Alqalam Journal of Medical and Applied Sciences. 2025;8(2):843-845
https://doi.org/10.54361/ajmas.258243

Original article

A Comparative Study of Hematological Parameters and Serum Ferritin Levels Between Males and Females in El-Beida City, Libya

Siham Alsagheer[1], Fayrouz Khaled[2]

[1]*Department of Biology, Faculty of Education, Omar Al-Mukhtar University, Al-Bayda, Libya*
[2]*Department of Chemistry, Faculty of Science, Omar Al-Mokhtar University, Al-Beida, Libya*
Corresponding email. *fayalzobair@yahoo.com*

Abstract
Sex-based differences in hematological parameters and iron storage biomarkers such as ferritin are well-documented in clinical literature, often attributed to hormonal influences, iron metabolism, and physiological differences between males and females. Understanding these variations is essential for interpreting laboratory results and managing gender-specific health conditions. This study aimed to compare age, serum ferritin levels, and key hematological indices between male and female participants to elucidate gender-related physiological differences. Descriptive statistical analysis was conducted on data obtained from male and female groups, including measurements of age, ferritin, white blood cells (WBC), hemoglobin (HB), red blood cells (RBC), platelet count, hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). The mean age was comparable between males (40.6 ± 1.902 years) and females (41.95 ± 1.772 years), though with a wider age range in males. Ferritin levels were significantly higher in males (148.73 ± 16.73 ng/mL) than in females (50.53 ± 20.34 ng/mL), reflecting differences in iron storage capacity. Males also exhibited higher values in HB (15.69 ± 0.92 g/dL), RBC (5.443 ± 0.19 $\times 10^6$/µL), and HCT (46 ± 1.64%), while females had higher WBC counts (7.145 ± 0.59 $\times 10^3$/µL) and platelet counts (289.9 ± 17.43 $\times 10^3$/µL). Red cell indices such as MCV, MCH, and MCHC were also greater in males compared to females.
Keywords. Serum Ferritin, Hematological Parameters, Male and Female.

Introduction

The complete blood count (CBC) is one of the most commonly used diagnostic tools in clinical medicine, providing essential information about the different cellular components of blood, such as red blood cells (RBCs), white blood cells (WBCs), hemoglobin, hematocrit, and platelets [1]. It plays a pivotal role in screening for a variety of conditions, including anemias, infections, and hematologic malignancies [2]. Importantly, the CBC also reflects physiological variations that exist between males and females due to intrinsic and extrinsic factors [3]. Differences in hormonal profiles, such as the stimulatory effect of androgens on erythropoiesis in males, along with periodic iron loss due to menstruation in females, contribute significantly to the observed disparities in CBC values between the sexes [4]. Establishing gender-specific reference ranges is therefore crucial for accurate diagnosis and effective treatment planning in diverse populations [5]. Numerous studies have focused on elucidating the differences in CBC parameters between males and females, consistently demonstrating that males tend to have higher RBC counts, hemoglobin concentrations, and hematocrit values compared to females. For example, research indicates that the androgen-mediated enhancement of erythropoiesis in males and the regular loss of iron through menstruation in females are key contributors to these observed variations [6]. Additionally, several investigations have reported that these differences are further modulated by factors such as nutritional status, genetic predispositions, and environmental influences, underscoring the need for population-specific reference intervals [7]. Ferritin is an intracellular protein that serves as the primary storage mechanism for iron, releasing it in a controlled manner when needed. Serum ferritin levels are widely recognized as a reliable marker of total body iron stores [8]. Notably, gender differences in ferritin concentrations have been observed, with males generally exhibiting higher levels than females [9]. This disparity is primarily attributed to physiological factors such as the regular menstrual blood loss in females and the androgen-driven stimulation of erythropoiesis in males, which influences iron metabolism and storage [10]. The complete blood count (CBC) is a fundamental diagnostic tool that measures various components of the blood, including red blood cells (RBCs), white blood cells (WBCs), hemoglobin, hematocrit, platelets, and other indices, providing invaluable insights into an individual's overall health [11]. These parameters are not only critical for the diagnosis and monitoring of diseases such as anemia and infections but also serve as indicators of the physiological variations between different demographics. Gender, in particular, has been shown to influence CBC values significantly, with factors such as hormonal differences, blood volume variations, and menstrual losses in females contributing to these variations.

Methods

A cross-sectional study was conducted in El–Beida city, Libya, involving 80 healthy participants comprising 40 males and 40 females aged 29–73 years. Participants were recruited from local health centers and underwent venous blood sampling. The hematological parameters, including RBC, Hb, Hct, WBC, and

Received*: 10-03-2025 -* ***Accepted****: 03-05-2024 -* ***Published****: 11-05-2025*

platelet count, were measured using an automated hematology analyzer. Serum ferritin was quantified with an immunoassay technique. Data were analyzed using standard statistical tests, with independent t-tests used to compare means between the two groups**.**

Results

In Table 1, the mean age was similar between males (40.6 ± 1.902 years) and females (41.95 ± 1.772 years). However, the age range in males was wider (29–73 years), while it was highly restricted in females (56–57 years), suggesting a more age-homogeneous female sample. This may introduce bias in age-related variables and should be considered in further analyses. Ferritin levels were significantly higher in males (148.725 ± 16.73 ng/mL) than in females (50.53 ± 20.335 ng/mL). This result is consistent with physiological norms, as males tend to have higher iron stores due to the absence of menstrual blood loss. This difference may also reflect hormonal and dietary influences.

Females showed higher WBC counts (7.145 ± 0.589 $x10^3$/µL) compared to males (6.43 ± 0.492 $x10^3$/µL), possibly indicating a stronger innate immune response in females. This is often attributed to estrogen's immunomodulatory effects, as supported by immunological studies. Males exhibited higher levels of hemoglobin (15.69 vs. 12.385 g/dL), RBC (5.443 vs. 4.59 million/µL), and hematocrit (46% vs. 36.01%). These differences are expected and reflect the erythropoietic effects of testosterone in males, which promote red blood cell production. Females had a higher mean platelet count (289.9 ± 17.43 $x10^3$/µL) than males (228 ± 12.4 $x10^3$/µL), which is in line with established hematological patterns. This may be due to hormonal variations, especially the influence of estrogen, which enhances platelet production and turnover. Males recorded higher values for: MCV (85.79 ± 0.726 fL vs. 81.05 ± 1.679 fL), MCH (29.435 ± 0.317 pg vs. 27.025 ± 0.744 pg), MCHC (34.27 ± 0.132 g/dL vs. 33.27 ± 0.268 g/dL). These differences suggest larger and more hemoglobin-rich erythrocytes in males, likely due to higher iron availability and testosterone stimulation.

Table 1. Descriptive Statistics of Age, Ferritin Level, and Hematological Parameters in Male and Female Groups.

Descriptive Statistics	Mean & Std.	Minimum	Maximum	Mean & Std.	Minimum	Maximum
	Male			Female		
Age	40.6 ±1.902	29	73	41.95 ±1.772	56	57
Ferritin level	148.725 ± 16.73	65	330	50.53 ± 20.335	8.5	397
WBC	6.43 ± 0.492	3.92	9.28	7.145 ± 0.589	4.76	15.76
HB	15.69 ±0.92	14	22.6	12.385± 0.407	8.7	15
RBC	5.443 ±0.19	4.68	8.3	4.59± 0.109	3.85	5.66
Platelet	228 ±12.4	88	328	289.9± 17.43	176	449
HCT	46 ±1.641	31.6	67.2	36.01± 1.642	12.3	44.6
MCV	85.79±0.726	80.2	93	81.05±1.679	59.3	90.5
MCH	29.435±0.317	27.1	31.6	27.025±0.744	17.9	31.5
MCHC	34.27±0.132	32.7	35.5	33.27±0.268	30.2	35.1

Discussion

The descriptive analysis of age among the study population showed relatively close mean values between males and females, suggesting age-matched groups. However, the male group demonstrated a broader age range, compared to the narrower range in females, which may impact the variability of certain physiological and hematological markers due to age-related hematopoietic changes. Age is known to influence bone marrow activity and iron metabolism, especially in older populations [12]. The mean serum ferritin level was markedly higher in males than in females. This result is consistent with known gender differences in iron storage, as menstruating females experience regular iron loss and tend to have lower ferritin levels. In contrast, adult males typically accumulate more iron, contributing to elevated ferritin concentrations. These findings are aligned with previous reports indicating that premenopausal women have significantly lower iron reserves than men [13].

WBC counts were slightly higher in females compared to males. Elevated WBC levels in females may be attributed to estrogenic modulation of immune responses, which enhances leukocyte proliferation and cytokine production. These immunological sex differences have been well documented and reflect the influence of sex hormones on the innate and adaptive immune systems [14]. Hemoglobin (HB) concentration and red blood cell (RBC) counts were significantly higher in males than in females. These gender-based differences are physiologically expected, as testosterone enhances erythropoiesis by stimulating erythropoietin production, while menstrual blood loss contributes to lower values in females. Such differences are routinely observed in clinical and population-based studies [15]. Hematocrit (HCT) values further support these findings, being notably higher in males compared to females. This is directly proportional to the elevated hemoglobin and RBC counts in males and is a marker of oxygen-carrying capacity.

Received*: 10-03-2025 -* ***Accepted****: 03-05-2024 -* ***Published****: 11-05-2025*

Variations in HCT between sexes are a fundamental hematological feature and reflect differences in erythrocyte mass [16]. Platelet counts were significantly higher in females compared to males, which is consistent with existing evidence indicating a gender difference in thrombopoiesis. Estrogen is known to influence megakaryocyte maturation and platelet production. These sex-specific platelet variations may also have clinical implications in coagulation and cardiovascular risk assessment [17]. In terms of red blood cell indices, males exhibited higher mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration compared to females. These parameters reflect the size and hemoglobin content of individual red cells and are crucial for detecting anemia subtypes. The higher values in males are attributable to greater erythropoietic activity and hemoglobin synthesis, possibly driven by androgens [18].

Conclusion

These findings confirm the existence of distinct gender-specific patterns in hematological and ferritin parameters. Males showed higher erythrocytic indices and iron storage, whereas females had elevated immune cell and platelet counts. Such differences should be carefully considered in clinical diagnostics and treatment planning.

Conflict of interest. Nil

References

1. Brihi E. Normal and abnormal complete blood count with differential. 2024.
2. Freeman A, Zubair M. Anemia screening. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025.
3. Zhu P, Tang Y, Fan J, Fang J, Peng X, Cui H. Hematological parameters and blood cell morphology of male and female *Schizothorax (Racoma) davidi* (Sauvage). J World Aquac Soc. 2017;48(5):821–30.
4. Naets JP, Wittek M. Mechanism of action of androgens on erythropoiesis. Am J Physiol. 1966;210(2):315–20.
5. Sanchez AL, Comer JS, LaRoche M. Enhancing the responsiveness of family-based CBT through culturally informed case conceptualization and treatment planning. Cogn Behav Pract. 2022;29(4):750–70.
6. Banyeh M, Kangkpi T, Bani SB, Zogli KE, Tanko MM, Atuahene PE, et al. Are sex differences in blood cell count and hemoglobin moderated by the 2D:4D ratio? A cross-sectional study in a Ghanaian population. Health Sci Rep. 2023;6(9):e1547.
7. Fenech M, El-Sohemy A, Cahill L, Ferguson LR, French TAC, Tai ES, et al. Nutrigenetics and nutrigenomics: viewpoints on the current status and applications in nutrition research and practice. Lifestyle Genomics. 2011;4(2):69–89.
8. Garcia-Casal MN, Pasricha SR, Martinez RX, Lopez-Perez L, Pena-Rosas JP. Serum or plasma ferritin concentration as an index of iron deficiency and overload. Cochrane Database Syst Rev. 2021;(5).
9. Han LL, Wang YX, Li J, Zhang XL, Bian C, Wang H, et al. Gender differences in associations of serum ferritin and diabetes, metabolic syndrome, and obesity in the China Health and Nutrition Survey. Mol Nutr Food Res. 2014;58(11):2189–95.
10. Badenhorst CE, Forsyth AK, Govus AD. A contemporary understanding of iron metabolism in active premenopausal females. Front Sports Act Living. 2022;4:903937.
11. Seo IH, Lee YJ. Usefulness of complete blood count (CBC) to assess cardiovascular and metabolic diseases in clinical settings: a comprehensive literature review. Biomedicines. 2022;10(11):2697.
12. Helwig NE, Ruprecht MR. Age, gender, and self-esteem: A sociocultural look through a nonparametric lens. Arch Sci Psychol. 2017;5(1):19.
13. Levi S, Finazzi D. Neurodegeneration with brain iron accumulation: update on pathogenic mechanisms. Front Pharmacol. 2014;5:99.
14. Sakelliou A, Fatouros IG, Athanailidis I, Tsoukas D, Chatzinikolaou A, Draganidis D, et al. Evidence of a redox-dependent regulation of immune responses to exercise-induced inflammation. Oxid Med Cell Longev. 2016;2016:2840643.
15. Murphy WG. The sex difference in haemoglobin levels in adults—mechanisms, causes, and consequences. Blood Rev. 2014;28(2):41–7.
16. Eckmann DM, Bowers S, Stecker M, Cheung AT. Hematocrit, volume expander, temperature, and shear rate effects on blood viscosity. Anesth Analg. 2000;91(3):539–45.
17. Dupuis M, Severin S, Noirrit-Esclassan E, Arnal JF, Payrastre B, Valéra MC. Effects of estrogens on platelets and megakaryocytes. Int J Mol Sci. 2019;20(12):3111.
18. Fazio F, Marafioti S, Arfuso F, Piccione G, Faggio C. Influence of different salinity on haematological and biochemical parameters of the widely cultured mullet, *Mugil cephalus*. Mar Freshw Behav Physiol. 2013;46(4):211–8.

Received*: 10-03-2025 -* ***Accepted****: 03-05-2024 -* ***Published****: 11-05-2025*