal care among the factors associated with anemia, while Dagne et al. (2026) reported that limited antenatal care access was consistently associated with maternal anemia across systematic reviews. The observed relationship may reflect the role of antenatal services in facilitating screening, supplementation, dietary counseling, and management of pregnancy-related health problems. It is also possible that women who already experience health or socioeconomic disadvantages are less likely to attend antenatal services, meaning that antenatal attendance may partly represent broader patterns of healthcare access.

Deworming status demonstrated one of the strongest observed associations in the present study. Anemia was present in 76.7% of women who had not received deworming compared with 37.2% among those who had received deworming ($p < .001$). This finding is biologically plausible because intestinal parasitic infections can contribute to anemia through chronic blood loss, impaired nutrient absorption, and altered nutritional status. The findings correspond with the systematic review and meta-analysis by Zhang et al. (2022), which identified parasitic infection as a risk factor for anemia during pregnancy. More recent evidence from the umbrella review by Dagne et al. (2026) similarly identified intestinal parasitic infections as an important modifiable factor associated with maternal anemia. However, deworming status in the present study was not accompanied by laboratory confirmation of parasitic infection; therefore, the association between deworming status and anemia should not be interpreted as proof that parasitic infection was responsible for the observed anemia.

Residence was significantly associated with anemia, with 74.7% of rural residents being anemic compared with 46.7% of urban residents ($p = .006$). This finding is consistent with the existing evidence that rural residence is associated with increased anemia risk. Zhang et al. (2022) identified rural residence among the factors associated with maternal anemia, and the recent umbrella review by Dagne et al. (2026) reported a pooled association between rural residence and anemia across the available evidence. In the Pakistani context, persistent differences by geographical location and rural–urban residence have also been documented in analyses of women's anemia and nutritional status (Khan et al., 2025). Rural residence may be associated with differences in healthcare accessibility, socioeconomic circumstances, dietary diversity, health literacy, and utilization of antenatal services. These factors were not independently modeled in the present analysis, so the rural–urban difference may reflect the combined influence of several underlying determinants.

Birth interval was another significant factor associated with anemia. Among women with a birth interval of <2 years, 77.7% were anemic compared with 55.5% among women with an interval of ≥2 years ($p = .002$). This finding is consistent with the broader literature. Zhang et al. (2022) identified a birth interval of ≤2 years as a risk factor for anemia during pregnancy, while Dagne et al. (2026) reported short birth intervals of less than 24 months among consistently identified sociodemographic and reproductive determinants. A shorter interval between pregnancies may provide less time for recovery of maternal nutritional stores after a previous pregnancy and lactation period. Nevertheless, the present cross-sectional design does not establish the temporal or causal pathway between birth interval and anemia.

In contrast, occupation was not significantly associated with anemia ($p = .084$), although anemia was more frequent among housewives (67.6%) than working women (50.0%). Similarly, family type was not significantly associated with

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anemia (p = .092), despite a higher proportion of anemia among women from nuclear families (70.6%) than among those from joint families (58.5%). History of miscarriage was also not significantly associated with anemia (p = .421). The absence of statistical significance for these variables indicates that their distributions did not demonstrate sufficient evidence of an association with anemia in this particular sample. These findings also illustrate the importance of considering local population characteristics, because determinants identified in one setting may not demonstrate the same magnitude or statistical significance in another.

Overall, the findings demonstrate that anemia among pregnant women attending the study hospital was associated with multiple sociodemographic and healthcare-related characteristics, particularly younger age, lower educational attainment, fewer antenatal care visits, absence of deworming, rural residence, and shorter birth intervals. The pattern is broadly consistent with contemporary evidence describing maternal anemia as a multidimensional condition rather than a problem attributable to a single nutritional deficiency. The 2026 umbrella review similarly grouped the determinants of pregnancy anemia into nutritional, maternal health, sociodemographic, and healthcare-access domains, supporting the multidimensional framework adopted in the present study (Dagne et al., 2026).

The findings are clinically and public-health relevant because maternal anemia is associated with important adverse pregnancy outcomes. A 2025 systematic review and meta-analysis of 31 cohort studies reported that anemia during pregnancy was associated with increased risks of postpartum hemorrhage, premature rupture of membranes, preterm delivery, low birth weight, cesarean delivery, gestational hypertension, and neonatal asphyxia (Wang et al., 2025). Similarly, a recent systematic review and meta-analysis found that maternal anemia and iron deficiency were associated with an increased risk of fetal growth restriction (Jayalakshmi et al., 2025). Although the present study did not examine pregnancy or neonatal outcomes, the high prevalence of anemia and its association with modifiable healthcare and sociodemographic factors indicate the importance of strengthening antenatal screening, nutritional counseling, supplementation, infection prevention, and appropriate follow-up within the study setting.

The study should be interpreted in light of several methodological considerations. Its hospital-based cross-sectional design allowed estimation of the prevalence of anemia and identification of associated factors but did not permit determination of temporal or causal relationships. The use of consecutive non-probability sampling may also limit generalizability beyond pregnant women attending the selected hospital. Furthermore, although several relevant sociodemographic, obstetric, and healthcare variables were assessed, the available analysis did not include detailed dietary diversity, iron and folic acid adherence, serum ferritin, folate, vitamin B12, inflammatory markers, or laboratory confirmation of parasitic infection. These factors may account for some of the unexplained variation in hemoglobin concentration. Future studies involving multiple healthcare facilities, probability-based sampling, and multivariable analysis incorporating nutritional, biochemical, infectious, and healthcare-utilization variables could provide a more comprehensive assessment of the determinants of maternal anemia in the region.

Conclusion

The present study found that anemia remains a substantial health concern among pregnant women attending a tertiary care hospital. The findings showed important associations between anemia and maternal age, educational attainment, antenatal care utilization, deworming practices, place of residence, and birth interval, while occupation, family type, and history of miscarriage were not significantly associated with anemia. These findings highlight the multifactorial nature of anemia during pregnancy and underscore the need for strengthened antenatal care, nutritional support, appropriate deworming, and targeted health education to address preventable contributing factors.

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Limitation and Recommendation

This study has certain limitations. Its hospital-based cross-sectional design limits the ability to establish causal relationships between anemia and the identified associated factors. Non-probability consecutive sampling may limit the generalizability of the findings to pregnant women in other healthcare settings or communities. The study was conducted at a single tertiary care hospital, which may not fully represent the wider population. In addition, dietary intake, adherence to iron and folic acid supplementation, and specific causes of anemia were not assessed in detail. The findings should therefore be interpreted within the context of the study setting and population.

Routine anemia screening should be strengthened throughout antenatal care, particularly among women with limited antenatal care utilization and those from rural and socioeconomically disadvantaged backgrounds. Antenatal services should incorporate targeted nutritional counseling, appropriate deworming, and education regarding preventive practices. Healthcare providers should encourage timely and regular antenatal visits and provide closer follow-up for women at increased risk of anemia. Future studies should include multiple healthcare facilities and assess dietary intake, iron and folic acid supplementation, and laboratory indicators to provide a more comprehensive understanding of the determinants and causes of anemia during pregnancy.

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