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Original article

Prevalence of Iron Deficiency Among Young Women in Misurata, Libya: The Role of Menstruation and Dietary Habits

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Abstract
Iron deficiency is a major global health concern, with young women being the most vulnerable population. While iron deficiency anemia (IDA) is clinically apparent, iron depletion without anemia- marked with low ferritin- is frequently overlooked despite its impact on cognitive and physical health. This study aimed to evaluate the prevalence of low ferritin levels among young women in Misurata, Libya, and to investigate the impact of menstruation and dietary habits as contributing factors. A cross-sectional study was conducted involving 103 female and 25 male medical students (aged 18–27 years). Serum ferritin, haemoglobin (Hb), and C-reactive protein (CRP) were measured to assess iron status. Additionally, dietary patterns were assessed via a structured dietary scoring system. A high prevalence of iron depletion was observed among females, with 52.4% exhibiting confirmed iron deficiency (ferritin < 15 µg/L) and only 5.8% maintaining sufficient iron stores (> 50 µg/L). Notably, among non-anaemic female participants (Hb≥ 12g/dl), 40% had ferritin levels below 15 µg/L, and 38% fell within the insufficient range of 15–30 µg/L. A highly significant gender difference was found (p < 0.0001), as no male participants had ferritin levels below 15 µg/L, and 76% had sufficient stores. Although dietary scores were significantly lower in females compared to males (p < 0.0001), menstruation was identified as the primary factor responsible for iron depletion, with poor dietary habits serving as a reinforcing cause. Subclinical iron deficiency is widespread among young females in Misurata, even in the absence of anaemia. This prevalence suggests a hidden risk for future complications such as IDA, particularly when biological requirements increase. The study emphasizes the role of menstruation as the major cause of iron deficiency, followed by poor dietary habits. The study suggests that the current clinical threshold may need to be increased to a higher target (e.g., 50 µg/L) to ensure sufficient iron stores and avoid late-stage anemia.
Keywords*. Iron Deficiency, Ferritin, Non-anemic Iron Deficiency, Misurata, Menstruation, Dietary Habits.*

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Introduction

Iron deficiency is one of the most common nutritional deficiencies around the globe, giving rise to iron deficiency anemia (IDA) as a major health concern. Although iron deficiency is prevalent among different populations, children and women of reproductive age are usually presented as the most vulnerable populations. Compared to IDA, which manifests with reduced hemoglobin levels, iron deficiency without anemia, which is marked with low ferritin levels, may remain undiagnosed despite causing significant health consequences such as fatigue, impaired cognitive function, limited work capacity, and a compromised immune system.

In clinical practice, ferritin is primarily used as a serum marker to assess total body iron stores. It plays a crucial role in both the diagnosis of iron deficiency and iron overload as well as follow-up of the management of these conditions. [1]. Although ferritin is widely recognized as the most reliable indicator of body iron stores, the appropriate diagnostic cut-off value is still contentious and periodically revised. Many local laboratories continue to use the outdated 12 µg/L threshold, whereas most international health organizations have adopted higher decision points. According to its 2020 guideline, the World Health Organization (WHO) recommends a ferritin cut-off of 15 µg/L for confirming iron deficiency in non-inflamed adults [2]. In contrast, the British Society for Haematology (BSH) and the American Society of Haematology (ASH) recommend a threshold of 30 µg/L, a level also supported by several comprehensive reviews [3]. Moreover, in its 2024 annual meeting, ASH proposed a cut-off of 50 µg/L as an early indicator of iron deficiency in women of reproductive age [3]. To reconcile these varying recommendations, the present study categorizes ferritin levels as: <15 µg/L (confirmed deficiency), 15–30 µg/L (insufficient stores), 30–50 µg/L (early insufficiency), and > 50 µg/L (sufficient iron stores).

Evidence from several studies suggests that iron deficiency is widespread, particularly among women, even in the absence of anemia. In Iran, for instance, nearly 50% of female medical students had iron deficiency, yet fewer than 5% had IDA [4]. Similarly, a U.S. study found that three out of four included women had iron inadequacy (ferritin <50

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μg/L), while anemia prevalence was below 7% [5]. High rates of iron deficiency were also reported in an Australian study that included more than 3400 young women [6]. Given iron's biological importance and the underdiagnosis of non-anemic individuals, this study aims to assess ferritin levels in young women in Misrata, where similar trends are anticipated.
Moreover, numerous studies suggest that iron status is influenced by several determinants, particularly dietary habits and menstruation. Since food is the usual source of daily iron requirements, an unbalanced diet, particularly low in heme-iron (mainly found in meat), significantly contributes to a low iron state. Studies from different countries, such as Ethiopia, the USA, and Saudi Arabia, highlight poverty, malnutrition, and infrequent meat consumption as risk factors [5, 7, 8]. Since meat, the gold-standard source of heme iron, is often unaffordable for low-income populations, iron deficiency may be more prevalent in these groups. This explanation is supported by a study conducted in Tabuk (KSA), where an association between infrequent meat consumption and the prevalence of iron deficiency anemia was demonstrated [8]. Moreover, vegetarian diets, which are rich in non-heme iron, often have lower bioavailability due to the presence of inhibitors like tannins and phytic acid [9, 10]. Therefore, dietary patterns or habits are also proposed to affect iron stores and ferritin levels.
Many studies indicate that menstruation is a significant factor associated with decreased ferritin levels. For example, a Chinese study conducted in 2016 compared the predisposition to low ferritin levels and IDA in 1360 males and 1545 females who followed the same dietary pattern, all aged between 18 and 50 years. The study found that the rate of iron deficiency (low ferritin levels) and IDA was higher in women than in men [9]. Moreover, multiple studies from Australia, Iraq, and elsewhere have shown that heavy menstrual bleeding depletes iron stores, particularly in young women [6, 11, 12]. This study aims to investigate the prevalence of low ferritin levels among young women in Misurata and to explore the influence of menstruation and dietary habits on ferritin status. The study examines ferritin prevalence, comparing results with a male control group, and exploring the impact of dietary habits and menstrual bleeding on serum ferritin, as such factors are hypothesized to contribute to low ferritin levels.

Methods

Study design and participants

This study was designed as a cross-sectional study utilizing data collected from 103 young women and 25 male controls (all aged 18–27 years). To ensure accurate questionnaire responses, all participants were medical students; their heightened awareness of iron importance was neutralized by excluding supplement users. Exclusion criteria included pregnancy, lactation, recent iron deficiency diagnosis, iron supplementation, and hormonal therapy. As ferritin is regarded as a positive acute-phase protein, participants with elevated CRP were also excluded.

Data collection and validity

Participants completed structured questionnaires assessing dietary iron (heme/non-heme intake). The dietary assessment questionnaire was designed based on the type of dietary iron. It comprised seven items covering iron sources, meal frequency, and inhibitors of iron absorption. Heme iron intake was evaluated, scoring red meat consumption as 3 points and white meat as 2 points toward the total score for heme iron.
The assessed serum parameters included serum ferritin, CRP, and hemoglobin. For each participant, demographic information such as age, sex, height, and weight was recorded at the time of sampling. Data and samples were collected over a relatively short time period-three weeks (July 2025)- and processed uniformly at Ibn Sena Laboratory to minimize the analytical variation that might result from different operators and reagents.

Ethical considerations

The study protocol emphasized informed consent; questionnaires were distributed in advance, and participants were invited to visit the IBN SENA Lab to provide a blood sample if they agreed to participate in the study. Blood samples were linked only to anonymized codes, ensuring participant confidentiality.

Statistical analysis

Normality was evaluated using Shapiro-Wilk/Kolmogorov-Smirnov tests. Data were organized in Excel and analyzed using GraphPad Prism 8.0.2 employing appropriate statistics based on distribution.

Results

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Distribution of serum ferritin among female participants, as presented in (Table 1), indicates a clear predominance of low ferritin levels among the female participants, as more than half (52.4%) had confirmed iron deficiency according to the WHO classification, while approximately the next one-third showed iron insufficiency. Moreover, according to the American Society of Hematology (ASH), only 6 out of 103 females had adequate iron stores.

Table 1. Distribution of ferritin levels among female participants.

Ferritin level (µg/L)	Female (n=103)
Below 15	52.4 % (n=54)
15-30	30.1% (n=31)
30-50	11.7% (n=12)
Above 50	5.8% (n=6)
Total	100%

The analysis of serum ferritin among female participants, as shown in (Table2), revealed a clear predominance of low ferritin levels, indicated by a median ferritin level = 13.48 µg/L, which is below the WHO-assigned level of confirmed iron deficiency. The third quartile was below the cutoff of normal ferritin used in many countries (30 µg/L), which was used in this research as a cutoff to indicate iron insufficiency. Moreover, the 90th percentile was below the ASH level of adequate iron stores.

Table 2. Descriptive statistics of ferritin levels in female participants.

Statistic	Females group result (n=103)
Mean ferritin level ± SD (µg/L)	17.89 ± 15.81
Std. Error of Mean (SEM) (µg/L)	1.558
Relative standard error (RSE)	8.7%,
Median ferritin level (µg/L)	13.48
Q3-Q1 (µg/L)	23.78-5.75
90th Percentile (µg/L)	36.64

Moreover, low ferritin levels were prevalent even among females with normal hemoglobin: 40% had ferritin <15 µg/L, and 38% fell between 15–30 µg/L, as presented in (Figure 1). Despite excluding recently diagnosed anemia cases, 23 participants were anemic, highlighting their susceptibility to anemia.

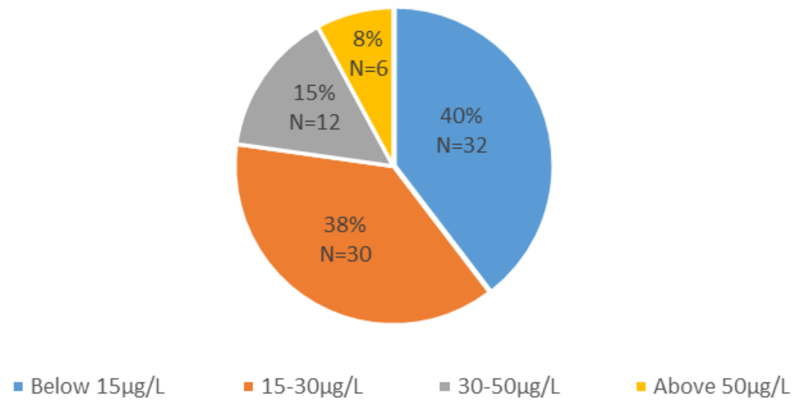

Figure 1. Percentage of different ferritin levels in non-anemic females (Hb≥ 12g/dl, n=80).

Even though many factors may contribute to the high prevalence of low ferritin among females, the two most important reasons — according to this study's hypothesis — are menstruation and diet. To highlight the effect of these factors, a comparison with a male control group might be useful.

To illustrate the difference between the two genders, boxplots were utilized. As shown in (Figure 2), a clear difference in ferritin level between genders was observed. Males show substantially higher ferritin levels with a higher median

(81.29 µg/L) and higher interquartile range compared to females. Results of the Mann–Whitney test showed a very significant (P value = <0.0001) difference between the two groups.
Moreover, distribution of ferritin level among male participants in comparison to females (Figure 3) demonstrated No male had a ferritin level below 15 µg/L (WHO decision point for confirmed iron deficiency), compared with more than 50% of females. Moreover, 76% of males had sufficient iron stores according to the ASH classification (above 50 µg/L), whereas only 6% of females reached this level.

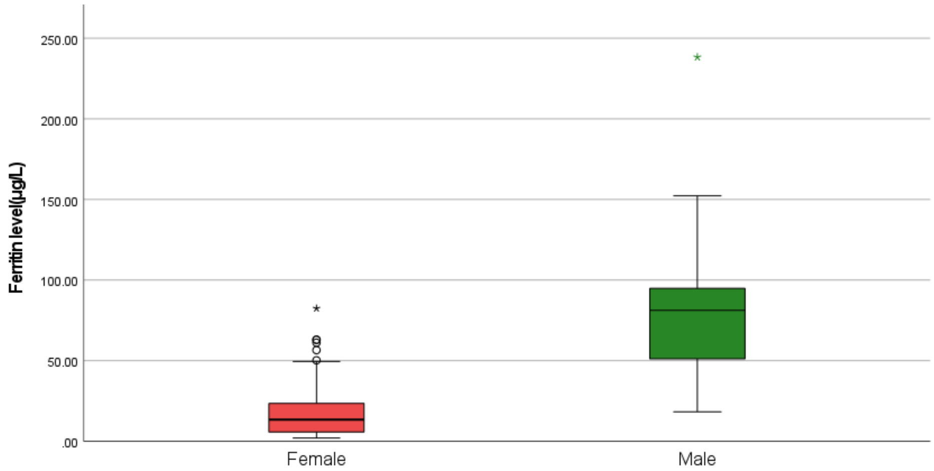

Figure 2. Comparison of serum ferritin levels between males and females

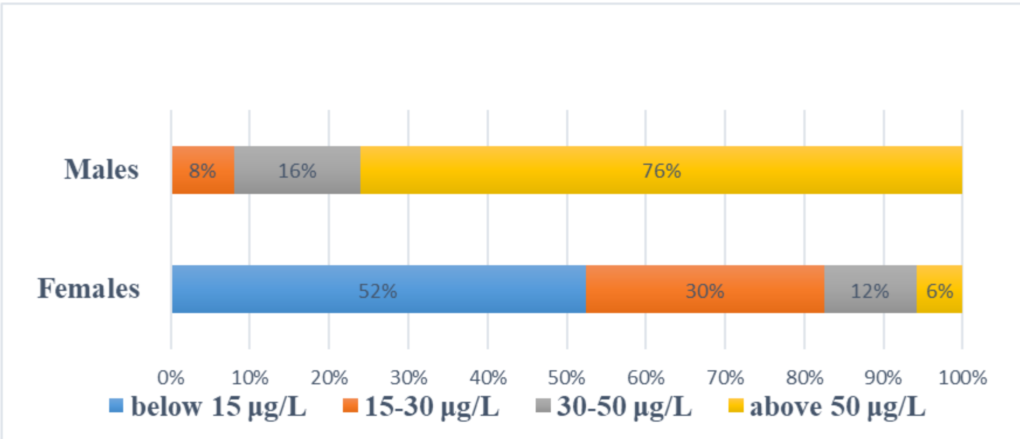

Figure 3. Percentage of different ferritin levels in males and females.

According to this study, dietary habits are the second most important factor contributing to lower ferritin levels in females. Results of the diet score questionnaire are summarized in (Table 4).

Table 4. Summary of descriptive analysis of diet score in males and females.

Statistic	Females (n=103)	Males (n=25)
Mean diet score	8.612	11.36
SD	3.344	2.271
SD. Error of mean	0.3295	0.4542
Relative standard error (RSE)	3.82%	4%
Median	9	11

The Mann-Whitney test result (p<0.0001) reveals a statistically significant difference between male and female dietary scores.

Discussion

Female ferritin levels in the study sample were non-parametric, with medians below WHO-defined deficiency thresholds (<15 μg/L) and third quartiles below the 30 μg/L cutoff for insufficiency. The 90th percentile fell below the ASH-recommended level for adequate stores (50 μg/L), confirming a high prevalence of low ferritin. The low relative standard error (<10%) supports generalizability to the broader population. These results align with global studies: Karbulut et al. [13] reported 46.1% of Mediterranean women had ferritin <12 μg/L, while Lestarini et al. [14] found 40% of Indonesian females had levels <15 μg/L. Similarly, Islam et al. [6] noted 34.8% of Australian females had ferritin <30 μg /L. The data thus validate the hypothesis of high low-ferritin prevalence. Analysis results of the non-anemic female participants (40% had ferritin <15 μg/L, and 38% fell between 15–30 μg/L) align with Abdalla et al. [15], who found 52.4% of non-anemic females had low ferritin, underscoring subclinical iron deficiency.

While anemia represents the late stage of iron inadequacy, non-anemic females with low ferritin remain vulnerable to anemia and related complications, particularly during pregnancy or bleeding episodes. These findings emphasize the importance of regular ferritin monitoring to prevent anemia and its associated adverse outcomes.

Menstruation and dietary habits were identified as key contributors to the high prevalence of low ferritin among females, as expected. Comparison with a male control group revealed clear differences: as no male participant had ferritin <15 μg/L, compared to over 50% of females. Additionally, 76% of males had sufficient iron stores (>50 μg/L), as per ASH classification, while only 6% of females reached this level.

These results support the findings of several studies; Urrechaga et al., for instance, [16] found low ferritin levels four times more prevalent in females than males in a study that included 1,407 women and 852 men. This finding was further supported by two different Libyan studies [15, 17], which confirmed significantly higher ferritin levels in males. Furthermore, Jingjing He et al. [9] demonstrated that even with identical diets, females had lower ferritin levels than males, attributing this to menstrual blood loss. In the same regard, evidence from WHO data [3] revealed no gender difference in ferritin levels among children, but higher levels in adult males compared to females, reinforcing menstruation's role in reducing ferritin in females.

About diet scores, a statistically significant difference between male and female groups was observed, which aligns with the hypothesis of this study. Moreover, the low relative standard error (RSE) (less than 10%) suggests that the results observed in the study sample are likely representative of the wider population. Consistently, a study conducted in Tabuk (KSA) reported an association between infrequent meat consumption and the prevalence of iron deficiency. (8) Although the effect of diet cannot be overlooked, it was not as large compared to the substantial difference in ferritin levels. According to this, it can be asserted that menstruation is the major factor responsible for lower iron stores in females compared to males.

Conclusions

In summary, low ferritin levels are highly prevalent among young females in Misurata, with more than 50% exhibiting deficiency and only 5.8% maintaining sufficient iron stores as per ASH criteria. It is noteworthy that iron stores depletion was prevalent even in non-anemic females, as 40% exhibited ferritin <15 μg/L, suggesting a hidden risk for IDA in the future, particularly during pregnancy. The pronounced gender variation in ferritin levels, with females consistently showing lower levels, clearly highlights menstruation as a primary contributing factor and indicates the significant influence of poor dietary habits as a reinforcing factor.

Recommendations and limitations

Enhance awareness among medical practitioners and the general population about the clinical significance of ferritin as an indicator of iron stores, recognizing that anemia represents a late stage of iron deficiency, while many important physiological consequences may occur earlier. Additionally, clinicians should be encouraged to use the most updated guidelines and consider targeting higher ferritin thresholds, such as 50 μg/L, to support optimal iron status, especially in the young female population.

The main limitation of this study was its reliance on self-reported information, which may introduce bias; therefore, future research directions should integrate multidisciplinary expertise (e.g., physicians, dietitians) and utilize more refined assessment tools.

Conflict of interest. Nil

References

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1. Knovich MA, Storey JA, Coffman LG, Torti SV, Torti FM. Ferritin for the clinician. Blood Rev. 2009 May;23(3):95-104.
2. World Health Organization. Executive summary: WHO guideline on use of ferritin concentrations to assess iron status in individuals and populations. Geneva: World Health Organization; 2020. Accessed October 14, 2025. Available from: https://www.who.int/publications/i/item/9789240000124
3. Deloughery EP, Deloughery TG. Global prevalence of iron deficiency utilizing differing ferritin cut-offs-15, 30, and 50 μg/L. Blood. 2024 Nov 5;144:5076.
4. Shams S, Asheri H, Kianmehr A, et al. The prevalence of iron deficiency anaemia in female medical students in Tehran. Singapore Med J. 2010 Feb;51(2):116.
5. Weyand AC, Chaitoff A, Freed GL, et al. Prevalence of iron deficiency and iron-deficiency anemia in US females aged 12-21 years, 2003-2020. JAMA. 2023 Jun 27;329(24):2191-2193.
6. Islam RM, Bell RJ, Skiba MA, Trambas CM, Davis SR. Iron insufficiency among young Australian women: a population-based survey. Intern Med J. 2020 Apr;50(4):420-426.
7. Haidar J. Prevalence of anaemia, deficiencies of iron and folic acid and their determinants in Ethiopian women. J Health Popul Nutr. 2010 Aug;28(4):359-368.
8. Alzaheb RA, Al-Amer O. The prevalence of iron deficiency anemia and its associated risk factors among a sample of female university students in Tabuk, Saudi Arabia. Clin Med Insights Womens Health. 2017 Nov 30;10:1179562X17745088.
9. He J, Shen X, Fang A, et al. Association between predominantly plant-based diets and iron status in Chinese adults: a cross-sectional analysis. Br J Nutr. 2016 Nov;116(9):1621-1632.
10. Perzia BM, Ying GS, Dunaief JL, Dunaief DM. Reduction in ferritin concentrations among patients consuming a dark-green leafy vegetable–rich, low inflammatory foods everyday (LIFE) diet. Curr Dev Nutr. 2022 Jun 1;6(6):nzac095.
11. Ghazzay H, Jasim MA, Shukur AS, Ibrahim SQ. Low ferritin with normal hemoglobin, a common neglected and hidden hematological disorder. Ann Trop Med Public Health. 2021;24:225-242.
12. Wang W, Bourgeois T, Klima J, Berlan ED, Fischer AN, O'Brien SH. Iron deficiency and fatigue in adolescent females with heavy menstrual bleeding. Haemophilia. 2013 Mar;19(2):225-230.
13. Karabulut A, Güler ÖT, Karahan HT, Özkan S, Koyuncu H, Demirciler I. Premarital screening of 466 Mediterranean women for serum ferritin, vitamin B12, and folate concentrations. Turk J Med Sci. 2015;45(2):358-363.
14. Lestarini IA, Ekawati A, Irawati D, Wedayani AA, Putra HS. Analysis of ferritin levels as a risk factor for anemia in adolescent girls on the West Lombok Coast. J Biol Trop. 2025 Mar 30;25(1):1143-1147.
15. Abdalla EH, Farag EM, Ali AS, Hussin JN, Gbril AK. Iron deficiency in non-anemic individuals: a retrospective analysis of Libyan population. GSC Biol Pharm Sci [Internet]. 2020;11:171–179.
16. Urrechaga E, Izquierdo-Álvarez S, Llorente M, Escanero JF. Prevalence of iron deficiency in healthy adolescents. Ann Nutr Disord Ther. 2016;3(7):1031.
17. Alsagheer S, Khaled F. A comparative study of hematological parameters and serum ferritin levels between males and females in El-Beida City, Libya. AlQalam J Med App Sci. 2025 May 11;8(1):843-845.