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Nutritional and Socio-Demographic Determinants of Hemoglobin Deficiency Among Unmarried Females

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Abstract

Hemoglobin deficiency is a major public health problem among adolescent and young women, particularly in developing countries, where nutritional deficiencies and socioeconomic factors increase the risk of anemia. This study aimed to assess the prevalence of hemoglobin deficiency and its associated factors among unmarried females aged 14–24 years. A descriptive cross-sectional study was conducted among 200 unmarried females aged 14–24 years. Socio-demographic and dietary information was collected using a structured questionnaire. Anthropometric measurements were recorded, and venous blood samples were collected to determine hemoglobin concentration using a hematology analyzer. Data were analyzed using descriptive statistics and presented as frequencies, percentages, mean, and standard deviation. Out of the 200 participants, 95 (47.5%) were anemic, while 105 (52.5%) had normal hemoglobin levels. Mild anemia was the most common type (35%), followed by severe anemia (10%) and moderate anemia (2.5%). The mean hemoglobin level was 10.8 ± 1.6 g/dL. Anemia was more prevalent among females aged

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14–18 years (75%) than those aged 19–24 years (25%). Low intake of iron-rich foods (48.42%), tea consumption immediately after meals (13.68%), low household income (16.84%), heavy menstrual bleeding (15%), and recurrent infections (5.26%) were identified as common factors associated with anemia. Hemoglobin deficiency was highly prevalent among unmarried females aged 14–24 years, with mild anemia being the predominant type. Poor nutrition, low socioeconomic status, menstrual blood loss, and recurrent infections were the main associated factors. These findings highlight the need for targeted nutrition education, early screening, and public health interventions to reduce anemia and improve the health of adolescent and young women.

Keywords: Hemoglobin deficiency, anemia, unmarried females, adolescents, nutritional status, iron deficiency.

Introduction

Anemia, defined by the World Health Organization as a haemoglobin concentration below 120 g/L in non-pregnant women, continues to be one of the most widespread nutritional deficiency disorders among women of reproductive age worldwide (1). Global analyses covering the period 2000–2019 show that after an initial decline, the worldwide prevalence of Anemia among women aged 15–49 years began rising again from 2013 onward (2), and more recent projections suggest that iron deficiency will remain a major contributor to the global disease burden through 2050 (3). Within this population, unmarried females—spanning adolescent girls and young unmarried women—constitute a distinct and understudied risk group, since accelerated pubertal growth, the onset of menarche, and recurring menstrual blood loss substantially raise their physiological iron requirements even before the added demands of pregnancy begin (4). Empirical studies from South Asia and the Middle East consistently report a high burden of Anemia among never-married adolescents and young women. A population-based longitudinal study from India found that socio-demographic characteristics, exposure to healthcare, and nutrition-related behaviours jointly predicted both the onset and remission of Anemia among never-married adolescents aged 10–19 years (5). Similarly, cross-sectional research among rural adolescent girls in western India linked poor dietary intake and socioeconomic disadvantage to elevated Anemia prevalence (6), while studies among female university and medical students in

Saudi Arabia and other settings have documented substantial rates of undiagnosed iron deficiency Anemia linked to dietary habits, psychological stress, and body composition (7,8). Comparable findings from university-based surveys elsewhere show that irregular meal patterns and low intake of fruit and heme-iron sources are significantly associated with lower haemoglobin levels (9), reinforcing the centrality of dietary quality to haemoglobin status in young, unmarried women. The determinants of hemoglobin deficiency in this population operate through interconnected nutritional and socio-demographic pathways. On the nutritional side, low dietary iron intake, poor diversity of iron-rich foods, and inadequate intake of absorption-enhancing nutrients are repeatedly identified as modifiable risk factors, and systematic reviews confirm that structured dietary interventions can meaningfully improve iron status in women (10,11). Socio-demographically, parental and personal education, household income, family size, place of residence, and access to sanitation and health services have each emerged as significant correlates of Anemia status among adolescent and young unmarried women, with lower socioeconomic position consistently predicting poorer haemoglobin outcomes across diverse settings (4,12). The consequences of unaddressed Anemia in unmarried females extend beyond the individual. Iron deficiency impairs cognitive performance, immune competence, and physical and occupational productivity (13), and because iron status established during adolescence strongly shapes maternal iron reserves at the time of marriage and subsequent pregnancy, Anemia among unmarried women is increasingly recognised as an upstream determinant of adverse maternal and perinatal outcomes (14).

This life-course perspective has prompted calls to extend nutrition-specific interventions—including iron-folic acid supplementation, dietary diversification, and integrated Anemia-control programming—to unmarried adolescents and young women rather than confining them to pregnant populations alone (15). National surveillance data from high-income settings confirm that Anemia prevalence remains markedly higher among adolescent girls and young women than among their male counterparts (16,17), while nationally representative surveys from Jordan and elsewhere show that sociodemographic factors continue to shape Anemia risk even among married women of reproductive age, underscoring the value of examining these determinants earlier in

the life course, before marriage (18,19). Regional burden-of-disease estimates further indicate that dietary iron deficiency remains a persistent public health problem across the Middle East and North Africa, disproportionately affecting women (20). Despite this expanding evidence base, most Anemia research continues to prioritise pregnant or ever-married women, leaving a comparative gap in understanding of the specific nutritional and socio-demographic pathways driving haemoglobin deficiency among unmarried females. Addressing this gap is essential for designing life-course-sensitive nutrition policies capable of intercepting Anemia before marriage and pregnancy compound its risks. The present study therefore examines the nutritional and socio-demographic determinants of hemoglobin deficiency among unmarried females, with the aim of informing targeted, evidence-based interventions for this underserved population.

Material and Methods

A descriptive cross-sectional study was conducted to assess hemoglobin deficiency among unmarried females aged 14–24 years. Ethical approval was obtained from the Institutional Research Ethics Committee of The Professional College of Medical Sciences (PCMS), affiliated with Khyber Medical University (KMU), Peshawar. Participation was voluntary, and written informed consent was obtained from all participants; for those younger than 18 years, parental or guardian consent was obtained along with participant assent. The study included unmarried females aged 14–24 years who met the eligibility criteria and agreed to participate. Married females, individuals with known chronic hematological disorders such as thalassemia or sickle cell disease, and those receiving iron supplementation or treatment for anemia were excluded to minimize potential confounding factors. Data was collected using a structured questionnaire to obtain socio-demographic information, including age, educational status, and family income, followed by anthropometric measurements such as height and weight to assess nutritional status. Venous blood samples were collected under sterile conditions by trained personnel, and hemoglobin concentration was measured using a hematology analyzer or a validated manual method where necessary. The data collected was entered into Microsoft Excel for data management and analyzed using descriptive statistics. Continuous variables were summarized using appropriate descriptive measures, while

categorical variables were presented as frequencies and percentages. The findings were presented in the form of tables, graphs, and figures.

Results

Demographic Data of Participants

A total of 200 unmarried females aged 14–24 years participated in the current study. Most participants (60%) were from rural areas, while 40% lived in urban areas. Regarding education, 155 (77.5%) were educated and 45 (12.5%) were not educated.

Table 1: Illustrate Demographic Characteristics of Participants

S. No	Variable	Group	Frequency (n=200)	Percentage (%)
1	Age	14-18	90	45
		19-24	110	55
2	Residence	Rural	120	60
		Urban	80	40
3	Education	Educated	155	77.5
		Un-educated	45	12.5

Assessment of Hemoglobin Status

Hemoglobin assessment showed that 47.5% (n=95) of participants were anemic, while 52.5% (n=105) had normal hemoglobin levels. Among anemic participants, mild anemia (35%) was most common, followed by moderate anemia (2.5%) and severe anemia (10%). The overall mean hemoglobin level was 10.8 ± 1.6 g/dL.

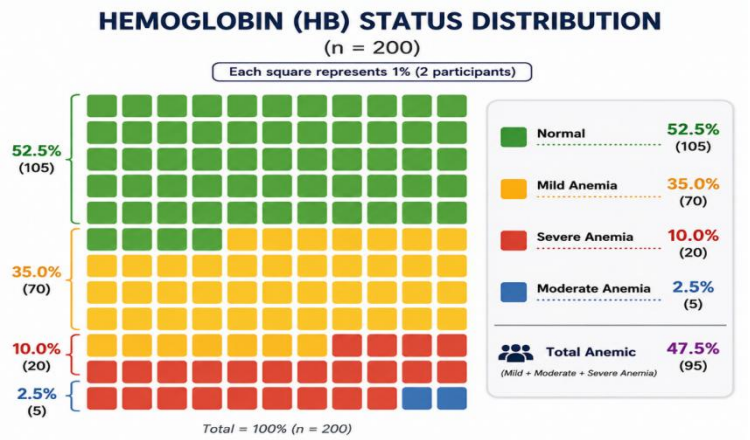

Figure no.1 showing Hb level in between study participants indicating anemia status

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Age Based Prevalence of Anemia

Age wise data indicated higher anemia prevalence in the 14–18 years age group (75%) compared to the 19–24 years age group (25%) as shown in below Figure no 2.

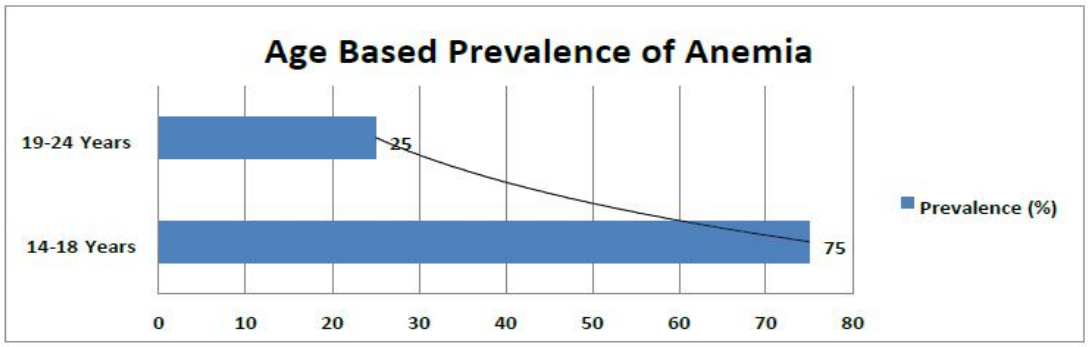

Figure 2: Illustrate Age Based Prevalence of Anemia

Factors Associated with Anemia

Dietary habits revealed that 48.42% of anemic participants had low intake of iron-rich foods and 13.68% consumed tea immediately after meals, which may inhibit iron absorption. Socioeconomic analysis showed that 16.84% of anemic participants belonged to low-income households. Health related factors indicated that 15% experienced heavy menstrual bleeding and 5.26% reported recurrent infections. Overall, hemoglobin deficiency was mildly high and associated with poor nutrition, low socioeconomic status, menstrual blood loss, and dietary habits as shown in below figure no.3

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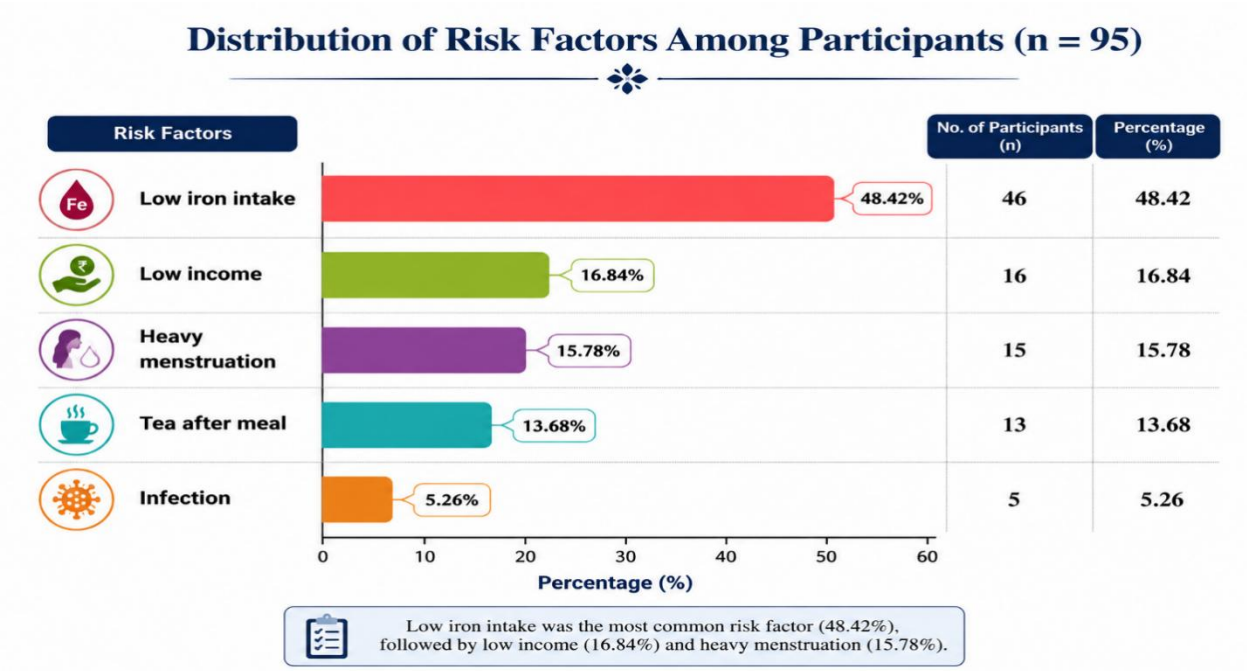

Discussion

Anemia prevalence among unmarried females aged 14 to 24 years in the Karak District of Pakistan was determined to be 47.5%, indicating a significant public health concern in an at-risk group. Adolescent girls and young women experience the highest prevalence of anemia due to their rapid growth and increased need for nutrients, along with menstrual blood loss. A Similar prevalence (and range of 40% to 60%) was found in developing countries for adolescent's girls; and national surveys in Pakistan found high rates of anemia among women of childbearing age, primarily due to iron deficiency. The findings of other studies in South Asia have attributed the high prevalence of anemia to low dietary diversity, poverty, and lack of nutritional knowledge. In this study, individuals aged 14 to 18 had a higher prevalence of anemia than did individuals ages 19 through 24, which is consistent with previous pediatric studies that demonstrate that early adolescence is an important time for physical growth and that girls in early adolescence require more iron than older girls. Likewise, studies conducted among school-going girls have also shown significantly higher anemia rates among younger girls than among older girls, primarily due to rapid growth and poor diet (21). Hemoglobin deficiency was highly associated with nutritional behaviors; most anemic participants reported

inadequate consumption of iron-rich foods, which is consistent with previous literature. Cereal-based diets comprised of a limited amount of animal protein are known to cause iron deficiency anemia, and many anemic participants also reported drinking large quantities of tea immediately after eating. Tannins, which have been shown to inhibit iron absorption, are found in tea (22). The socioeconomic status of participants had a strong correlation with the prevalence of anemia, with over 50% of the anemic participants being from low-income families. This finding mirrors prior research that associates low income with inadequate diets, limited nutrient-rich food, and decreased dietary diversity. Studies performed in rural South Asia have also shown that low levels of maternal education and household income affect the nutritional status of adolescent girls (23). Participants reported difficulties related to menstrual health (i.e., heavy menstrual bleeding), which contributes to the loss of iron and puts younger women at greater risk of developing anemia. Prior studies have found that heavy menstrual blood loss is one of the most significant predictors of iron-deficiency anemia in adolescents (24). There were also reports of recurrent infections in participants, which may lead to anemia through poor absorption of nutrients and decreased synthesis of hemoglobin. In low-resource settings, higher rates of anemia have been associated with parasitic infections, poor sanitation, and chronic illness through both blood loss and poor utilization of nutrients (25). The predominance of mild anemia in this study aligns with prior literature that suggests that many cases of anemia go undiagnosed because people often overlook symptoms such as fatigue or decreased attention span, however, mild anemia has been shown to affect cognitive performance, academic performance, and physical stamina (26). Overall, the findings of this study align with national and regional evidence indicating that hemoglobin deficiency among adolescent and young females is influenced by nutritional inadequacy, socioeconomic challenges, menstrual health, and dietary practices. These results highlight the need for improved nutrition education, promotion of iron rich diets, menstrual health awareness, and routine screening programs in Karak District to reduce anemia prevalence and improve the health and future well-being of young females.

Conclusion

This study found a high prevalence of anemia (47.5%) among unmarried females aged 14–24 years, with mild anemia being the most common type. Haemoglobin deficiency was associated with poor nutrition, low socioeconomic status, heavy menstrual bleeding, and recurrent infections. These findings emphasize the need for targeted nutritional and public health interventions to reduce anemia and improve the health of young women.

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