

Gender-Based analysis of Some Complete Blood Account Parameters at Al-Qarabouli General Hospital, Libya

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Abstract:

Complete blood count (CBC) is one of the most commonly used laboratory tests for evaluating hematological status and detecting various blood disorders . This study aimed to assess selected hematological parameters and investigate gender related differences among individuals attending Al-Qarah Bulli General Hospital. The study was conducted on 100 CBC testes, including 41 males and 59 females. Hematological parameters including RBC, WBC, HGB, PLT, HCT, MCV, MCH, and MCHC were analyzed using an automated hematology analyzer. Data were analyzed using SPSS software, and results were expressed as mean $\pm$ standard deviation (SD). Independent sample t-test was used to compare males and females, with statistical significance considered at $P < 0.05$. The results showed significantly higher values of RBC, HGB, HCT, MCV, and MCH in males compared with females ($P < 0.05$), while no significant differences were observed in WBC, PLT, and MCHC ($P < 0.05$).

Keywords: Complete Blood Count, Hematological Parameters, Gender Differences, Blood Analysis, Hematology.

الملخص

يُعدّ تعداد الدم الكامل (CBC) من أكثر الفحوصات المخبرية استخدامًا لتقييم الحالة الدموية والكشف عن مختلف اضطرابات الدم. هدفت هذه الدراسة إلى تقييم بعض المؤشرات الدموية ودراسة الفروق المرتبطة بالجنس بين الأفراد المترددين على مستشفى القره بوللي العام. أجريت الدراسة على 100 فحص لتعداد الدم الكامل، شملت 41 ذكرًا و59 أنثى. وتم تحليل المؤشرات الدموية التي تضمنت عدد كريات الدم الحمراء (RBC)، وعدد كريات الدم البيضاء (WBC)، والهيموغلوبين (HGB)، والصفائح الدموية (PLT)، والهيماتوكريت (HCT)، ومتوسط حجم الكرية (MCV)، ومتوسط كمية الهيموغلوبين في الكرية (MCH)، ومتوسط تركيز الهيموغلوبين في الكرية (MCHC)، باستخدام جهاز تحليل دم آلي. جرى تحليل البيانات باستخدام برنامج SPSS، وعُبر عن النتائج بالمتوسط $\pm$ الانحراف المعياري (SD). واستخدم اختبار t للعينات المستقلة للمقارنة بين الذكور والإناث، واعتُبرت الفروق ذات دلالة إحصائية عند $P < 0.05$. أظهرت النتائج ارتفاعًا معنويًا في قيم عدد كريات الدم الحمراء، والهيموغلوبين، والهيماتوكريت، ومتوسط حجم الكرية، ومتوسط كمية الهيموغلوبين في الكرية لدى الذكور مقارنة بالإناث ($P < 0.05$)، بينما لم تُسجل فروق ذات دلالة إحصائية في عدد كريات الدم البيضاء، والصفائح الدموية، ومتوسط تركيز الهيموغلوبين في الكرية بين الجنسين. الكلمات المفتاحية: تعداد الدم الكامل (CBC)، المؤشرات الدموية، الجنس، الذكور، الإناث، مستشفى القره بوللي العام

1- Introduction:

Complete blood count (CBC) is one of the most commonly requested laboratory tests in clinical practice. It is providing essential information about blood cellular components and plays a key role in the diagnosis of hematological disorders¹.

Several studies have demonstrated significant gender-related differences in hematological parameters, including red blood cells (RBCs), white blood cells (WBCs), hemoglobin (Hb), hematocrit (HCT), and platelets (PLT)¹⁻². These variations are mainly attributed to physiological, hormonal, and genetic factors². Hematological parameters measured by CBC are influenced by physiological factors such as gender². Males generally have higher hemoglobin levels than females due to hormonal differences and the effect of testosterone on erythropoiesis³. While females tend to have lower hemoglobin levels partly due to menstrual blood loss³.

previous studies have demonstrated significant gender differences in hematological parameters⁴ reported that males have higher red blood cell count (RBC), hemoglobin (Hb), and hematocrit (HCT) compared to females. Similarly, study by (Mustafa *et al*, 2024) found that males exhibit higher hemoglobin levels, whereas females tend to have higher white blood cell (WBC) and platelet counts.

In Libya, study by Khaled and Hasan(2025) conducted a large cross-sectional study involving 1200 participants. The study found significantly higher RBC, Hb, and HCT values in males, while anemia was more prevalent among females. In addition, Alsagheer and Khaled (2025) confirmed that males have higher RBC, HGB, and HCT levels, whereas females show higher WBC and platelet counts.

Previous studies conducted in different populations have reported that males generally exhibit higher RBC, Hb, and HCT values, whereas females tend to have higher platelet counts and may show different hematological profiles⁵. Despite these findings, limited data are available regarding gender related variations in CBC parameters among the Libyan population, particularly in the Al-Qarabulli region. The lack of local studies creates a gap in understanding normal hematological variations according to gender and may affect the interpretation of laboratory results in clinical practice.

Therefore, this study aims to evaluate hematological parameters (CBC) including RBC, WBC, Hb, HCT, PLT, MCV, MCH, and MCHC, according to gender among patients attending AL-Qarabolly Hospital, and to determine whether these differences are statistically significant.

2- Materials and Methods:

2.1- Blood Sample Acquisition: blood samples used in this study were collected from individuals attending the laboratory of Al-Qarah Bulli General Hospital for routine CBC analysis using EDTA-coated tubes to prevent blood coagulation. The study was conducted over a period of three months and included a total of 100 b, consisting of 59 females and 41 males.

2.2- CBC Analysis Procedure:

Venous blood samples were collected in EDTA tubes to prevent blood coagulation. The samples were gently mixed and then analyzed using an automated hematology analyzer (Sysmex KX-21N). The analyzer was used to determine hematological parameters including Red Blood Cells (RBCs), White Blood Cells (WBCs), Hemoglobin(Hb), Platelets(PLT), Hematocrit(HCT), and red cell indices. All obtained results were recorded and subsequently subjected to statistical analysis

2.3 -Statistical Analysis:

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) software 2025. Descriptive statistics were expressed as mean $\pm$ standard deviation (SD) for continuous variables. Hematological parameters (RBCs, WBCs, Hb, PLT, HCT, and red cell indices) were compared between males and females using an independent samples t-test. A P-value of less than 0.05 was considered statistically significant.

3- Results and 4- Discussion:

In this study, the hematological parameters (RBC, WBC, HGB, PLT, HCT, MCV, MCH, and MCHC) were examined their distribution between males and females using CBC data.

A total of 100 participants were included in this study, comprising 41 males and 59 females.

The descriptive statistics of the hematological parameters measured by CBC analysis are presented in Table 1. The results are expressed as mean $\pm$ standard deviation (SD) for both male and female groups. A statistically significant difference was observed between males and females in RBC count ($P=0.012$), hemoglobin concentration ($P<0.001$), hematocrit ($P<0.001$), MCV ($P=0.003$), and MCH ($P<0.001$). In all these parameters, males showed higher mean values than females. No statistically significant differences were found for WBC count ($P=0.675$), platelet count ($P=0.321$), or MCHC ($P=0.322$) as shown in figure 1.

Table (1) presents the comparison of hematological parameters between males and females using the independent samples t-test.

Parameter	Normal range	Male(n=41) (Mean $\pm$ SD)	Female(n=59) (Mean $\pm$ SD)	P-value
RBCs ($\times 10^6/\mu\text{L}$)	M:4.5-5.9 F:4.1-5.1	4.609 $\pm$ 0.833	4.236 $\pm$ 0.617	0.012
HGB (g/dL)	M:13.5-17.5 F:12-15.5	13.683 $\pm$ 2.394	10.119 $\pm$ 5.731	<0.001
WBCs ($\times 10^6/\mu\text{L}$)	4-11	9.685 $\pm$ 3.918	11.481 $\pm$ 1.614	0.675
PLT ($\times 10^6/\mu\text{L}$)	150-450	234.756 $\pm$ 92.545	254.79 $\pm$ 102.914	0.321
HCT (%)	M:41-53 F:36-46	41.11 $\pm$ 6.693	34.934 $\pm$ 4.45	<0.001
MCV (fL)	80-100	89.276 $\pm$ 10.587	83.236 $\pm$ 8.991	0.003
MCH (pg)	27-33	29.912 $\pm$ 3.508	27.375 $\pm$ 3.537	<0.001
MCHC (g/dL)	32-36	33.237 $\pm$ 1.787	32.859 $\pm$ 1.917	0.322

Note: $P<0.05$ was considered statistically significant.

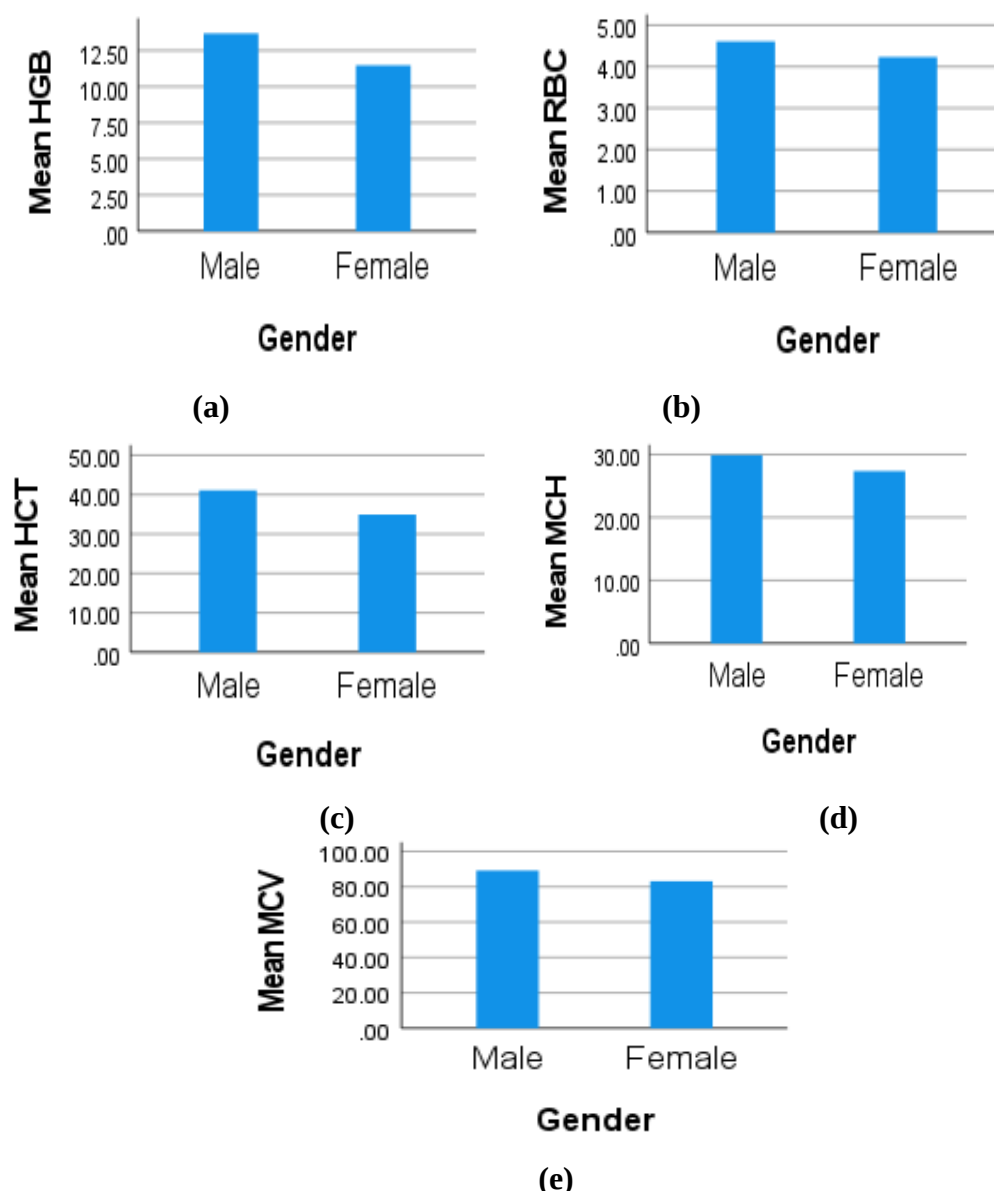


Figure 1: Comparison of the mean values of selected hematological parameters (HGB= a , HGB= b , HCT= c , MCH= d , MCV= e) between males and females

The results demonstrated clear gender-related variations in several red blood cell indices, while WBCs and PLT counts showed no statistically significant differences

Hemoglobin(HGB), RBC, and Hematocrit(HCT)

The present study revealed significantly higher hemoglobin levels in males compared to females ($P < 0.001$). Similarly, RBC count and HCT values were also significantly higher in males. These findings are consistent with previous studies conducted in El-Beyda City, Libya⁶, which reported that hemoglobin levels vary significantly according to gender, with males exhibiting higher values than females. Similarly, previous studies⁷ reported significantly higher Hb, RBC, and HCT levels in males.

Furthermore, previous studies⁸ confirmed that males had higher hemoglobin and RBC indices compared to females. A similar pattern was also observed in a previous study conducted in the western Sudanese population⁹, which found that hemoglobin was significantly higher in males, although some RBC indices did not show strong gender variation.

The lower HGB and HCT levels in females observed in the present study may be explained by physiological factors such as menstrual blood loss, increased iron requirements, and reproductive demands. These explanations are supported by previous evidence¹⁰, which highlighted that testosterone stimulates erythropoiesis in males, whereas menstrual blood loss contributes to lower hemoglobin HGB levels in females.

Red Blood Cell indices (MCV and MCH)

The present study showed significantly higher MCV and MCH values in males compared to females ($P < 0.05$). These findings are consistent with previous studies⁷, who reported similar gender-based differences in red cell indices, with males showing higher MCV and MCH values. Similarly, previous studies⁸ observed significant differences in MCV and MCH between genders, supporting the current findings. However, another study⁹ reported that most RBC indices such as MCV and MCH showed no significant gender differences, indicating that these variations may depend on population characteristics, nutritional status, and geographic factors.

White Blood Cells (WBC) and Platelets (PLT)

In the present study, no statistically significant differences were observed in WBC and PLT counts between males and females ($P < 0.05$). This finding is consistent with previous studies⁷⁻⁸, who also reported minimal or no gender-related differences in WBC and PLT parameters. These results suggest that leukocyte and platelet parameters are stable and less influenced by gender compared to red blood cell indices².

Mean Corpuscular Hemoglobin Concentration (MCHC)

No significant differences were observed in MCHC between males and females in the present study ($P < 0.05$). This finding aligns with previous studies⁷, who reported inconsistent or non-significant gender differences in MCHC across different age groups. Similarly, another study⁹ found that MCHC values remained relatively stable regardless of gender, supporting the present results.

General Interpretation

Overall, the findings of this study confirm that gender is a major determinant of red blood cell-related parameters, particularly HGB, RBC count, HCT, MCV, and MCH, while WBC, PLT, and MCHC remain largely unaffected. These results are consistent with previous studies that reported significant gender-related differences in erythrocyte parameters and minimal variation in leukocyte and platelet count⁷⁻¹⁰. These differences can be explained by physiological factors such as hormonal influence (testosterone and estrogen), menstrual blood loss, nutritional status, and population-specific factors⁶⁻¹⁰. The observed variations across different studies also highlight the importance of establishing population-specific reference values. Environmental, genetic, and dietary factors may influence CBC results²⁻¹⁰.

5- Conclusion

The present study demonstrated significant differences between males and females in several hematological parameters, including RBC, HGB, HCT, MCV, and MCH. Male participants showed higher mean values than females for these parameters. In contrast, WBC, PLT, and MCHC did not show statistically significant differences between genders. These findings indicate that gender has an important influence on RBC related parameters and should be considered when interpreting CBC results. Further studies with larger sample sizes are recommended to establish local reference values and to investigate additional factors that may affect hematological parameters in the Libyan population.

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