

Prevalence of Anemia and Its Association with Menstrual Health and Lifestyle Factors among University female students in Islamabad

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Abstract

Anemia is a significant public health concern among women of reproductive age, particularly in developing countries where nutritional deficiencies are common. The purpose of this cross-sectional study was to determine the prevalence of anemia among female university students and examine its association with lifestyle and menstrual health factors. A cross-sectional study was conducted from October to November 2025 at Hamdard University, Islamabad campus. Using convenience sampling, 322 female students aged 18–25 years were included in this study. Students who provided written consent were included, while those with chronic diseases or who were using iron supplements were excluded. Hemoglobin analysis and a structured questionnaire were used to gather data. The WHO classifies anemia as hemoglobin levels below 12 g/dL. The characteristics of the participants were summarized using descriptive statistics. Mean hemoglobin levels between anemic and non-anemic groups were compared using an independent t-test, and correlations between anemia and lifestyle factors and menstrual characteristics were examined using the chi-square test. A p-value <0.05 was considered statistically significant. Overall, 37.9% of people were anemic. The anemic group showed a significantly lower mean hemoglobin concentration (10.24 ± 1.08 g/dL) than the non-anemic group (12.76 ± 0.92 g/dL) ($p=0.003$). Anemia was shown to be statistically significantly associated with both heavy menstrual bleeding ($p=0.03$) and irregular menstruation ($p=0.041$). However, there was no clear association between anemia and lifestyle factors such as physical activity or smoking. The findings highlight that menstrual characteristics are significantly associated among female university students. Targeted nutritional interventions and menstrual health awareness programs are recommended to reduce the burden of anemia in this population.

Keywords: Anemia prevalence, Female students, Lifestyle factors, Menstrual health, Reproductive-age women

Highlights

- High prevalence of anemia was observed among female university students.
- Heavy menstrual bleeding was significantly associated with anemia.
- Nutritional factors play a crucial role in the development of anemia among young women.
- Lifestyle factors showed no significant association.
- Early screening and nutritional interventions are recommended.

1. Introduction

Globally, anemia is a nutritional issue. An estimated two billion people in Asia and Africa suffer from anemia. Anemia caused by micronutrient deficiencies has received little attention in both public health and current clinical practice. Malnutrition and malabsorption syndromes affect an increasing number of people, mostly in low and middle-income countries, resulting in a variety of micronutrient deficiencies that can lead to anemia resistant to treatment with iron, folate, or vitamin B12 (Datta Mitra & Green, 2026). In addition to physiological factors, a lack of iron-rich foods in the diet is a key contributor to anemia in young women. Diets low in heme iron sources such as meat, chicken, and fish, as well as a lack of plant-based iron sources such as legumes and green leafy vegetables, might raise the risk of iron deficiency. Furthermore, poor dietary patterns among university students, such as skipping meals and eating nutritionally unbalanced diets, may lead to low iron intake and an increased risk of anaemia (Pasricha et al., 2021). As per the WHO, anemia ranks as the tenth most significant health issue of the twenty-first century. Hemoglobin (Hb) levels in males and women must be below 13.0 and 12.0 g/dL, respectively. However, physiological state, gender, and ethnicity all affect the typical distribution of hemoglobin. Anemia can be described as (i) microcytic (smaller than normal RBCs owing to iron shortage), (ii) normocytic (normal cell size but fewer due to acute blood loss) or (iii) macrocytic (bigger than normal RBCs due to cyanocobalamin or folate insufficiency) (Chamoli, 2018). Malnutrition, specifically a lack of key nutrients such as iron, riboflavin (B2), cyanocobalamin (B12), and folate, is a major cause of anemia (Abioye & Fawzi, 2020). Women of reproductive age, expectant mothers, school-age children, and teenagers are among the groups most at risk for anemia. Although the male population is equally at risk for anemia (Domenica Cappellini & Motta, 2015a). According to the WHO, 40% of children aged 6-59 months, 37% of pregnant women, and 30% of women aged 15-49 years are anemic globally (World Health Organization, 2014). About 75% of cases of anemia are due to iron deficiency. Over 20% of

women of reproductive age suffer from iron deficiency anemia (Camaschella, 2017). The World Health Organization (WHO) aims to reduce the prevalence of anemia among women by 50% by 2025 (WHO, 2014). The role of iron in the human body is not just for haemoglobin synthesis or oxygen transport; it is also a component of many biological processes, such as energy metabolism, neurotransmitter production, and immune system function. Two mechanisms of iron deficiency: firstly, low iron intake or poor iron absorption; and secondly, due to clinical problems like gastrointestinal bleeding (Pasricha et al., 2021). Symptoms such as tiredness and exhaustion, mental fog, muscle weakness, shortness of breath, dizziness, pica, sleeplessness, restless legs, and hair loss (Munro et al., 2023). Excess blood loss during the menstrual period may lead to serious health problems, such as iron-deficiency anemia or fatigue. Both anemia and fatigue have negatively affected the quality of life of women (Bruinvels et al., 2016). Adolescents suffering from anemia may struggle academically due to a lack of motivation and attention. Anemia can stunt physical growth and weaken the immune system. As a result, people are prone to illness. Anemia can lead to lower energy output and lactate buildup in muscles (Mosiño et al., 2020). Teenagers eating choices impact their health throughout their lives, including adulthood and beyond. Iron deficiency can cause anemia and lethargy, hindering youngsters from pursuing job prospects. Adolescents require more iron, while women need additional iron to replace that lost through menstrual blood (Utami et al., 2021). A study found that IDA (iron deficiency anemia) is most prevalent among women and children due to inadequate dietary iron intake (Islam et al., 2024). The university student often obtains their meals from the hostel canteen, which may lack a balanced nutritional profile. Such eating habits may result in inadequate consumption of vital micronutrients, including iron, folate, and vitamin B12, which are required for the production of hemoglobin and the avoidance of anemia (Abioye & Fawzi, 2020). However, irregular dietary habits are influenced by many other factors, like financial problems, poor time management, or a lack of interest in meal preparation. Late-night sleeping, skipping breakfast, and a poor lifestyle are more likely to increase the risk of nutritional deficiencies (Kabir et al., 2018). The connection between menstrual cycles and iron levels is well-established. Individual iron levels are significantly influenced by menstrual characteristics, including cycle length, blood loss, and flow duration (Harvey et al., 2005). One of the main causes of iron deficiency anemia (IDA) in premenopausal women is heavy menstrual bleeding (HMB), which is defined as blood loss above 80 milliliters per cycle. Anaemia risk is also increased by frequent periods (polymenorrhea) and protracted menstruation (menorrhagia), which both increase cumulative monthly blood loss (Fraser et al., 2015). A study shows a positive relationship of lifestyle factors (smoking, alcohol drinking, bad dietary habits, or inadequate sleeping) and the risk of anemia. Showed that how are less active or regularly smoke are at high risk of anemia (Paramastri, Hsu, Lee, & Chao, 2021). Alcohol drinkers are at high risk of anemia (46%) compared to underweight (20%), overweight (23%), obese (34%), and central obese (28%) (Paramastri, Hsu, Lee, Lin, et al., 2021). Light smokers are at a higher risk of developing IDA, which is duration-dependent (Vivek et al., 2023a). The purpose of this study is to determine the prevalence of anemia among female university students and to evaluate the association between nutrition habits, anemia, menstrual patterns, and lifestyle factors.

2. Materials and Methods

A cross-sectional study was conducted from October to November 2025 among 322 female students selected using a convenience sampling approach at Hamdard University, Islamabad campus. The aim of this study to check the anemia prevalence and its association with menstrual health and lifestyle factors. The sample size was calculated using Raosoft software with a 95% confidence interval and a 5% margin of error. Data were collected using a structured questionnaire and laboratory analysis. Female students aged 18–25 years who consented to participate were included. Students with chronic diseases or those taking iron supplements were excluded.

2.1. Data collection tool and procedure

Data were obtained after students provided written consent. A well-structured questionnaire was used to gather the data. The questionnaire was split into four sections.

2.2.1. Sociodemographic data: Data were collected on residence status, economic status, age, weight, height, and BMI. The Body Mass Index (BMI) was calculated by using the formula: $BMI = \text{Weight (kg)}/\text{Height (m)}^2$. The World Health Organization (WHO) guidelines were used for classifying the BMI levels. Underweight is defined as a BMI of less than 18.5. Normal BMI ranges from 18.5-24.9. BMI of 25-29.9 indicates overweight. Obese: BMI > 30 (Body Mass Index (BMI), 2026).

2.2.2. Menstrual history: Menstrual cycle length (in days, categorized as <21, 21–35, >35), and self-perceived amount of bleeding (scanty, normal, heavy) (History et al., 2025a).

2.2.3. Lifestyle: Physical activity (categorical ordinal: Sedentary (No regular exercise) / Moderate (1–3 days/week) / Active (≥ 4 days/week) and smoking (yes/no).

2.2.4. Clinical Symptoms: Fatigue, Dizziness, Shortness of breath, Pale skin, Bittle nails, Pica (yes/no for each symptom).

2.2. Hematological Analysis

A medical lab technologist took the venous blood sample. The sample was analysed within 2 hours of collection for haemoglobin (Hb) concentration using an automated, calibrated haematological analyser (laboratory-based method). According to the WHO Anemia was defined as an Hb concentration <12g/dl (Domenica Cappellini & Motta, 2015b).

2.3. Data analysis

The collected data were analysed by using SPSS version 22.0 (IBM). Descriptive analysis was also performed. An independent t-test is performed to compare the hemoglobin concentrations of the anemic and non-anemic groups. Chi-square was used to assess the association between anemia and menstrual characteristics or lifestyle factors (physical activity level and smoking). Odds Ratios (OR) with 95% Confidence Intervals (CI) were computed using logistic regression analysis. Considering a p-value below 0.05 as statistically significant.

3. Results and Discussion

Overall, 322 students participated in this study. Table 1 presents general sociodemographic characteristics of the anemic participants. The average age of the anemic participants was 20.46 years, with a mean BMI of 20.93 kg/m². Of 122 anemic students, 77.9% were living with family, and 22.1% were living in a hostel. 25.4% of students were underweight, while 59.8% and 14.8% were in the normal or overweight BMI categories, respectively. Based on clinical symptoms, 57.4% show fatigue, 31.1% shortness of breath, 32.8% pale skin, 50.8% brittle nails, and 53.3% dizziness.

Table 1: General and Sociodemographic Features of Anemic Participants (N=122)

Characteristic	Category	Frequency (n)	Percentage (%)
Residence	With family	95	77.9
	At hostel	27	22.1
BMI	Underweight	31	25.4
	Normal	73	59.8
	Overweight	18	14.8
	Obesity	0	0.0
Socioeconomic Status	Lower class	4	3.3
	Middle class	107	87.7
	High class	11	9.0
Symptoms variations	Fatigue	70	57.4
	Shortness of Breath	38	31.1
	Pale skin	40	32.8
	Brittle nails	62	50.8
	Dizziness	65	53.3

In this study, the total prevalence of anemia was 37.9% (n=122). The remaining were non anemic 62.2% (n=200). As shown in Table 2, the mean Hemoglobin level in the anemic group and non-anemic group was significantly different (p-value 0.003). The anemic group had a mean hemoglobin level of 10.24 g/dl, whereas the non-anemic group had a mean of 12.67 g/dl.

Table 2: Anemia Prevalence and Hemoglobin Level Comparison between Anemic and Non-Anemic Groups

Parameter	Anemic group (n=122)	Non-Anemic Group (n=200)	Total (N=322)	p-value
Prevalence (%)	37.9%	62.1%	100%	
Mean hemoglobin (g/dL)	10.24 ± 1.08	12.76 ± 0.92		0.003

∴ An independent t-test was used for hemoglobin comparison.

The association between menstrual characteristics and anemia status of the study population is shown in Table 3. Participants reporting irregular cycles were more common among anemic students (31.1%) than among non-anemic students (21.0%), a statistically significant difference (OR=0.58, 95% CI: 0.352–0.981, p-value 0.041). The difference in self-perceived menstrual bleeding flow is highly significant between the anemic and non-anemic groups. The prevalence of anemia among students who reported heavy bleeding was 23.8%, normal 63.9%, and scanty 12.3% (OR = 0.374, 95% CI: 0.198–0.703, p-value 0.03).

Table 3: Association Between Menstrual Characteristics and Anemia Status

Menstrual Characteristic	Category	Anemic (n=122)(%)	Non-Anemic (n=200)(%)	Total (n=322)(%)	p-value
Cycle length	Regular	84 (68.9)	158 (79)	242 (75.2)	0.041
	Irregular	38 (31.1)	42 (21)	80 (24.8)	
Bleeding Flow	Scanty	15 (12.3)	36 (18)	51 (15.8)	0.03
	Normal	78 (63.9)	144 (72)	222 (68.9)	
	Heavy	29 (23.8)	20 (10)	49 (15.2)	

∴ p-values determined by the Chi-square test

Physical activity determined with a structured self-administered questionnaire in which individuals reported the frequency of their weekly activities. Participants were divided into three groups based on their stated physical activity levels: sedentary, moderately active, and active. Smoking status was reported as yes or no. There was no significant association between anemia and lifestyle factors such as physical activity (p -value > 0.05) or smoking (p -value > 0.05) as presented in Table 4.

Table-4: Association of lifestyle factors with anemic or non-anemic group

Characteristic	Category	Anemic (n=122)(%)	Non-Anemic (n=200)(%)	Total (n=322)(%)	p-value
Physical activity	Sedentary (noregular exercise)	25(20.5)	32 (16)	57(17.7)	0.52
	Moderate (3days/week)	71 (58.2)	118 (59)	189 (58.7)	
	Active (≥4days/week)	26 (21.3)	50 (25)	76 (23.6)	
Smoking	Yes	3 (2.5)	9 (4.5)	12 (3.7)	0.34
	No	119(97.5)	191(95.5)	310(96.3)	

p-values calculated using the Chi-square test

The current study aims to investigate the prevalence of anemia among university female students and its association with menstrual health and lifestyle factors. Anemia is a major global health concern, particularly in low and middle-income countries. In 2025, the WHO reported that 30% of women worldwide are anemic (Anaemia, 2026). In the current study, the prevalence of anemia is 37.9%, and the mean haemoglobin value is 10.24g/dl. A study conducted by Jazan University, Saudi Arabia, showed that anemia is more prevalent in women (67.35%) than in men (4.7%), and that their mean haemoglobin level is less than 12 g/dL (Hamali et al., 2020). A cross-sectional study conducted at a public-sector university in Punjab showed that the prevalence of anemia among female resident university students was 38%, with a mean hemoglobin (Hb) level of 10.5 g/dL (Khokhar et al., 2022). Another study conducted in Dubai showed that the prevalence of anemia among female university students was 18.1 % (Al Sabbah, 2020a). A cross-sectional study conducted among Palestinian female university students showed that 34.8% of subjects were anemic (Qasrawi et al., 2024). A study conducted in Bangladesh showed that 48.6% of women were anemic, and irregular eating patterns are common (Khatun et al., 2025). A study in India found that 25.3% of medical students had anemia, with anemic students having a significantly lower mean hemoglobin concentration (10.8 ± 0.9 g/dL) than non-anemic students (12.9 ± 1.1 g/dL) (History et al., 2025a). A lack of proper nutrition can lead to anemia, which can reduce mental ability, focus, achievement, and passion for learning. Poor dietary habits among students, such as a lack of iron-rich meals and limited intake of fruits and vegetables that improve iron absorption, may lead to the development of iron-deficiency anemia. Furthermore, diets heavy in processed foods and poor in micronutrient density may worsen nutritional inadequacies in young women (Islam et al., 2024). Anemia can also affect the reproductive system and organs, making them more susceptible to disease. The current study shows a significant association between anemia and menstrual patterns, including cycle length and menstrual bleeding flow. The anemic female group shows a higher proportion of irregular menstrual cycle length (31.1%) than the non-anemic female group (21%). The anemic female group shows heavy menstrual bleeding (23.8%), as does the non-anemic female group (10%). A study conducted by Semra in 2019 shows that the prevalence of heavy menstrual bleeding in anemic patients was 37.9%. Ferritin levels or physical function decrease significantly, resulting in increased menstrual duration (Kocaoz et al., 2019). A study conducted among Malaysian female university students found that students with anemia experienced heavy menstrual bleeding and long menstrual cycle duration compared to non-anemic students (Mok et al., 2024). A study carried out in India among female medical students reported that heavy menstrual bleeding was significantly more common in anemic students (59.2%) than in non-anemic students (19.6%) ($p < 0.001$). (History et al., 2025b). A study conducted at the University of Sindh reported that 44.52% of participants had irregular menstrual cycles (Masood Baig et al., 2021). A study conducted among undergraduate female students of Berhan University, Ethiopia, shows that (32.6%) had menstrual irregularity, and there is a strong association with anemia (Zeru et al., 2021). A study found that 18% of females experience heavy bleeding during menstruation, which is significantly associated with anemia, but no significant association with 57.4% have irregular menstrual cycles (Edison et al., 2023). In the current study, no statistically significant lifestyle factors, such as smoking and physical activity, were found. The present study showed no association between anemia and physical activity. This contrasts with previous literature that has shown a strong correlation between anemia and physical activity. After reviewing multiple studies, they highlight that Iron deficiency can lead to a decrease in physical activity among youngsters due to reduced oxygen delivery to the tissues (Yunanci et al., 2023). A study in Dubai revealed that students with anemia engaged in less physical activity than their non-anemic peers (Al Sabbah et al., 2020b). However, similar to findings from Indonesia (reported no significant association between anemia and physical activity) (Sholihah & Mayasari, 2024). The absence of a significant association

in this study may be explained by the similar lifestyles of university students who tend to have the same daily routine and activity habits. Because of their similar lifestyles, there was not much difference in the participants' physical activity levels. Additionally, the assessment of physical activity relies on self-reported data, which may introduce recall bias. Furthermore, anemia is a multifactorial condition, and physical activity is not the only independent factor predicting anemia when other important factors, such as dietary intake and menstrual blood loss, are not considered. Tobacco smoking as a potential risk factor for anemia is often ignored in the young population. A study revealed that cigarette smoking was strongly associated with iron-deficiency anemia ($p < 0.0001$) (Vivek et al., 2023b). The present study did not observe a significant association between smoking and anemia. Similar findings have been reported in a cross-sectional survey of the Iranian population, the Khuzestan Comprehensive Health survey (KCHS), which showed no significant association between smoking and anemia (Akbarpour et al., 2022). Based on another cross-sectional study, data collected from 13036 women indicate no significant association between smoking and anemia prevalence (Torrejon-Echaccaya et al., 2025). The lack of a significant association in this study may be related to the low prevalence of smoking among female university students in the study population. However, food consumption was not measured in the current study, which might be a significant factor influencing iron deficiency among university students. Future studies should examine food patterns and micronutrient intake to understand the nutritional causes of anemia.

Conclusion

This study concluded that 37% participants were anemic. Our findings showed a significant association between anemia and menstrual pattern, including menstrual blood flow and cycle length. These menstrual characteristics serve as vital clinical indicators for identifying people at high risk. To combat this disease, a comprehensive plan is necessary that includes adequate nutritional education, promotion of iron-rich meals such as green leafy vegetables, legumes, meat, and fortified cereals, monitoring nutritional status, provision of iron supplements, and promotion of physical activity programs for university female students. There was no significant association between physical lifestyle factors, such as smoking or physical activity, so in the future, conduct the study on a larger population to determine the association between anemia and lifestyle factors. Finally, reducing anemia in this age group guarantees a healthy future.

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Conflict of Interest

The authors declare that they have no competing interests.

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NA

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