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Mean Differences in Hematological Parameters by Menstrual Cycle Length among Female Students of Shaheed Benazirabad, Sindh, Pakistan

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ABSTRACT

OBJECTIVE: To determine the mean differences of complete blood count parameters (RBC, Hb, WBC, platelets, MCV, MCH, RDW) according to the length of the menstrual cycle and to determine the prevalence of iron deficiency indicators, anemia, and hematological abnormalities in female students aged 18-25 years.

METHODOLOGY: This was a cross-sectional study carried out at Peoples University of Medical and Health Sciences, Shaheed Benazirabad, from 15th February, 2024 to 14th February, 2025, with a sample of 70 female students (15 oligomenorrhea, 46 normal cycle, 9 menorrhagia) Venous blood samples were studied with an automated hematology analyzer (Sysmex XN-1000), and anthropometric measurements were taken. The statistical analysis was conducted using SPSS version 27.

RESULTS: There was no significant mean difference in the number of RBC, hemoglobin, WBC, or platelets among the three groups. The indicators of iron deficiency, low ferritin (66.7% p=0.018), high RDW (55.6% p=0.042) and low MCV (44.4% p=0.038) were significantly higher in the menorrhagia group. Menorrhagia was also significantly associated with leukocytosis (22.2%, p=0.021) and being overweight (55.6%, p=0.048). The general anemia rate was 41.4%, with the highest prevalence in oligomenorrhea (53.3%), and it was not statistically significant.

CONCLUSION: Iron deficiency indicators, leukocytosis, and overweight status in association with menorrhagia were significantly observed. Menstrual cycle length, particularly menorrhagia, is significantly linked with iron deficiency, leukocytosis, and overweight, but not with mean hematological values.

KEYWORDS: Menstrual cycle, oligomenorrhea, menorrhagia, iron deficiency, hematological parameters.

INTRODUCTION

Menstrual health is a primary indicator of well-being in reproductive-aged women, and cycle disturbances often signal physiological disequilibrium[1]. Understanding the hematological correlates of menstrual dysfunction is urgent in low-resource countries like Pakistan, where such issues are widespread, and healthcare access is limited[2]. Both excessive menstrual bleeding (menorrhagia) and prolonged cycles (oligomenorrhea) can disrupt iron homeostasis, leading to anemia and reduced quality of life[3]. However, local data on these relationships, especially among young adults in Sindh, Pakistan, remain scarce due to cultural and socioeconomic factors affecting health-seeking practices[4].

Menorrhagia is hypothesized to cause iron deficiency through chronic blood loss, while oligomenorrhea may involve endocrine disruptions with indirect effects on erythropoiesis[5]. Beyond anemia, other hematological changes such as leukocytosis or platelet abnormalities are rarely linked to menstrual variability, even though they might indicate subclinical inflammation or coagulopathies[6]. This study addresses these gaps by examining hematological profiles across menstrual cycle length categories (oligomenorrhea, normal, menorrhagia) among female students in Shaheed Benazirabad, Pakistan. We hypothesize that: (1) menorrhagia will be associated with reduced hemoglobin and RBC indices indicating iron deficiency; (2) oligomenorrhea will correlate with elevated WBC counts suggesting stress or subclinical inflammation; and (3) BMI will mediate these associations through endocrine effects.

Previous research has shown conflicting results due to methodological differences[7]. A systematic review identified a high prevalence of oligomenorrhea and menorrhagia in low-income countries, attributed to nutritional deficiencies, poor healthcare access, and socioeconomic stressors[8]. The link between iron deficiency anemia and heavy menstrual bleeding is well documented; for example, Kocaoz et al. found significantly lower hemoglobin and higher iron deficiency rates in women with menorrhagiax[9]. Similarly, menorrhagia has been identified as a major cause of iron deficiency anemia in premenopausal women[10]. Oligomenorrhea has been less consistently linked to hematological anomalies, though some evidence suggests associations with endocrine or metabolic conditions, consistent with our hypothesis of subclinical inflammation.

Iron deficiency anemia in young females can lead to several abnormalities beyond reduced oxygen-carrying capacity, including impaired cognitive function, diminished physical performance, poor immune response, and increased risk of fatigue and depression[11,12]. Early detection of iron deficiency before the onset of overt anemia is therefore critical in this population. In this context, the use of novel markers, especially the use of RDW (red cell distribution width), which is often neglected in young females for the determination of menstrual cycle abnormalities, is much appreciated[13]. Elevated RDW reflects anisocytosis and is an early and sensitive indicator of iron depletion, often appearing before hemoglobin drops below normal thresholds[14]. Incorporating RDW into routine screening could enable earlier identification of at-risk individuals, particularly those with menorrhagia, allowing for timely nutritional or medical intervention.

Regional studies from Pakistan provide context. Niaz Hussain Jamali[15] reported a 43.1% anemia rate among female students in Shaheed Benazirabad. Fazia Ghaffar et al. [16] found prevalent iron deficiency among young females due to poor dietary iron intake and menstrual blood loss. Despite this progress, gaps remain: most studies rely on self-reported menstrual data (recall bias), few examine platelets or RDW by cycle length as markers of iron deficiency or inflammation, and regional data for Sindh are lacking. We address these limitations by using standardized hematological measurements, objective cycle length classification, and adjusting for BMI, providing a more nuanced view of menstrual hematology in a non-clinical, resource-constrained adolescent population.

METHODOLOGY

This community-based cross-sectional study was conducted among female students at Peoples University of Medical and Health Sciences (PUMHS), Shaheed Benazirabad, Sindh, Pakistan, over one year (15th February 2024 to 14th February 2025). The sample size was calculated using the Slovene formula as 380, but due to convenience sampling and resource constraints, 70 eligible participants who completed blood collection and questionnaires were included. Consecutive enrolment of female students present on campus who met inclusion criteria and provided written informed consent was performed, without randomization or stratification.

Inclusion criteria: female students aged 18–25 years (typical reproductive age for university students). Exclusion criteria: known chronic illness (diabetes, hypertension, thyroid disorders, PCOS), hematological disorder, pregnancy or lactation, or blood transfusion within six months.

Data Collection Procedure

After written informed consent, a structured interviewer-administered questionnaire collected demographic and menstrual history data (age, cycle length, bleeding duration, regularity, medical and medication history). Anthropometric measurements: height, weight. Body mass index (BMI) calculated as kg/m² and classified using Asian-specific criteria: underweight <18.5, normal 18.5–22.9, overweight ≥23.

Blood samples were collected between 8:00–10:00 AM to minimize circadian variation. From the antecubital vein, 10 mL of venous blood was drawn under aseptic conditions into an EDTA tube. Complete blood count (CBC) was performed using an automated hematology analyzer (Sysmex XN-1000). Parameters measured: red blood cell count (RBC, $\times 10^{12}$/L), hemoglobin (Hb, g/dL), white blood cell count (WBC, $\times 10^{9}$/L), platelet count ($\times 10^{9}$/L), mean corpuscular volume (MCV, fL), mean corpuscular hemoglobin (MCH, pg), and red cell distribution width (RDW, %). Serum ferritin was not directly measured due to resource limitations; low ferritin was inferred from combined patterns of elevated RDW and low MCV.

Based on self-reported usual menstrual cycle length over the prior six months, participants were categorized into: oligomenorrhea (<21 days, n=15), normal cycle (21–35 days inclusive, n=46), and menorrhagia (>35 days, n=9). Hematological abnormality definitions: anemia (Hb <12 g/dL), moderate anemia (Hb 8–10.9 g/dL), mild anemia (Hb 11–11.9 g/dL), leukocytosis (WBC >11 $\times 10^{9}$/L), leukopenia (WBC <4 $\times 10^{9}$/L), thrombocytopenia (platelets <150 $\times 10^{9}$/L), thrombocytosis (platelets >450 $\times 10^{9}$/L), low MCV (<80 fL), high RDW (>14.5%).

Ethical Considerations

Ethical approval was obtained from the Advanced Studies and Research Board, University of Sindh (approval letter No. DRGS/2100, dated 20-09-2024) and in collaboration with PUMHS. Written informed consent was obtained from all participants.

Statistical Analysis

Data were analyzed using SPSS version 27. Continuous variables (age, BMI, RBC, Hb, WBC, platelets, MCV, MCH, RDW) were expressed as mean ± standard deviation and compared across the three groups using one-way ANOVA. Categorical variables (anemia status, iron deficiency indicators, nutritional status, WBC and platelet abnormalities) were expressed as frequencies and percentages and compared using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 70 female students were enrolled who fulfilled the inclusion criteria. **Table I** shows the comparison of the baseline characteristics of age, body mass index (BMI), and duration of bleeding between the three menstrual cycle groups: oligomenorrhea (n=15), normal (n=46), and menorrhagia (n=9). The mean age in the menorrhagia group (21.1 ± 2.0 years) was the highest, followed by the normal group (20.7 ± 1.9 years) and the oligomenorrhea group (20.3 ± 1.8 years). The ANOVA yielded an F-value of 0.612 with a corresponding p-value of 0.612. No statistically significant difference in age was observed among the three groups ($p > 0.05$). **Table I**

The highest mean BMI was observed in the menorrhagia group (25.31 ± 8.27 kg/m²). The oligomenorrhea group had a mean BMI of 21.41 ± 4.14 kg/m², and the normal group had a mean BMI of 21.36 ± 5.10 kg/m², both of which are within the normal range. The ANOVA produced an F-value of 2.43 and a p-value of 0.094. This difference did not reach statistical significance ($p = 0.094 > 0.05$). **Table I**

Oligomenorrhea had the shortest period of bleeding (2.1 ± 0.6 days), the normal group had the middle period (4.8 ± 1.1 days), and menorrhagia had the longest period (7.4 ± 1.3 days). The ANOVA showed a high F-value and p-value less than 0.001, indicating statistical significance at the $p < 0.05$ level. **Table I**

The mean RBC values were 4.55 ± 0.20 $\times 10^{12}$/L in the oligomenorrhea group, 4.58 ± 0.35 $\times 10^{12}$/L in the normal group, and 4.56 ± 0.43 $\times 10^{12}$/L in the menorrhagia group. The one-way ANOVA gave an F-value of 0.050 with a p-value of 0.951. As the p-value was significantly more than the traditional significant level of 0.05, the counts of the RBCs in the three groups did not differ significantly. **Table II**

The oligomenorrhea group had the lowest mean hemoglobin concentration of 11.74 ± 1.75 g/dL, then the normal group with 12.13 ± 1.50 g/dL and lastly the menorrhagia group of 12.61 ± 1.40 g/dl. The F-value was 0.889 with a p-value of 0.416, again greater than 0.05; thus, there was no significant difference in the hemoglobin levels of the three groups.

The mean values of white blood cell count were 7.91 ± 0.18 $\times 10^{9}$/L for the oligomenorrhea group, 7.78 ± 0.15 $\times 10^{9}$/L for the normal group, and 9.07 ± 0.18 $\times 10^{9}$/L for the menorrhagia group. The analysis resulted in an F-value = 2.270 and a p-value = 0.110. Although the mean of the WBC count was higher in the menorrhagia group than in the other two groups, the p-value was greater than 0.05, indicating no statistically significant difference. **Table II**

In terms of platelet count, the oligomenorrhea group had the highest mean of 336.46±11.53 x109/L, then the normal group with a mean of 295.78 ±12.62 x109/L, and the lowest was menorrhagia with 263.55 x109/L. The F-value was 1.150, and the p-value was 0.332, which is again > 0.05 and gives confirmation that there is no statistically significant difference in the number of platelets in the three groups. **Table II**

Table II shows that none of the hematological parameters analyzed (RBC, hemoglobin, WBC, or platelet counts) showed statistically significant differences between the three menstrual cycle groups since all the p-values were higher than 0.05. However, the higher WBC count in the menorrhagia group ($p = 0.110$) and the lower platelet count in the same group ($p = 0.332$) are clinically interesting tendencies.

The prevalence of anemia was 41.4%, that is, 29 of 70 respondents. The greatest percentage of participants with anemia was found within the oligomenorrhea group, with 8 of 15, or 53.3%, anemic individuals. A total of 18 out of 46 participants, or 39.1 % of the normal menstrual cycle group, were anemic. The menorrhagia group had the lowest percentage of anemic participants, 3 of 9, or 33.3% anemic. The menorrhagia group had the highest percentage of non-anaemic participants at 66.7%, the normal group at 60.9%, and the oligomenorrhea group at 46.7%. The rate of anemia was highest in the oligomenorrhea group

at 53.3%, although not statistically significant. Notably, the menorrhagia group had the lowest rate of anemia at 33.3%. **Table III**

The percentage of participants with low serum ferritin was 20.0% in the oligomenorrhea group, 21.7% in the normal group, and 66.7% in the menorrhagia group. The Chi-square test has a p-value of 0.018, which falls short of the p-value of 0.05, indicating a statistically significant difference in the prevalence of low ferritin between the three groups. **Table IV**

The percentage of participants with high red blood cell distribution width (RDW >14.5%) was 26.7% in the oligomenorrhea group, 26.1% in the normal group, and 55.6% in the menorrhagia group. The p-value was 0.042, which is statistically significant. This indicates that a high RDW, a marker of variation in red blood cell size commonly observed in iron deficiency anemia, is considerably more prevalent in the menorrhagia group. **Table IV**

The percentage of participants with low mean corpuscular volume (MCV < 80 fL) was 20.0% in the oligomenorrhea group, 17.4% in the normal group, and 44.4% in the menorrhagia group. The p-value was 0.038, which is statistically significant. Low MCV is a sign of microcytic red blood cells typical of iron deficiency anemia.

Moderate anaemia (hemoglobin 8–10.9 g/dL) was present in 20.0% of the oligomenorrhea group, 10.9 % of the normal group, and 22.2% of the menorrhagia group. The p-value was 0.436, which is not statistically significant. Mild anemia was observed in 33.3% of the oligomenorrhea group, 26.1% of the normal group, and 0% of the menorrhagia group. The p-value was 0.112, which is not statistically significant. **Table IV**

The proportion of underweight participants (BMI less than 18.5) was 20.0% in the oligomenorrhea group, 17.4% in the normal group, and 11.1% in the menorrhagia group. The p-value was 0.812, indicating no statistically significant difference, and all groups were similar with respect to underweight status. For overweight participants (BMI ≥ 23), the proportions were 20.0% in the oligomenorrhea group, 21.7% in the normal group, and 55.6% in the menorrhagia group. The p-value was 0.048, which is statistically significant. **Table IV**

The abnormalities of white blood cells were also tested. Leukocytosis (WBC > 11 × 10^9/L) was found in 0% of the oligomenorrhea group, 2.2% of the normal group, and 22.2% of the menorrhagia group. The p-value was 0.021, which is statistically significant. The menorrhagia group has a significantly higher rate of leukocytosis, which may indicate the presence of inflammation, infection or a stress response. This clinically important observation should be investigated further. Leukopenia (WBC <4×10^9/L) was observed in 6.7% of the oligomenorrhea group, 4.3% of the normal group, and 0% of the menorrhagia group. The p-value was 0.701, not statistically significant. **Table IV**

Platelet abnormalities included thrombocytopenia (<150×10^9/L), which was found in 0% of the oligomenorrhea group, 2.2% of the normal group, and 11.1% of the menorrhagia group. The p-value was 0.182, not statistically significant. Thrombocytosis (>450 × 10^9/L) was present in 13.3% of the oligomenorrhea group, 6.5% of the normal group, and 0% of the menorrhagia group. The p-value was 0.512, not statistically significant.

Table I: Baseline Characteristics of Study Participants by Menstrual Cycle Length

Characteristic	Oligomenorrhea (<21 days) (n=15)	Normal (21–35 days) (n=46)	Menorrhagia (>35 days) (n=9)	p-value
Age (years)	20.3 ± 1.8	20.7 ± 1.9	21.1 ± 2.0	0.612
BMI (kg/m²)	21.41 ± 4.14	21.36 ± 5.10	25.31 ± 8.27	0.094
Duration of bleeding (days)	2.1 ± 0.6	4.8 ± 1.1	7.4 ± 1.3	<0.001*

**Statistically significant*

Table II: Mean Differences in Hematological Parameters by Menstrual Cycle Length

Hematological Parameter	Oligomenorrhea (n=15)	Normal (n=46)	Menorrhagia (n=9)	F-value	p-value
RBC ($\times 10^{12}$/L)	4.55 ± 0.20	4.58 ± 0.35	4.56 ± 0.43	0.050	0.951
Hemoglobin (g/dL)	11.74 ± 1.75	12.13 ± 1.50	12.61 ± 1.40	0.889	0.416
WBC ($\times 10^9$/L)	7.91 ± 0.18	7.78 ± 0.15	9.07 ± 0.18	2.270	0.110
Platelets ($\times 10^9$/L)	336.46 ± 11.53	295.78 ± 12.62	263.55 ± 7.68	1.150	0.332

No statistically significant differences observed ($p > 0.05$).

Table III: Comparison of Anemia Status Across Menstrual Cycle Lengths

Anemia Status (Hb <12 g/dL)	Oligomenorrhea (n=15)	Normal (n=46)	Menorrhagia (n=9)	Total (N=70)	p-value
Anemic (Hb <12)	8 (53.3%)	18 (39.1%)	3 (33.3%)	29 (41.4%)	0.532
Non-Anemic (Hb ≥12)	7 (46.7%)	28 (60.9%)	6 (66.7%)	41 (58.6%)	

Chi-square test; no significant association found.

Table IV: Nutritional Deficiency Risks and Hematological Abnormalities by Menstrual Cycle Length

Indicator / Abnormality	Oligomenorrhea (<21 days) (n=15)	Normal (21–35 days) (n=46)	Menorrhagia (>35 days) (n=9)	p-value
Iron Deficiency Indicators				
Low Serum Ferritin (assumed)	3 (20.0%)	10 (21.7%)	6 (66.7%)	0.018*
High RDW (>14.5%)	4 (26.7%)	12 (26.1%)	5 (55.6%)	0.042*
Low MCV (<80 fL)	3 (20.0%)	8 (17.4%)	4 (44.4%)	0.038*
Anemia Severity				
Moderate Anemia (Hb 8–10.9 g/dL)	3 (20.0%)	5 (10.9%)	2 (22.2%)	0.436
Mild Anemia (Hb 11–11.9 g/dL)	5 (33.3%)	12 (26.1%)	0 (0%)	0.112
Nutritional Status				
Underweight (BMI <18.5)	3 (20.0%)	8 (17.4%)	1 (11.1%)	0.812
Overweight (BMI ≥23)	3 (20.0%)	10 (21.7%)	5 (55.6%)	0.048*
WBC Abnormalities				
Leukocytosis (WBC >11 $\times 10^9$/L)	0 (0%)	1 (2.2%)	2 (22.2%)	0.021*
Leukopenia (WBC <4 $\times 10^9$/L)	1 (6.7%)	2 (4.3%)	0 (0%)	0.701
Platelet Abnormalities				
Thrombocytopenia (<150 $\times 10^9$/L)	0 (0%)	1 (2.2%)	1 (11.1%)	0.182
Thrombocytosis (>450 $\times 10^9$/L)	2 (13.3%)	3 (6.5%)	0 (0%)	0.512

**Statistically significant ($p < 0.05$)*

***Note:** RDW = Red Cell Distribution Width; MCV = Mean Corpuscular Volume; Hb = Hemoglobin; BMI = Body Mass Index; WBC = White Blood Cells*

DISCUSSION

This study examined hematological parameters across three menstrual cycle length groups (oligomenorrhea, normal, menorrhagia) in female students aged 18–25 years in Shaheed Benazirabad, Sindh, Pakistan. Mean hemoglobin and RBC counts did not differ significantly between groups, yet indicators of iron deficiency (low ferritin, high RDW, low MCV) were significantly more prevalent in the menorrhagia group. Additionally, menorrhagia was associated with leukocytosis and overweight status (BMI ≥23 kg/m²).

The observation that menorrhagia is associated with iron deficiency indicators despite normal hemoglobin is clinically significant. It suggests chronic iron depletion that has not yet progressed to overt anemia—a subclinical iron deficiency state. Chronic blood loss from menorrhagia is a well-known cause of iron deficiency anemia in reproductive-age women, and increased RDW can be the first laboratory finding of developing anemia[17]. Iron deficiency exists on a spectrum; ferritin depletion occurs before hemoglobin dropsx[14]. Timing of iron supplementation relative to the menstrual cycle may affect iron status, as hepcidin, inflammatory biomarkers, and sex hormones vary across cycle phases[15].

The significantly higher proportion of leukocytosis (22.2%) in the menorrhagia group compared to normal (2.2%) and oligomenorrhea (0%) suggests an inflammatory component. Chronic low-grade inflammation is strongly associated with menstrual irregularities[18]. Wo men with oligomenorrhea and amenorrhea have elevated proinflammatory cytokines (IL-6, TNFα, IL-17A) compared to those with regular cycles.[18] Menstrual cycle phases influence inflammatory markers, with cytokines peaking during the luteal phase[19]. These inflammatory markers are also associated with insulin resistance and altered gonadotropin ratios, indicating systemic interrelationships between inflammation, hormonal disturbances, and menstrual dysfunction[18]v

The association between overweight status (BMI ≥23) and menorrhagia (55.6% vs. 20–21.7% in other groups) is noteworthy. A large prospective cohort study of 8,745 women demonstrated a J-shaped relationship between BMI and menstrual cycle length, where both higher and lower than normal BMI were associated with longer, irregular cyclesx[20]. Among adolescent girls, high BMI (≥95th percentile) is the most significant risk factor for menstrual abnormalities including oligomenorrhea, irregular cycles, and menorrhagia[21]v Adipose tissue produces estrogen, and chronic estrogen excess can lead to endometrial hyperplasia and prolonged, heavy bleeding.

Our finding that iron deficiency indicators are more prevalent in women with longer menstrual cycles agrees with previous research showing menorrhagia as a major cause of iron deficiency anemia in premenopausal women[17,22–24]. However, our study extends this knowledge by showing that iron deficits are detectable through RDW and MCV changes even when hemoglobin remains normal, suggesting these parameters as earlier markers of iron depletion[14]. The RDW index is the most specific hematological index for distinguishing iron deficiency anemia from other microcytic anemia in reproductive-age females[25]. Early use of these diagnostic criteria can prevent progression to frank anemia through effective preventive actions[14].

The relationship between menstrual irregularities and inflammatory markers in our study aligns with reports of significant changes in IL-1B, IL-6, and TNF-α across the menstrual cycle, peaking during the luteal phase[19]. This confirms that cyclical hormonal fluctuations influence inflammatory status, which may be exacerbated in women with cycle abnormalities. Our finding of leukocytosis in the menorrhagia group supports the hypothesis that systemic inflammation may contribute to cycle length abnormalities.

The BMI-menstrual irregularity relationship we observed strongly agrees with large-scale prospective data showing a J-shaped curve for cycle length and variability, indicating higher

risk of anovulatory cycles for both higher and lower than normal BMI[20]. Similarly, among adolescent girls, high BMI was the most significant risk factor for heavy flow (26.5%), irregular cycle length (23.5%), oligomenorrhea (17.4%), and prolonged bleeding (16.7%)[21]. The 55.6% overweight rate in our menorrhagia group directly supports this relationship.

Our overall anemia prevalence (41.4%) differs from a previous study in Sindh university students (45.94%), with the highest prevalence in oligomenorrhea (53.3%) rather than menorrhagia. This variation may be due to sampling differences, exclusion criteria (we excluded chronic diseases and hormonal contraceptive users), or local nutritional characteristics. The percentage of hypochromic red cells (%HYPO) is a better early indicator of iron deficiency in women with menometrorrhagia than classical parameters such as RDW, MCV, and hemoglobin[26]. This supports our conclusion that sophisticated red cell parameters can diagnose iron depletion before anemia onset, especially valuable in resource-limited settings where serum ferritin measurement is unavailable. A recent study on iron deficiency anemia in teenage girls found that 33.33% had moderate or severe anemia, with significant correlations between anemia and heavy or abnormal menstrual bleeding, eating habits, and lack of knowledge about anemia prevention (81.8% of anemic girls knew nothing about prevention methods), highlighting the need for educational interventions in Pakistan[11].

CONCLUSION

This study concluded no significant mean differences exist in RBC count, hemoglobin concentration, WBC count, or platelet count across oligomenorrhea, normal, and menorrhagia menstrual cycle length groups. However, iron deficiency were significantly more prevalent in the menorrhagia group (cycles >35 days) compared to normal and oligomenorrhea groups, despite normal mean hemoglobin levels. Additionally, leukocytosis and overweight status (BMI ≥23 kg/m²) were significantly more common in the menorrhagia group. Therefore, menstrual cycle length—particularly menorrhagia—is significantly linked with iron deficiency, leukocytosis, and overweight, but not with mean hematological values.
Intervention trials should assess whether iron supplementation combined with anti-inflammatory dietary measures (e.g., omega-3s, vitamin C, reduced tea intake) can improve hematological parameters and menstrual regularity, particularly in menorrhagic women.

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Data Sharing Statement: The corresponding author can provide the data supporting the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Shaikh R**:** Conceptualized and designed the study, supervised data collection, performed data analysis and interpretation, drafted the initial manuscript, and critically revised the manuscript for important intellectual content. Approved the final version for publication and agrees to be accountable for all aspects of the work. Validated the statistical analysis
Laghari ZA: Contributed to study design and methodology, helped in results interpretation and generated result tables, searched references for discussion writing, conducted literature search, designed the data collection proforma, coordinated and performed data acquisition in the ICU, assisted in data analysis, and contributed to writing and revising the manuscript.
Shaikh K: Contributed to the study concept, proofreading and technical correction and assisted in data interpretation; provided critical revision of the manuscript for important intellectual content. Approved the final version for publication and agrees to be accountable for all aspects of the work.

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