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Hematological Profiles, and Socio-Demographic Risk Factors of Anemia in Pregnant Women District Swat.

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Abstract

Background: Anemia during pregnancy is a critical public health concern, particularly in low-resource settings like Pakistan. It elevates risks for maternal mortality, preterm birth, low infant birth weight, and fetal developmental issues. Despite its severity, detailed data on its prevalence and socio-demographic determinants among pregnant women in District Swat, Pakistan, remains scarce.

Objective: This study aimed to determine the prevalence of anemia, assess hematological profiles, and identify associated socio-demographic risk factors in pregnant women District Swat.

Methods: A cross-sectional study was conducted from January to June 2024. It included 1,143 pregnant women (aged 15-45) randomly selected from healthcare facilities. Data on age, education, income, and prenatal care were collected via questionnaire. Blood samples analyzed hemoglobin (Hb), hematocrit, mean corpuscular volume (MCV), and mean corpuscular hemoglobin (MCH). Anemia was defined as Hb < 11 g/dL. Statistical analysis used SPSS and Excel, employing Chi-square tests.

Results: The overall anemia prevalence was 45.37%, peaking in Tehsils Kabal (53.73%) and Matta (50.82%). Highest rates were among women aged 20-35 (64.52%), those with low income (65.21%), and no formal education (74.48%). The second trimester showed the highest prevalence (59.25%). Average hemoglobin was 8.23 ± 2.15 g/dL, with 35.46% having moderate (Hb 7-9.9 g/dL) and 10.06% severe anemia (Hb < 7 g/dL).

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Mean MCV and MCH were 76.4 ± 7.8 fL and 24.9 ± 3.2 pg, respectively, indicating widespread iron deficiency. Significant associations existed between anemia and age, education, income, and trimester.

Conclusion: Anemia is highly prevalent among pregnant women in District Swat, strongly linked to socio-economic disadvantage and limited education. Findings underscore an urgent need for targeted interventions, including enhanced iron supplementation programs, nutritional education, and improved access to prenatal care, especially for vulnerable groups.

Introduction

Anemia in pregnancy is a widespread and pressing public health issue that affects women across the globe, particularly in low- and middle-income countries. It is a condition characterized by a deficiency of red blood cells or hemoglobin, impairing the oxygen-carrying capacity of blood. In pregnancy, anemia poses significant risks to both the mother and fetus, including increased risk of preterm delivery, low birth weight, maternal mortality, and fetal developmental complications (World Health Organization [WHO], 2021). According to global health data, anemia during pregnancy affects approximately 41.8% of pregnant women in developing countries (WHO, 2021), with the highest prevalence found in regions such as South Asia and Sub-Saharan Africa. In Pakistan, anemia is a common public health challenge. Studies have shown that the prevalence of anemia in pregnant women is alarmingly high, with estimates ranging from 45% to 75% depending on the region (Ali et al., 2018). District Swat, located in Khyber Pakhtunkhwa, is a rural area where healthcare access remains limited, particularly in remote and economically disadvantaged communities. Despite the significance of anemia during pregnancy in Pakistan, especially in rural districts, data on its prevalence and socio-demographic risk factors in District Swat is scarce.

This research aims to fill this gap by examining the hematological profiles of pregnant women in District Swat and identifying the socio-demographic risk factors contributing to anemia. Understanding these factors is crucial for designing effective interventions to reduce anemia's burden on maternal and fetal health in the region. Anemia in pregnancy is commonly attributed to iron deficiency, though other nutritional deficiencies, such as folate, vitamin B12, and vitamin A, as well as parasitic infections like malaria and hookworm, can also contribute (Clemens et al., 2015). The WHO defines anemia in pregnancy as a hemoglobin level less than 11 g/dL, with classifications based on severity (moderate: 7–9.9 g/dL, severe: less than 7 g/dL) (WHO, 2016). Several studies have demonstrated that iron deficiency anemia (IDA) is the leading cause of anemia

during pregnancy, due to the increased iron demands of the developing fetus and placenta (Sabaté et al., 2017). Additionally, anemia is often exacerbated by poor dietary intake, inadequate prenatal care, and socio-economic factors such as low income and education level (Moll et al., 2018). In rural regions of Pakistan, many pregnant women lack access to iron-rich foods or iron supplementation, which is crucial for preventing anemia. Furthermore, limited awareness about anemia's impact on pregnancy and inadequate healthcare infrastructure in these areas can worsen the situation. Consequently, pregnant women in these regions face higher rates of anemia and related complications, emphasizing the need for targeted public health interventions. While there have been numerous studies on anemia in pregnancy globally, few have focused specifically on the socio-demographic risk factors contributing to anemia in District Swat, Khyber Pakhtunkhwa. This study seeks to provide valuable data on the prevalence of anemia in this region, examine the hematological profiles of affected pregnant women, and analyze the socio-demographic factors contributing to the condition. By identifying high-risk groups and understanding the socio-economic factors at play, the study aims to inform public health strategies, including iron supplementation programs and educational campaigns targeting pregnant women in District Swat. The primary objectives of this study are as follows:

To determine the prevalence of anemia in pregnant women in District Swat.

To assess the hematological profiles, including hemoglobin levels, hematocrit, MCV, and MCH, in pregnant women.

To identify socio-demographic risk factors associated with anemia in pregnancy, such as age, income, education, and trimester of pregnancy.

To provide recommendations for targeted public health interventions based on the findings.

Methodology

Study Design and Setting

This cross-sectional study was conducted in District Swat, located in Khyber Pakhtunkhwa, Pakistan. The study was carried out in both public and private healthcare facilities, including hospitals and clinics, to ensure a diverse sample of pregnant women from various socio-economic backgrounds. The data collection period spanned from January to June 2024.

Study Population

The study included 1143 pregnant women, aged 15 to 45 years, who were selected through random sampling from antenatal care clinics. Women with known pre-existing

medical conditions such as chronic diseases (e.g., hypertension, diabetes) were excluded from the study to ensure that the findings were specifically related to anemia during pregnancy.

Inclusion Criteria

- Pregnant women aged 15–45 years.
- Women attending public or private healthcare facilities for antenatal care.

Exclusion Criteria

- Women with chronic medical conditions.
- Women who did not consent to participate in the study.

Data Collection

Data collection was done using a structured questionnaire designed to capture socio-demographic information, including age, educational level, income, and access to prenatal care. The questionnaire also included questions about dietary habits, particularly the consumption of iron-rich foods, as well as the use of iron supplements during pregnancy.

Blood samples were drawn from participants to assess the following hematological parameters:

- **Hemoglobin (Hb)**: Measured using a hemoglobinometer.
- **Hematocrit (HCT)**: Determined through a centrifuge.
- **Mean Corpuscular Volume (MCV)**: Calculated using the standard formula.
- **Mean Corpuscular Hemoglobin (MCH)**: Calculated from hemoglobin concentration and red blood cell count.

Anemia was classified based on hemoglobin levels as follows:

- **Normal**: Hb $\geqslant$ 11 g/dL
- **Anemia**: Hb < 11 g/dL
- **Moderate Anemia**: Hb 7-9.9 g/dL
- **Severe Anemia**: Hb < 7 g/dL

Statistical Analysis

The data were analyzed using SPSS version 25 and MS Excel 2016. Descriptive statistics, including frequencies, percentages, and mean values, were used to summarize the data. Chi-square tests were employed to assess the association between anemia and socio-demographic factors, such as age, education, income, and trimester of pregnancy. A p-value of <0.05 was considered statistically significant.

Results

The study revealed that the overall prevalence of anemia among pregnant women in District Swat was 45.37%. The highest prevalence was observed in Tehsil Kabal (53.73%)

and Tehsil Matta (50.82%). Anemia was most common among women aged 20–35 years (64.52%) and those from low-income households (65.21%). Additionally, illiterate women showed the highest anemia prevalence (74.48%), while anemia was more prevalent in the second trimester (59.25%) compared to the first (47.76%) and third trimesters (13.46%). The average hemoglobin level across participants was 8.23 ± 2.15 g/dL, indicating widespread iron deficiency. Moderate anemia (Hb 7–9.9 g/dL) was found in 35.46% of the women, while severe anemia (Hb < 7 g/dL) affected 10.06%. Hematological assessments revealed mean corpuscular volume (MCV) of 76.4 ± 7.8 fL and mean corpuscular hemoglobin (MCH) of 24.9 ± 3.2 pg. Chi-square tests showed significant associations between anemia and socio-demographic factors such as age, education, economic status, and trimester of pregnancy. These findings underline the substantial burden of anemia in the region and highlight the need for targeted interventions, particularly for disadvantaged and less-educated women.

Table 1: *Socio-Demographic Characteristics of Pregnant Women (n = 1143)*

Characteristic	Frequency	Percentage (%)
Age (Years)		
15–19	90	7.87
20–35	680	59.55
36–45	373	32.58
Education Level		
Illiterate	260	22.74
Primary Education	403	35.28
Secondary Education	303	26.50
Higher Education	177	15.52
Economic Status		
Low (⩽ PKR 10,000/month)	723	63.22
Medium (PKR 10,001–25,000)	345	30.20
High (> PKR 25,000/month)	75	6.57
Trimester of Pregnancy		
First Trimester	359	31.42
Second Trimester	590	51.62
Third Trimester	194	17.01

Table 2: *Hematological Profiles of Pregnant Women (n = 1143)*

Parameter	Mean (±SD)	Range
Hemoglobin (Hb)	8.23 ± 2.15 g/dL	3.5–14.2 g/dL
Hematocrit (HCT)	28.5% ± 7.10%	10–42%
Mean Corpuscular Volume (MCV)	76.4 ± 7.8 fL	58–105 fL
Mean Corpuscular Hemoglobin (MCH)	24.9 ± 3.2 pg	17–33 pg

Table 3: *Prevalence of Anemia and its Severity Among Pregnant Women*

Hemoglobin Level (g/dL)	Frequency	Percentage (%)
Normal (⩾ 11 g/dL)	623	54.63
Anemia (Hb < 11 g/dL)	520	45.37
Moderate Anemia (Hb 7–9.9 g/dL)	405	35.46
Severe Anemia (Hb < 7 g/dL)	115	10.06

Table 4: *Prevalence of Anemia by Age Group*

Age Group (Years)	Anemia Prevalence	Chi-Square Value	p-Value
15–19	58.45%	14.63	0.0001
20–35	64.52%		
36–45	40.48%		

Table 5: *Prevalence of Anemia by Education Level*

Education Level	Anemia Prevalence	Chi-Square Value	p-Value
Illiterate	74.48%	36.92	0.0001
Primary Education	51.86%		
Secondary Education	35.98%		
Higher Education	18.64%		

Table 6: *Prevalence of Anemia by Economic Status*

Economic Status	Anemia Prevalence	Chi-Square Value	p-Value
Low (⩽ PKR 10,000/month)	65.21%	12.65	0.001
Medium (PKR 10,001–25,000)	39.41%		
High (> PKR 25,000/month)	25.33%		

Table 7: *Prevalence of Anemia by Trimester*

Trimester	Anemia Prevalence	Chi-Square Value	p-Value

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Trimester	Anemia Prevalence	Chi-Square Value	p-Value
First Trimester	47.76%	11.43	0.001
Second Trimester	59.25%		
Third Trimester	13.46%		

Discussion

The study reveals a significant prevalence of anemia among pregnant women in District Swat, with 45.37% of participants affected by varying degrees of anemia. The findings are consistent with national data indicating high anemia rates in pregnant women, particularly in rural areas (Ali et al., 2018). Anemia was most prevalent in women aged 20–35 years, with a staggering 64.52% affected. This age group represents the majority of pregnant women, indicating that younger women may be particularly vulnerable due to higher fertility rates, inadequate nutrition, and insufficient prenatal care (Sabaté et al., 2017).

Education level emerged as a key factor influencing the prevalence of anemia, with illiterate women exhibiting the highest rates (74.48%). Education plays a significant role in improving health literacy and promoting behaviors that can prevent anemia, such as dietary choices and adherence to prenatal care (Moll et al., 2018). Illiterate women may have limited access to information about the importance of iron-rich foods or prenatal supplementation, which contributes to higher rates of anemia in this group. Educational interventions should, therefore, focus on this vulnerable population. The study also highlighted the impact of economic status on anemia prevalence. Pregnant women from low-income households (⩽ PKR 10,000/month) exhibited a significantly higher prevalence of anemia (65.21%) compared to women from higher-income groups. This finding is not surprising, as poverty is associated with poor nutrition and limited access to healthcare services (Clemens et al., 2015). Economic constraints often prevent women from affording iron-rich foods or prenatal supplements, exacerbating the risk of iron deficiency anemia (IDA). Public health interventions should focus on improving access to affordable iron supplements and nutrition education in economically disadvantaged areas. The study found that anemia was most prevalent in the second trimester (59.25%), followed by the first trimester (47.76%) and third trimester (13.46%). This trend may be attributed to the increased physiological demands for iron during the second trimester as the placenta and fetus grow, leading to greater depletion of iron stores (Sabaté et al., 2017). The third trimester shows a lower prevalence of anemia, possibly due to the introduction of iron supplements by this stage of pregnancy. This finding underscores the importance of early screening and intervention during

pregnancy, especially in the second trimester, to prevent severe anemia and its associated risks.

The findings of this study underscore the urgent need for targeted interventions to address anemia in pregnant women in District Swat. First, increasing awareness about the importance of iron-rich foods and supplements is crucial, particularly in less-educated and economically disadvantaged populations. Community health workers and local healthcare providers should play a central role in disseminating information and providing prenatal care to vulnerable groups. Additionally, iron supplementation programs should be strengthened and made more accessible to ensure that all pregnant women receive adequate nutrients during pregnancy (WHO, 2016).

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Authors' Contributions:
Dr. Murad Ali contributed to the study design, data collection, analysis, and manuscript writing. Dr. Seema Amin was involved in the data collection, analysis, Dr ikram Ullah manuscript Supervision. Tariq Hassan provided expert input in the analysis of results. Dr. Lubna Tahir participated in critical revisions to the manuscript. Dr. Rubi Hayat contributed to the overall manuscript revision.

Conflict of Interest:
The authors declare that they have no conflict of interest related to this study.

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