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Hematological Disorders among Hemodialysis Patients in Surman Region, Western Libya

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Abstract : Background: *Millions of individuals worldwide suffer from chronic kidney disease (CKD), a widespread ailment that contributes to high rates of morbidity and death. Common side effects of chronic kidney disease include hematological abnormalities, which are characterized by anemia and worsen as the illness progresses. The most popular treatment for severe and irreversible kidney failure is hemodialysis, which has emerged as a viable therapeutic option.* ***Objectives:*** *The current study aimed to evaluate the hematological disorders among hemodialysis patients in Surman region.* ***Materials and Methods:*** *The present study was conducted on 200 hemodialysis patients, attending Surman Dialysis Centerin western Libya from the 1st May 2023 to 1st December, 2024, and 100 normal healthy subjects. Ethical approval and patient consent statements were taken from every patient. Their ages varied from 25 to 90 years old. A standardized questionnaire was used to obtain personal information, including age, area, and file number. A blood sample of 3 ml was drawn by venous puncture from each normal healthy individual and hemodialysis patient and was collected in K-EDTA tubes for the hematological examinations. The data of hematological parameters were analyzed using the Statistical Package for Social Sciences (SPSS 26) software. The statistical significance of differences between groups was evaluated with the independent t-test. The percentages were estimated using Chi-square.* ***Results:*** *The results showed that 79% male &* ***75****% female hemodialysis patients were anemic. 12% male and 6 % female were with mild anemia, 71% male and 79% female were with moderate anemia, and 17% male and 15% female were with severe anemia. The types of anemia was microcytic hypochromic in 15% male and 13% female, normocytic hypochromic in 83% male and 85% female, and macrocytic hypochromic 2% in male and female patients. The higher distribution of anemic hemodialysis patients was 30% male and 28% female patients in the age group (50-59) years while the lower distribution was 02% male and 4% female patients in the age group (≥ 80) years. The results showed that a significant (P<0.01) decrease in RBCs counts, hemoglobin concentrations, Hematocrit values, MCHC, Lymphocytes %, and platelets count in both genders of hemodialysis patients compared with the healthy individuals. A significantly (P<0.05) decreased was observed in mean corpuscular volume in males hemodialysis patients compared with the males healthy individuals. But, a significant (P<0.01) increase in MCH WBCs count, neutrophils %, and Mixed %were observed in both genders of hemodialysis patients when compared with the healthy individuals. The results showed that 16% of males and 25% of females patients have been thrombocytopenia (<150 x 10^3/μL). The degrees of thrombocytopenia were mild thrombocytopenic in 14% of males and 2% of females, and moderate thrombocytopenic in 2% of males and 23% of females. The WBCs count of hemodialysis patients was (<4 x 10^3 cells/μL) in 11% of males and 9% of females, (4-10 x 10^3 cells/μL) in 86% of males and 89% of females, and (>10 x 10^3 cells/μL) in 3% of males and 2% of females.* ***Conclusion:*** *It can be concluded that the results showed that a significant decrease RBCs counts, Hb, Hct, MCHC, Lymphocytes %, and platelets count and a significant increase in MCH WBCs count, neutrophils %, and Mixed % in hemodialysis patients compared to the control group. The results showed that 79% male &* ***75****% female hemodialysis patients were anemic. The more prevalent anemia was moderate , normocytic hypochromic anemia, and the higher distribution of anemia was in the age group (50-59) years in both genders. 16% of males and 25% of females patients have been thrombocytopenia. The most prevalent thrombocytopenia was mild thrombocytopenic in 14% of males, and moderate thrombocytopenic in 23% of females. Improving patient treatment and results requires research on the connection between hematological illnesses and their clinical importance in renal failure. For this patient population, a comprehensive evaluation and effective anemia therapy are essential.*

Keywords: Hematological Disorders, Hematological parameters, Anemia, Thrombocytopenia, Surman, Western Libya.

1. Introduction:

Chronic kidney disease (CKD) is defined as a decrease renal excretory function (Glomerular Filtration rate less than 60mL/min/1.73m 2) or proteinuria for more than 3 months (Levey *et al.*, 2005, Albeshti *et al.*, 2024). It is a common condition that affects millions of people worldwide, and is responsible for high morbidity and mortality rates. The progression of CKD is associated with several serious complications and changes in blood composition (Albeshti *et al.*, 2024). CKD affects the hematopoietic system, and its most common clinical manifestation is anaemia, which contributes significantly to the morbidity and mortality rates in CKD condition (Rahman *et al.*, 2022, Albeshti *et al.*, 2024).

Renal failure is a condition due to inadequate removal of toxins and waste products by kidneys from the blood. It classified into two types of acute and chronic (Prasad *et al.*, 2012, Dorgalaleh *et al.*, 2013).

Prolonged decline in the ability of the kidney to regulate acid–base balance, eliminate waste products, and manage water homeostasis, and entered chronic phase, toxic metabolic accumulates and erythropoietin secretion by the kidney is decreasing and causes hematological changes include decrease of HCT, MCV, RBCs, and platelet counts (Dorgalaleh *et al.*, 2013, Azab & Alshoukry, 2023).

A dialysis is only a supportive treatment, and it does not treat the problem completely, as it provides an artificial alternative, when the kidneys are unable to eliminate of waste and fluids accumulated from the body effectively. However, the waste continues to accumulate in the blood between sessions may cause acute problems with severe morbidity, besides the operation of dialysis devices, the amount of damage to haematological parameters is significant (Albeshti *et al.*, 2024). Hemodialysis became a practical treatment for kidney failure and is the most common method used to treat advanced and permanent kidney failure (Foote & Manley, 2008, Azab & Alshoukry, 2023).

Previous study revealed that patients with chronic renal failure were anemic and most RBC indices including red blood cell count, Hb level, HCT concentration and MCHC level were significantly lower in comparison with the control group (Dorgalaleh *et al.*, 2013). The study of Mohamed, 2010 revealed that the patients with renal failure are at high risk of bleeding due to thrombocytopenia and platelet dysfunction.

Anemia in chronic kidney disease (CKD) can occur as soon as glomerular filtration rate falls below 60 ml/min/1.73m2. It is one of the most frequent complications in chronic hemodialysis patients (Amidou *et al.*, 2024).

Hematological disorders are common complications of chronic kidney disease leading by anemia which increase with the severity of the disease (Kaze *et al.*, 2020).

2. Objectives

The current study aimed to evaluate the hematological disorders among hemodialysis patients in Surman region.

3. Materials and Methods

3.1. Experimental design:

The present study was conducted on 200 renal failure patients (100 males& 100 females), attending Surman Dialysis Center for dialysis from the 1st May 2023 to 1st December, 2024 and 100 normal healthy subjects (50 males& 50 females). Ethical approval and patient consent statements were taken from every patient. Their ages varied from 25 to 90 years old. A standardized questionnaire was used to obtain personal information, including age, area, and file number.

3.2. Blood sampling

A blood sample of 3 ml was drawn by venous puncture from each normal healthy individual and hemodialysis patient and was collected in K-EDTA tubes for the hematological examinations.

3.3. Determination of a complete blood count (CBC)

The complete blood count (RBCs count, Hb, HCT, MCV, MCH, MCHC, WBCs count, differential count of WBCs, and Platelets count) were determined by using an automated hematology analyzer Sysmex (KX 21) machine.

3.4. Determination of anemia, and thrombocytopenia among hemodialysis patients

The World Health Organization (WHO, 2001) states that women must have hemoglobin levels below 12 gm/dL and men must have hemoglobin levels below 13 gm/dL. The reference ranges for MCV, MCH, and MCHC were 80–100 fl, 27–32 pg, and 32–36 g/dl, respectively. MCV less than 80fl and MCH less than 27 were considered indicators of microcytic anemia. When MCV was more than 100fl, macrocytic was taken. When all hematological indices fall within the range, a normocytic normochromic was taken. According to the World Health Organization, hemoglobin concentrations of 11–12.9, (8–10.9), and less than 8 g/dL were indicative of mild, moderate, and severe anemia in males aged 14 and up, and of 11–11.9, (8–10.9), and less than 8 g/dL in females aged 14 and up, respectively (Qureshi *et al.*, 2015, Azab & Alshoukry, 2023).

Platelet count of less than 150 x10^3 platelets/µl was considered thrombocytopenia. According to Schlappi *et al.* (2018), there are three levels of platelet insufficiency: mild (100-150 x10^3 platelets/µl), moderate (50-100 x10^3 platelets/µl), and severe (<50 x10^3 cell/µl).

Thrombocytopenia was defined as a platelet count below 150 x103 platelets/µl. Platelet insufficiency was categorized as mild (100-150 x103 platelet/µl), moderate (50-100 x103 platelet/µl), or severe (<50 x103 cell/µl) (Schlappi *et al.*, 2018).

3.5. Statistical analysis

The data of hematological parameters were analyzed using the Statistical Package for Social Sciences (SPSS 26) software. The statistical significance of differences between groups was evaluated with the independent t-test. The percentages were estimated using Chi-square. A P-value of <0.05 was considered significant for all statistical test.

4. Results

4.1. The distribution of anemia among hemodialysis patients according to gender

The results show the anemic hemodialysis patients were **79** female patients (79%) & **75** male patients (75%) and none anemic patients were 21 female patients (21%) & **25** male patients (25%) (Table. 1 & Figure. 1).

Table.1: The distribution of anemia among hemodialysis patients according to gender

Gender	Males		Females	
Groups	Frequency	Percent (%)	Frequency	Percent (%)

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Anemic Patients	**79**	**79**	**75**	**75**
None anemic Patients	**21**	**21**	**25**	**25**

4.2. Distribution of anemic hemodialysis patients according to the degrees of anemia and gender

The distribution of anemic hemodialysis patients according to the degrees of anemia and gender were 12 male patients (12%) and 6 female patients (6%) with mild anemia, 71 male patients (71%) and 79 female patients (79%) with moderate anemia, and 17 male patients (17%) and 15 female patients (15%) with severe anemia (Table. 2& Figure. 2).

Table.2: The distribution of anemic hemodialysis patients according to the gender and degrees of anemia

Gender	**Males**		**Females**	
Degrees of anemia	**Frequency**	**Percent (%)**	**Frequency**	**Percent (%)**
Mild anemia	**12**	**12**	**6**	**6**
Moderate anemia	**71**	**71**	**79**	**79**
Severe anemia	**17**	**17**	**15**	**15**

4.3. Distribution of anemic hemodialysis patients according to the type of anemia

The distribution of anemic hemodialysis patients according to the types of anemia was 15 male patients (15%) and 13 female patients (13%) with Microcytic hypochromic, 83 male patients (83%) and 85 female patients (85%) with normocytic hypochromic, and 2 male patients (2%) and 2 female patients (2%) with macrocytic hypochromic anemia (Table. 3& Figure. 3).

Table .3: Distribution of anemic hemodialysis patients according to the type of anemia

Types of anemia	**Males**		**Females**	
	Frequency	**Percent (%)**	**Frequency**	**Percent (%)**
Microcytic hypochromic (MCV<80)	**15**	**15**	**13**	**13**
Normocytic hypochromic [MCV(80-98)]	**83**	**83**	**85**	**85**
Macrocytic hypochromic (MCV>98)	**2**	**2**	**2**	**2**

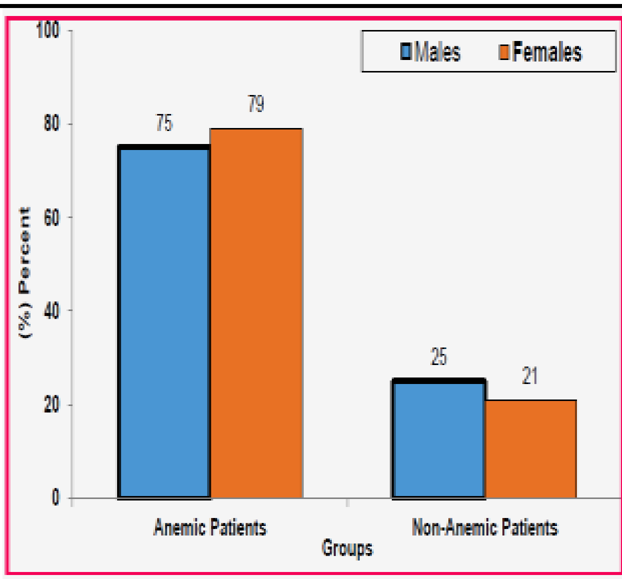

Figure.1: The distribution of anemia among hemodialysis patients according to gender

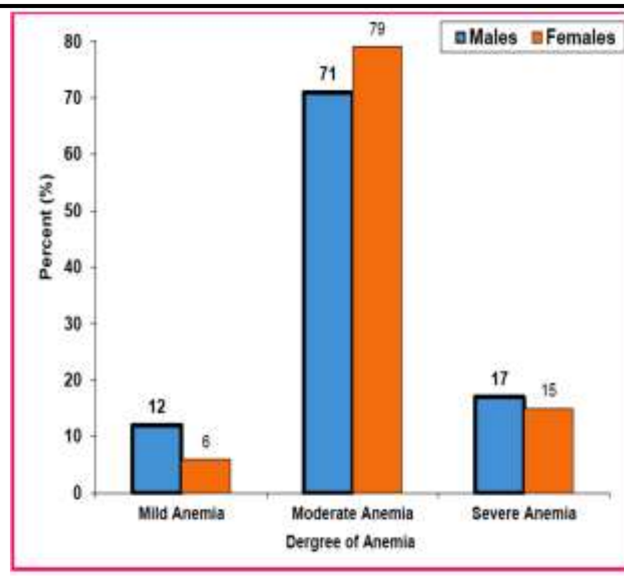

Figure.2: The distribution of anemic hemodialysis patients according to the gender and degrees of anemia

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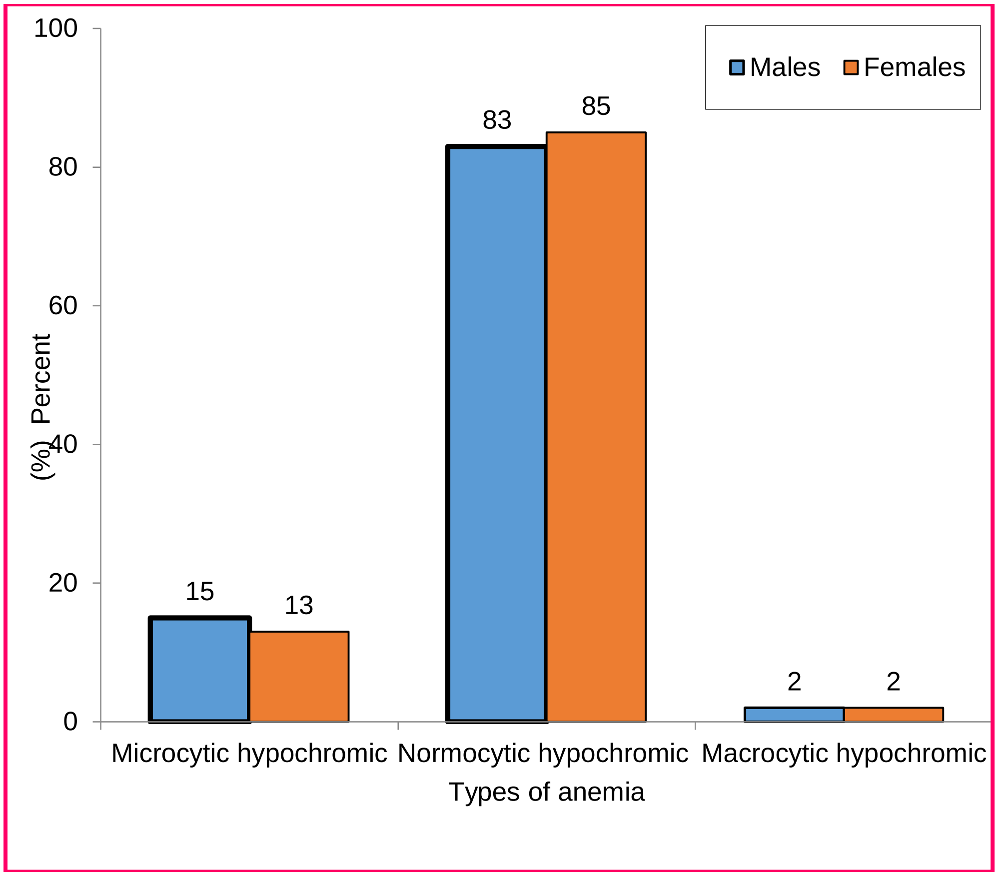

Figure .3: Distribution of anemic hemodialysis patients according to the type of anemia.

4.4. The distribution of anemic males and females hemodialysis patients according to age groups.

Data in table (4) and figure (4) show the distribution of healthy individuals and hemodialysis patients according to age groups. The higher distribution of anemic hemodialysis patients was 30 male patients (30%) and 28 female patients (28%) in the age group (50-59) years while the lower distribution of anemic hemodialysis patients was 02 male patients (2%) and 4 female patients (4%) in the age group (≥ 80) years.

Table .4: The distribution of anemic males and females hemodialysis patients according to age groups.

Groups / Age group (Years)	Males hemodialysis patients		Females hemodialysis patients	
	Frequency	Percent (%)	Frequency	Percent (%)
< 30	06	6%	05	5%
30-39	13	13%	09	9%
40-49	21	21%	21	21%
50-59	30	30%	28	28%
60-69	20	20%	23	23%
70-79	9	9%	10	10%
≥ 80	01	1%	04	4%

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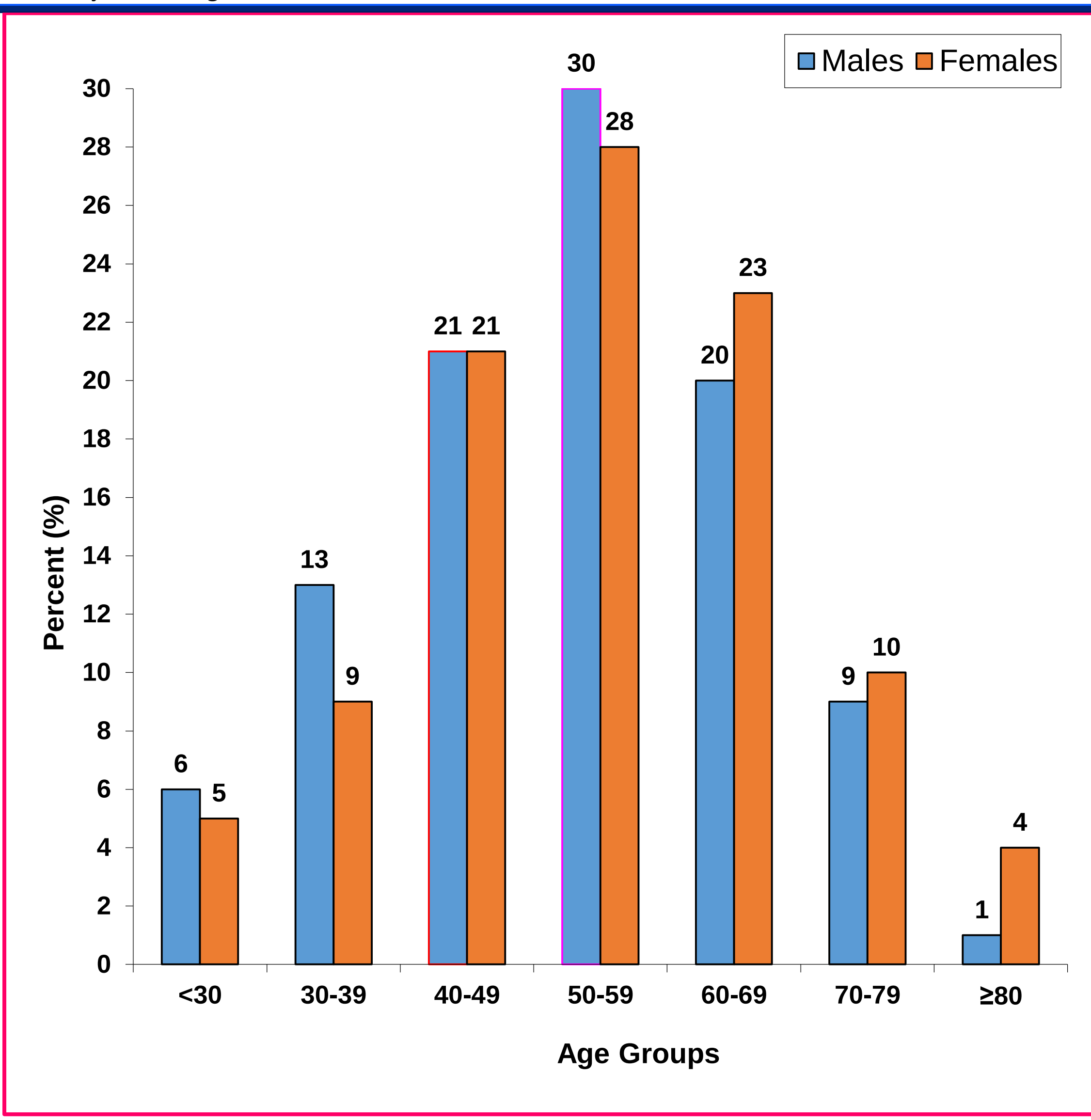

Figure .4: The distribution of anemic males and females hemodialysis patients according to age groups.

4.5. Haematological parameters in healthy individuals and hemodialysis patients

4.5.1. RBCs count and its indices in males and females (healthy individuals and hemodialysis patients)

The data shown in table (5) and figure (5) showed a significant (*P<0.01*) decrease in RBCs counts (3.30 ± 0.06) x10^6 cell/µl in males and (3.14 ± 0.05) x10^6 cell/µl in females hemodialysis patients compared with (5.06 ± 0.07) x10^6 cell/µl in the males and (4.92 ± 0.07) x10^6 cell/µl in the females healthy individuals.

Table. 5: RBCs count and its indices in males and females (healthy individuals and hemodialysis patients)

Groups	Males		Females	
	Healthy Individuals	Hemodialysis Patients	Healthy Individuals	Hemodialysis Patients
Parameters	**Mean ± SE**	**Mean ± SE**	**Mean ± SE**	**Mean ± SE**
RBCs Count (x10^6 Cells/µL)	5.06 ± 0.07	3.30 ± 0.06**	4.92 ± 0.07	3.14 ± 0.05**

Hb (g/dl)	13.40 ± 0.07	9.37 ± 0.14**	12.66 ± 0.04	8.97 ± 0.12**
Hct (%)	38.87 ± 0.83	28.14 ± 0.51**	36.93 ± 1.39	27.38 ± 0.38**
MCV (fl)	88.76 ± 0.80	86.58 ± 0.60*	84.16 ± 2.27	87.56 ± 0.62
MCH (Pg)	26.65 ± 0.32	28.72 ± 0.25**	25.93 ± 0.37	28.76 ± 0.23**
MCHC (g/dl)	34.95 ± 0.48	33.11 ± 0.17**	35.50 ± 0.72	32.84 ± 0.12**

Males & females healthy individuals (n=50); Males & females hemodialysis Patients (n=100); *: Significant at *P<0.05* compared with the healthy individuals of the same gender; **: Significant at *P<0.01* compared with the healthy individuals of the same gender.

A significant (*P<0.01*) decreased in hemoglobin concentrations (9.37 ± 0.14) g/dl in males and (8.97 ± 0.12) g/dl in females hemodialysis patients compared with (13.40 ± 0.07) g/dl in the males and (12.66 ± 0.04) g/dl in the females healthy individuals (Table. 5& Figure. 6).

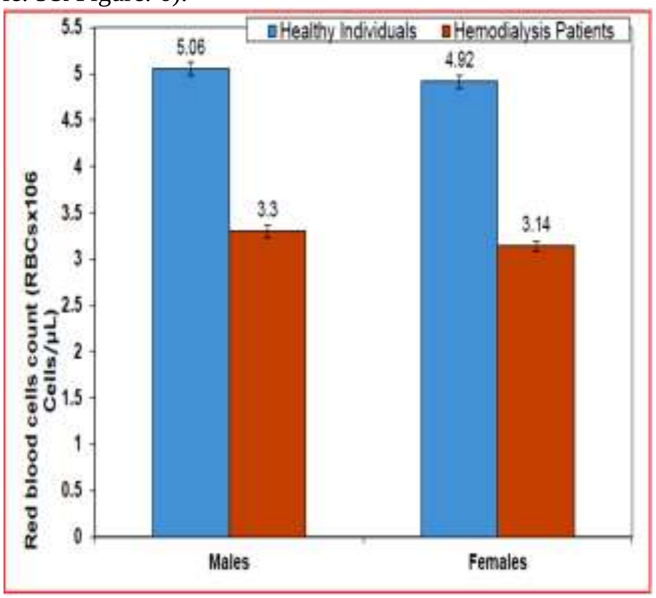

Figure.5: RBCs count in males and females (healthy individuals and hemodialysis patients)

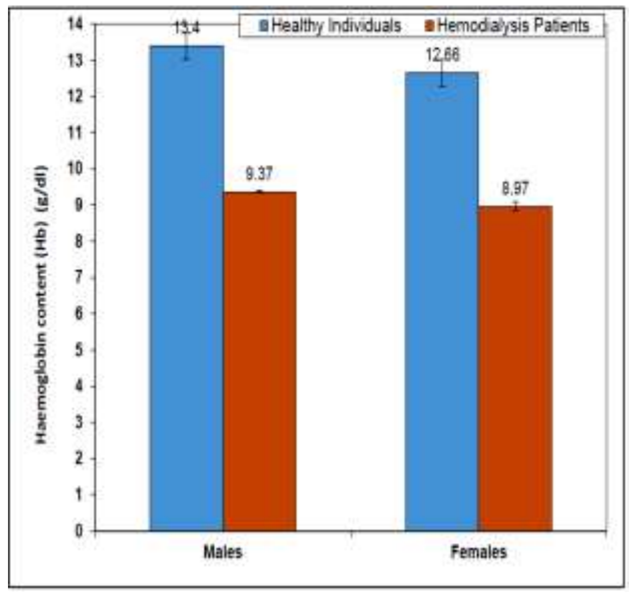

Figure.6: Hemoglobin concentration in males and females (healthy individuals and hemodialysis patients)

Hematocrit values were a significantly (*P<0.01*) decreased (28.14 ± 0.51) % in males and (27.38 ± 0.38) % in females hemodialysis patients compared with (38.87 ± 0.83) % in the males and (36.93 ± 1.39) % in the females healthy individuals (Table. 5& Figure. 7).

A significantly (*P<0.05*) decreased was observed in mean corpuscular volume (MCV) (86.58 ± 0.60 fl) in males hemodialysis patients compared with (88.76 ± 0.80 fl) in the males healthy individuals (Table. 5& Figure. 8).

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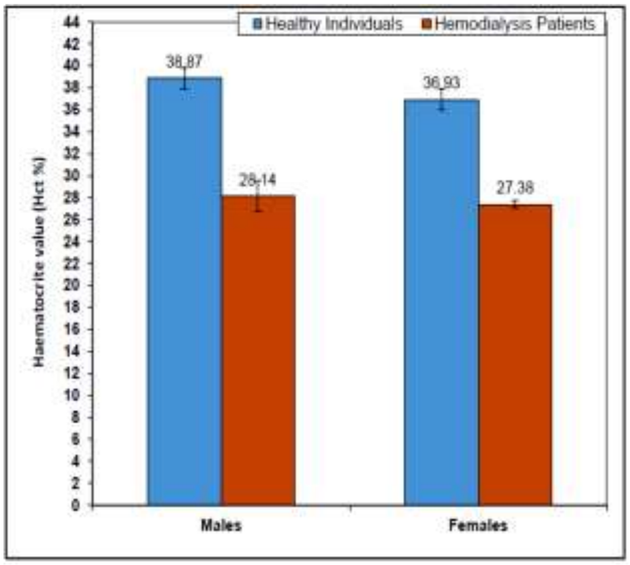

Figure.7: Hematocrit value in males and females (healthy individuals and hemodialysis patients)

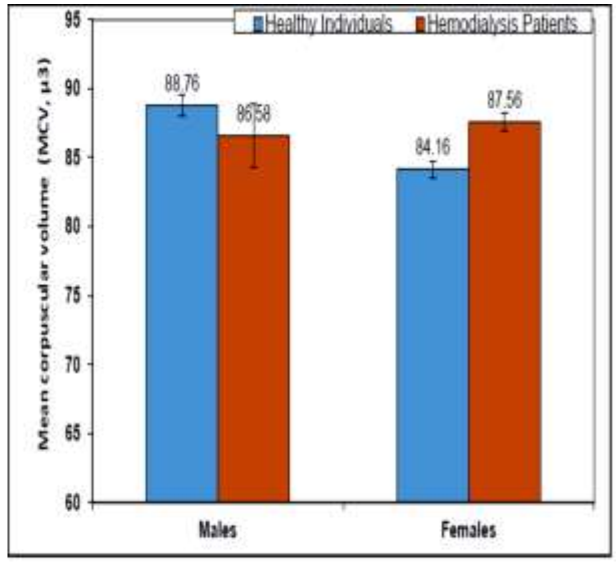

Figure.8: Mean corpuscular volume in males and females (healthy individuals and hemodialysis patients)

A significant (*P<0.01*) increase in MCH was observed (28.72 ± 0.25 Pg) in males and (28.76 ± 0.23 Pg) in females hemodialysis patients when compared with (26.65 ± 0.32 Pg) in the males and (25.93 ± 0.37 Pg) in the females healthy individuals (Table .5 & Figure 9).

Table (5) & figure (10) were showed a significant (*P<0.01*) decrease in MCHC (33.11 ± 0.17 g/dl) in males and (32.84 ± 0.12 g/dl) in females hemodialysis patients when compared with (34.95 ± 0.48 g/dl) in the males and (35.50 ± 0.72 g/dl) in the females healthy individuals.

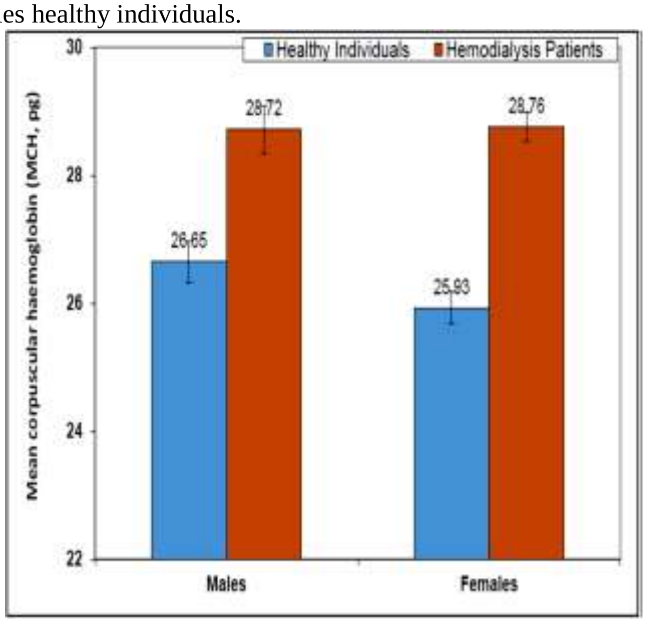

Figure.9: Mean corpuscular hemoglobin in males and females (healthy individuals and hemodialysis patients).

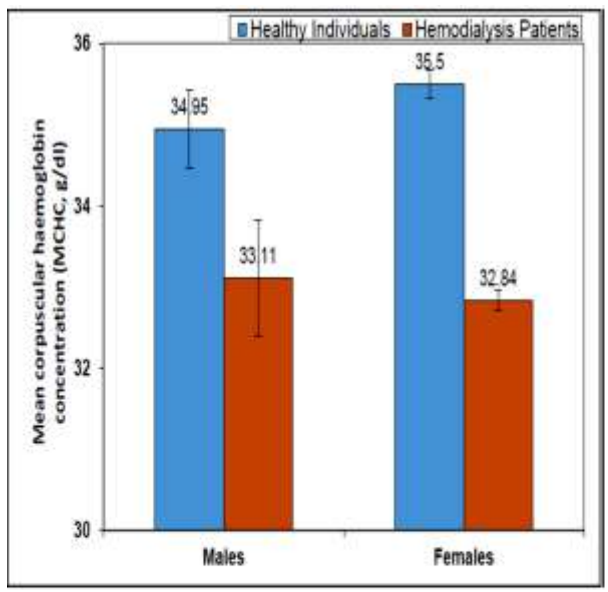

Figure.10: Mean corpuscular hemoglobin concentration in males and females (healthy individuals and hemodialysis patients).

4.5.2. WBCs count, Neutrophils %, Lymphocytes%, and Platelets Count in males and females (healthy individuals and hemodialysis patients)

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WBCs count was showed a significant increase (7.14 ± 0.29) x10^3 cell/µl in males and (7.74 ± 0.30) x10^3 cell/µl females hemodialysis patients as compared to (6.34 ± 0.16) x10^3 cell/µl males and (6.20 ± 0.20) x10^3 cell/µl healthy individuals (Table .6 & Figure .11).

Table.6: WBCs count, Neutrophils %, Lymphocytes%, and Platelets Count in males and females (healthy individuals and hemodialysis patients)

Groups	Males		Females	
	Healthy Individuals	Hemodialysis Patients	Healthy Individuals	Hemodialysis Patients
Parameters	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
WBCs Count (x10^3 Cells/µL)	6.34 ± 0.16	7.14 ± 0.29*	6.20 ± 0.20	7.74 ± 0.30**
Neutrophils %	65.67 ± 0.46	68.90 ± 0.79 **	65.51 ± 0.40	68.00 ± 0.66 **
Lymphocytes %	26.47 ± 0.50	22.01 ± 0.84 **	27.30 ± 0.37	22.0 ± 0.78**
Mixed %	7.86 ± 0.32	9.09 ± 0.62 **	7.19 ± 0.32	10.00 ± 0.46 **
Platelets Count (x10^3 Cells/µL)	291.48 ± 14.35	192.16 ± 5.49 **	257.38 ± 11.25	215.98 ± 6.33 **

Males & females healthy individuals (n=50); Males & females hemodialysis Patients (n=100); *: Significant at *P<0.05* compared with the healthy individuals of the same gender; **: Significant at *P<0.01* compared with the healthy individuals of the same gender.

The data recorded in table (6) and figure (12) indicated a significant (*P<0.01*) increase was observed in neutrophils % (68.90 ± 0.79) % in males and (68.00 ± 0.66) % females hemodialysis patients as compared with (65.67 ± 0.46) % in males and (65.51 ± 0.40) % in females healthy individuals.

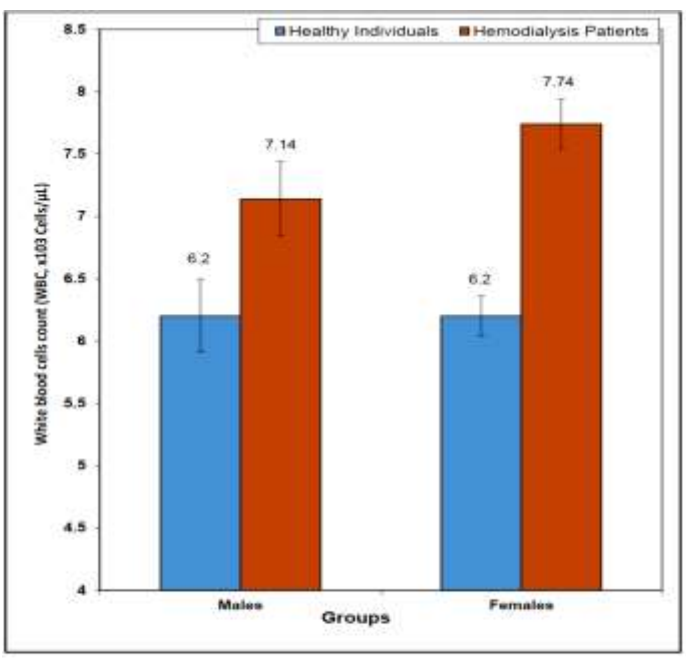

Figure.11: White blood cells count in males and females (healthy individuals and hemodialysis patients)

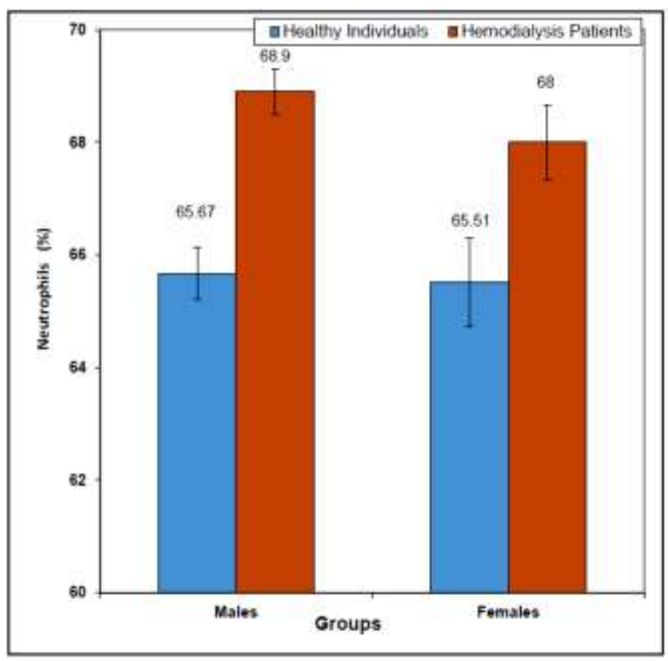

Figure.12: Neutrophils (%) in males and females (healthy individuals and hemodialysis patients)

Lymphocytes % was significantly (*P<0.01*) decreased (22.01 ± 0.84) % in males and (22.0 ± 0.78) % females hemodialysis patients as compared with (26.47 ± 0.50) % in males and (27.30 ± 0.37) % in females healthy individuals (Table. 5 & Figure. 13).

Mixed % of leukocytes was showed a significant (*P<0.01*) increase (9.09 ± 0.62) % in males and (10.00 ± 0.46) % females hemodialysis patients as compared to (7.86 ± 0.32) % males and (7.19 ± 0.32) % healthy individuals (Table .6 & Figure .14).

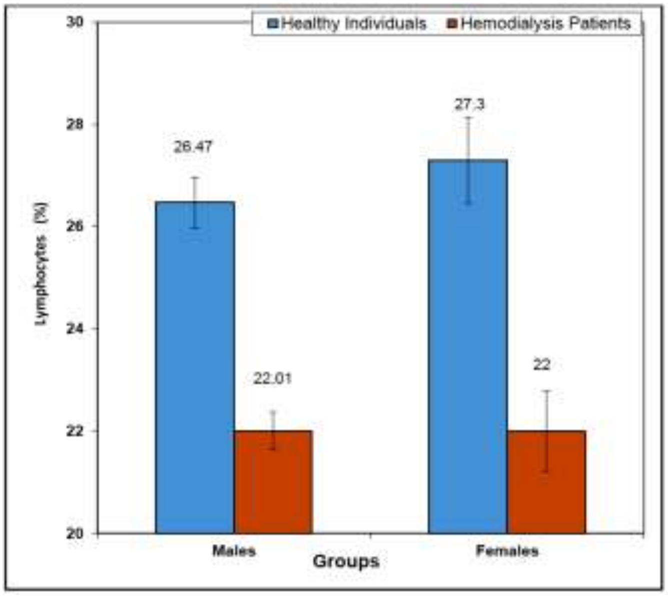

Figure.13: Lymphocytes % in males and females (healthy individuals and hemodialysis patients)

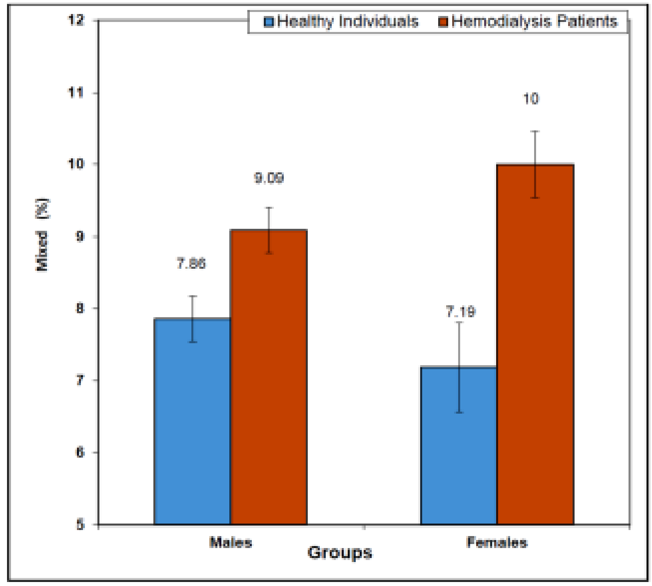

Figure.14: Mixed % in males and females (healthy individuals and hemodialysis patients)

The blood platelets count was significantly (*P<0.01*) decreased (192.16 ± 5.49)x 10^3/µl in males and (215.98 ± 6.33)x 10^3/µl in females hemodialysis patients when compared with (291.48 ± 14.35) x 10^3/µl in males and (257.38 ± 11.25)x 10^3/µl in females healthy individuals (Table. 6 & Figure. 15).

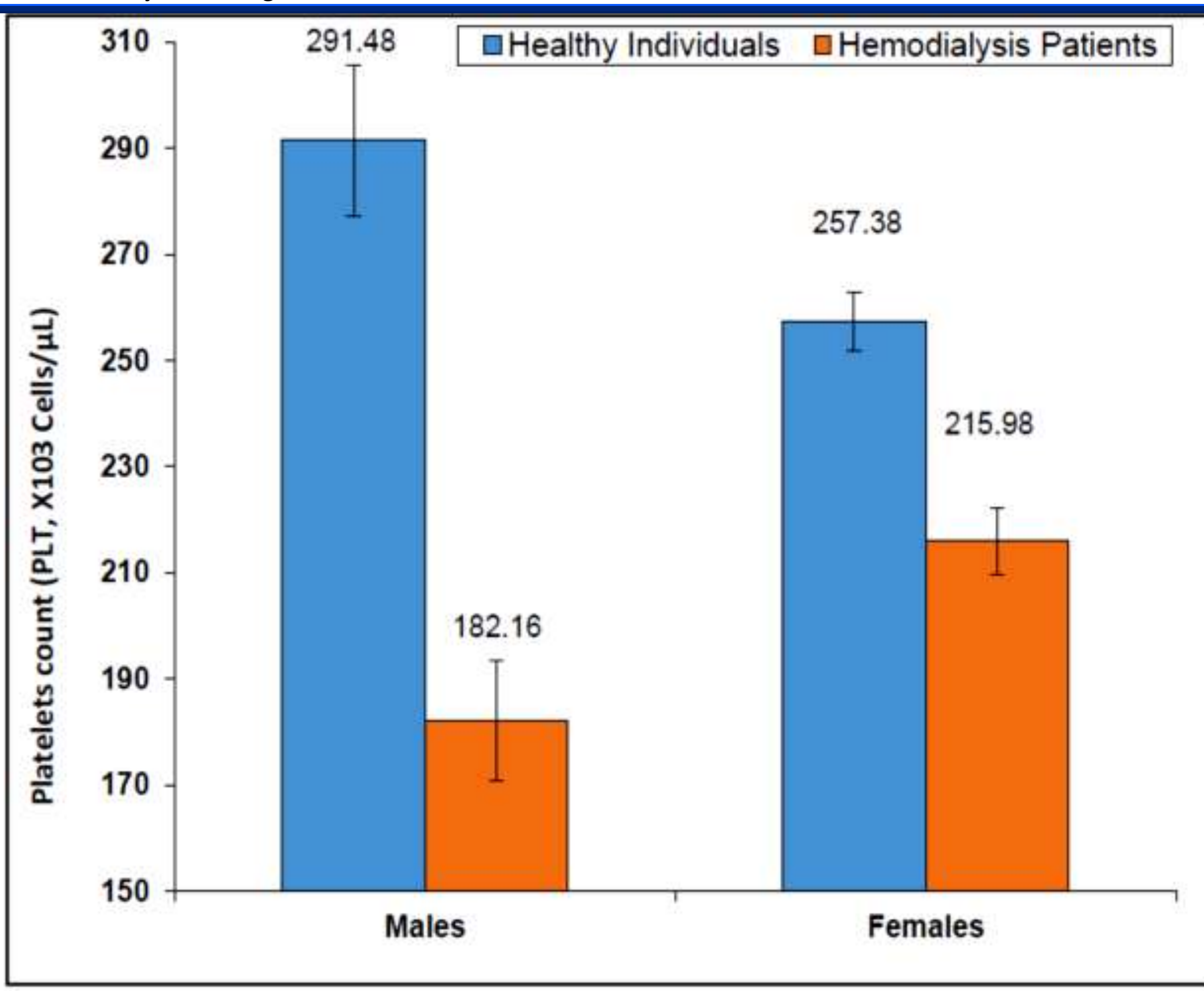

Figure. 15: The blood platelets count in males and females (healthy individuals and hemodialysis patients)

4.6. Distribution of both genders of hemodialysis patients according to Platelets count.

Statistical analysis of the results showed that 16% of males and 25% of females patients have been thrombocytopenia (<150 x 10^3/µL) (Table. 7& Figure. 16).

Table 7. Distribution of hemodialysis patients according to Platelets count

Gender	Males		Females	
Platelets count	Number of patients	(%)	Number of patients	(%)
<150 x 10^3/µL	16	16%	25	25%
(150-450) x10^3/µL	84	84%	75	75%

4.7. Distribution of both genders of hemodialysis patients according to the degrees of thrombocytopenia

Data in table (8) and figure (17) shown that the distribution of thrombocytopenic hemodialysis patients according to the degrees of thrombocytopenia. The degrees of thrombocytopenia were mild thrombocytopenic in 14% of males and 2% of females, and moderate thrombocytopenic in 2% of males and 23% of females.

Table 8. Distribution of both genders of hemodialysis patients according to the degrees of thrombocytopenia

Degrees of thrombocytopenia / Gender	Males		Females	
	Number of patients	(%)	Number of patients	(%)
Mild thrombocytopenia (100-150)x10^3/µL	14	14%	2	2%
Moderate thrombocytopenia (50-90)x10^3/µL	2	2%	23	23%

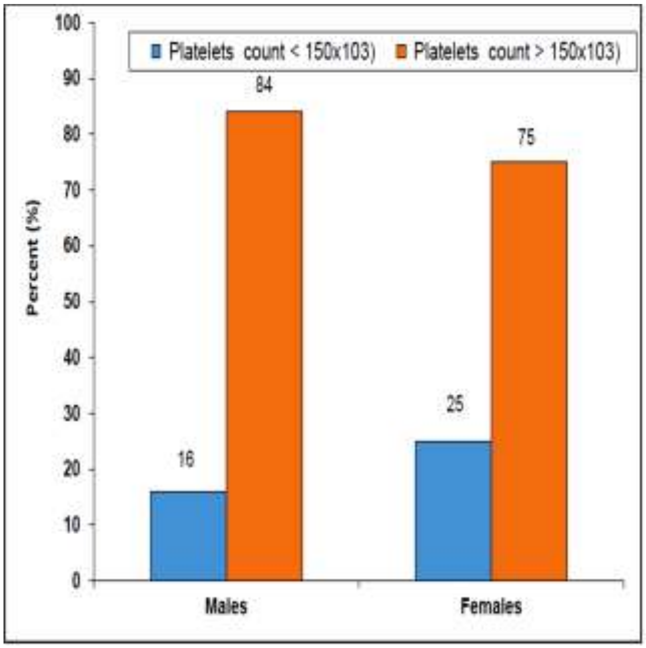

Figure.16: Distribution of both genders of hemodialysis patients according to Platelets count

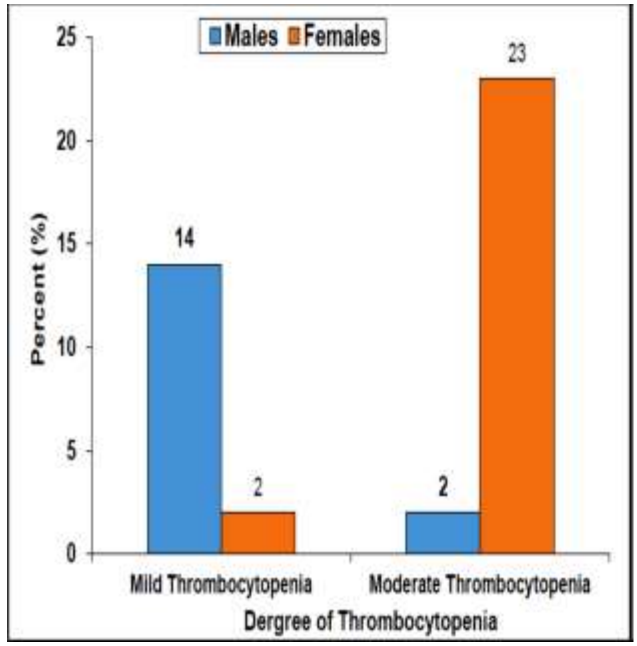

Figure.17: Distribution of both genders of hemodialysis patients according to the degrees of thrombocytopenia

4.8. Distribution of both genders of hemodialysis patients according to the white blood cells count.

Statistical analysis of the results showed that WBCs count of hemodialysis patients was (<4 x 10^3 cells/µL) in 11% of males and 9% of females, (4-10 x 10^3 cells/µL) in 86% of males and 89% of females, and (>10 x 10^3 cells/µL) in 3% of males and 2% of females (Table. 9 & Figure. 18).

Table 9. Distribution of both genders of hemodialysis patients according to the white blood cells count.

White blood cells count / Gender	Males		Females	
	Number of patients	(%)	Number of patients	(%)
<4 x10^3 cells/µL	11	11%	9	9%
(4-10) x10^3 cells/µL	86	86%	89	89%
>10 x10^3 cells/µL	3	3%	2	2%

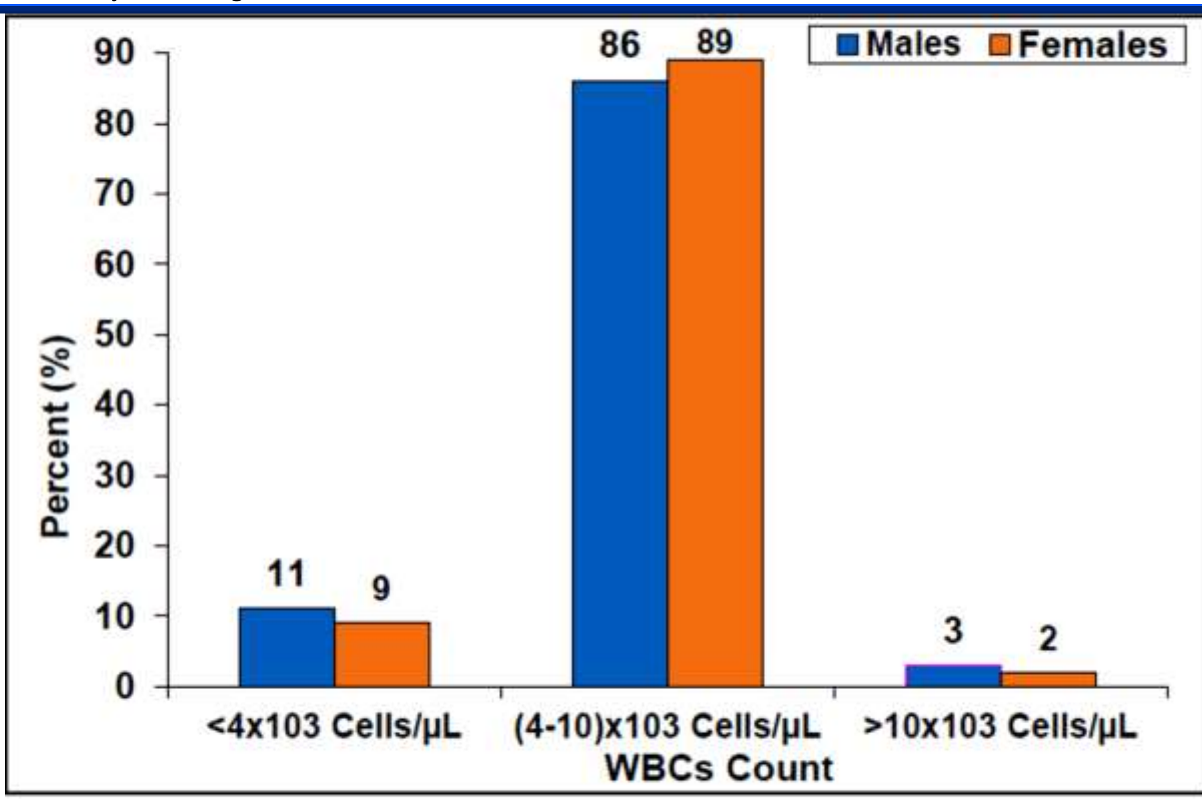

Figure. 18. Distribution of both genders of hemodialysis patients according to the white blood cells count**.**

5. Discussion

The present study was conducted on 200 hemodialysis patients, attending Surman Dialysis Center for dialysis from the 1st May 2023 to 1st December, 2024 to evaluate the hematological disorders among hemodialysis patients in Surman region, Western Libya. Numerous hemopoietic alterations are linked to renal disorders (Dodds and Nicholls,1983).

The present study showed that a significant ($P<0.01$) decrease in RBCs counts, hemoglobin concentrations, Hematocrit values, and MCHC and a significant ($P<0.01$) increase in MCH in both genders and a significantly ($P<0.05$) decreased was observed in mean corpuscular volume in males of hemodialysis patients compared with the healthy individuals.

These findings are consistent with those of Al-Khayat *et al.* (2016), who discovered that anemia in patients with renal failure was strongly correlated with hematological parameters and that patients with CKD receiving hemodialysis had a noticeably lower hemoglobin level than controls. According to Humudat (2023), almost all (96%) hemodialysis patients with chronic renal disease had a lower red blood cell count. Red blood cell count, hemoglobin concentration, and hematocrit value were all considerably (P<0.05) lower in patients with chronic renal failure (Suresh *et al.*, 2012).

The results of the present study showed that 79% male & **75**% female hemodialysis patients were anemic. 12% male and 6 % female were with mild anemia, 71% male and 79% female were with moderate anemia, and 17% male and 15% female were with severe anemia. The types of anemia was microcytic hypochromic in 15% male and 13% female, normocytic hypochromic in 83% male and 85% female, and macrocytic hypochromic 2% in male and female patients. These findings are comparable to those of Rathod *et al.* (2014), who discovered that anemia—primarily normocytic normochromic anemia—is the most prevalent hematological abnormality in chronic renal failure. Because of an erythropoietin shortage, anemia in chronic renal illness has remained straightforward, with RBC shape remaining constant or normocytic normochromic (Wasti *et al.*, 2013). According to Tounkara *et al.* (2017), 84.12% of hemodialysis patients in Mali had anemia. In August 2016, hemodialysis patients at Point G University Hospital had an average hemoglobin level of 8.57g/dl± 2.39. 79.7% of hemodialysis patients in Algeria were anemic, according to a multicenter research involving 473 patients (Arbaoui *et al.*, 2018). Another five-year retrospective research conducted in Mali revealed that 95% of hemodialysis patients had anemia, with an average hemoglobin level of 9.38 ± 1.86 g/dl (Yattara *et al.*, 2020). According to the Dorgalaleh *et al.* (2013) study, the severity of anemia (HCT, Hb, and MCV) was significantly higher in the acute and chronic renal failure groups compared to the control groups (P>0.05). According to Amidou *et al.* (2024), 95.24% of patients receiving continuous hemodialysis had anemia. The average hemoglobin level was 7.24 ± 1.52 g/dL, 29.27% of hemodialysis patients had iron deficiency, and 71.43% of chronic hemodialysis patients had severe anemia. Juma (2012) discovered that among patients with chronic kidney disease at Muhimbili National Hospital in Dar essalaam, the prevalence of anemia was 97% (26% mild, 40% moderate, and 31% severe and 47.4% normocytic normochromic, 28.9% Microcytic Hypochromic, 16.5% Normocytic Normochromic and Microcytic Hypochromic, 5.2% Macrocytic, and 2% Microcytic Normochromic). The severity of renal impairment is correlated with anemia (Dodds and Nicholls,1983). The frequency and significance of normochromic normocytic generative anemia, which is caused by chronic kidney disease, rise in proportion to the severity of renal failure (Moranne *et al.,* 2009, Amidou *et al.,* 2024). The incidence of anemia in this patient group can be attributed to a number of factors, including decreased EPO production, a shorter lifespan of red blood cells (Cohen *et al.,* 2007, Vanholder *et al.,* 2007, Piroddi *et al.,* 2007, Kanbay *et al.,* 2010, Floris *et al.,* 2011, Nasouti *et al.,* 2017), blood loss, chronic inflammation, and deficiencies in iron, vitamin B12, and folic acid (Tsubakihara *et al.,* 2008, Amidou *et al.,* 2024). According to research, uremic toxins in CKD patients change how cells function and hasten the breakdown of cell membranes (Kanbay *et al.,* 2010, Floris *et al.,* 2011, Nasouti *et al.,* 2017). By reducing erythrocyte lifespan from the typical 120 days to 60-90 days and disrupting iron homeostasis by encouraging functional iron deficit or by other means, circulating uremic inhibitors of erythropoiesis lead to anemia (Vos *et al.,* 2011). Patients with underlying malnutrition and systemic inflammation are frequently affected by functional iron insufficiency (Drueke, 2001). However, iron utilization in response to erythropoiesis stimulating agent therapy, poor gastrointestinal iron absorption, frequent phlebotomy, blood trapping in the dialysis machine, and chronic bleeding from uremia-associated platelet dysfunction are the main causes of absolute iron deficiency (Besarab and Ayyoub, 2007).

Although absolute shortages of iron or folate may also be involved, a relative deficiency of erythropoietin has been implicated in the anemia of renal failure. Heavy metal poisoning, blood loss, and a decrease in red cell survival brought on by harmful radicals are further contributing factors (Mojdehkar *et al.,*2004). Due to decreased erythropoietin production, increased hemolysis, hematuria, and gastrointestinal blood loss from retained uremic components, patients with chronic renal failure have poorer hematological indices (Dodds and Nicholls,1983, Suresh *et al.,* 2012). All of the haematological indicators have a negative connection with the serum creatinine levels. Additionally, the severity of renal failure determines the extent of alterations (Suresh et al.,2012).

Henry (2006) described how iron's physiologic chemistry might have harmful consequences by producing harmful oxygen radicals that can target any biological molecule. Furthermore, iron has a variety of impacts on cell-mediated immunity, including influencing the immunological potential of macrophages through iron-mediated suppression of interferon-directed immune response pathways and modifying the proliferation and differentiation of lymphocyte subsets. However, iron can take part in a variety of processes that result in the production of free radical species, which have the potential to harm cellular components. Therefore, sustaining vital cellular activities requires strict management of iron homeostasis.

The death of RBC precursors and a reduction in the number of erythropoietin receptors on progenitor cells may be caused by tumor necrosis factor-alfa (TNFα) (Means, 2003). Furthermore, the presence of inflammatory cytokines such as TNF-alpha, IL-1, and IL-6 might promote RBC destruction and decrease erythropoiesis and the cell cycle. Additionally, uremic toxins impact RBC survival and intensify micro-inflammation. Hemodialysis may lengthen the life of red blood cells and enhance erythropoiesis. Dialysis reduces the body's plasma level of waste products, which in turn lowers uremic toxins and inflammatory cytokines in patients with chronic kidney disease (Priyadarshi and Shapiro, 2006, Spiegel *et al.,* 2010, Nasouti *et al.,* 2017).

The current study showed that the higher distribution of anemic hemodialysis patients was 30% male and 28% female patients in the age group (50-59) years. Similarly, According to Sankalia and Tanna (2013), the age group of 41–50 years had the highest incidence of chronic renal failure (26%), followed by the age group of 51–60 years (24%), and the age group of 31–40 years (24%).

Our results showed that a significant ($P<0.01$) decrease in Lymphocytes % and increase in WBCs count, neutrophils %, and Mixed % were observed in both genders of hemodialysis patients when compared with the healthy individuals. These findings are consistent with a 2016 research by Al-Khayat *et al.*(2016) that found that individuals with CKD had higher WBC counts, particularly granulocytosis, which was substantially linked to anemia in these patients. According to Rathod *et al.* (2014), leukocytosis was seen in 22% of patients with end-stage renal illness who had chronic renal failure.

According to Humudat (2023), based on the local control percentage (20–40%), the majority of patients (68%) had lymphocyte values that were within the normal range (20.6±8.31% for men and 23.7±9.61% for females). Furthermore, the findings revealed that 34% of patients had neutrocyte values (68±21.62 percent for men and 68.6±11.17 percent for women) that were higher than the typical local standard percentage range of 40%–60% in HD individuals. According to Kahdina *et al.* (2018), HD patients generally have a tendency to strengthen their defenses, which may manifest as inflammation. The white blood cell count was significantly greater in people with chronic renal disease (Nwaozor *et al.,* 2025). Chronic kidney disease patients are in an inflammatory state due to increased cytokine production, oxidative stress, vitamin D deficiency, malnourishment, and infection susceptibility. The inflammatory state of chronic renal disease leads to problems that increase white blood cell counts (Shankar *et al*., 2014, Nwaozor *et al.,* 2025). Chronic inflammatory illnesses including chronic kidney disease have been shown to increase the white blood cell count, a crucial part of the immune response. Elevated white blood cell counts are often associated with endothelial dysfunction and systemic inflammation, which worsen the cardiovascular morbidity observed in chronic kidney disease patients (Shah, 2015, Nwaozor *et al.,* 2025). Additionally, as diabetes and hypertension are common in individuals with chronic kidney disease (CKD), high WBC counts may be a sign of deteriorating kidney damage or the presence of concurrent diseases (Kovacs *et al.,* 2013, Nwaozor *et al.,* 2025).

The current study showed that a significant (*P<0.01*) decrease in platelets count in both genders of hemodialysis patients compared with the healthy individuals. platelets count in both genders of hemodialysis patients compared with the healthy individuals. 16% of males and 25% of females patients have been thrombocytopenia (<150 x 10^3/μL). The degrees of thrombocytopenia were mild thrombocytopenic in 14% of males and 2% of females, and moderate thrombocytopenic in 2% of males and 23% of females. These findings are consistent with the findings of a research conducted in 2023 by Humudat, 2023, which found that the platelet count in HD patients tended to be lower than that of healthy controls, with a mean of 176.5±66.5x10^3μL (166±27x10^3μL for men and 187±70.67x10^3μL for females), compared to 342±66.9 10^3μL. According to Daugirdas and Bernardo, (2012), the local standard reference count (150-40x10^3μL) was 34% lower. According to Al-Khayat *et al.* (2016), patients with CKD receiving hemodialysis had a noticeably lower platelet count than controls (P value = 0.0001). Few individuals with end-stage renal illness who had chronic renal failure also had thrombocytopenia, according to research by Rathod *et al.* (2014). Platelet counts were considerably (P<0.05) lower in individuals with chronic renal failure (Suresh *et al.*, 2012). According to Gafter *et al.* (1987), patients with end-stage renal failure receiving continuous hemodialysis and predialysis patients with CRF prior to hemodialysis had lower platelet counts and moderate thrombocytopenia. The platelet count was statistically significantly lower than that of healthy people (P<0.0001), according to Dorgalaleh *et al.* (2013). A small percentage of the patients in our research had thrombocytopenia, which was a significant risk factor for bleeding. Additionally, we discovered that while some of our patients had moderate thrombocytopenia, only 8% of them had platelet counts that would have put them at risk for bleeding.

6. Conclusion

It can be concluded that the results showed that a significant decrease RBCs counts, Hb, Hct, MCHC, Lymphocytes %, and platelets count and a significant increase in MCH WBCs count, neutrophils %, and Mixed % in hemodialysis patients compared to the control group. The results showed that 79% male & **75%** female hemodialysis patients were anemic. The more prevalent anemia was moderate , normocytic hypochromic anemia, and the higher distribution of anemia was in the age group (50-59) years in both genders. 16% of males and 25% of females patients have been thrombocytopenia. The most prevalent thrombocytopenia was mild thrombocytopenic in 14% of males, and moderate thrombocytopenic in 23% of females. Improving patient treatment and results requires research on the connection between hematological illnesses and their clinical importance in renal failure. For this patient population, a comprehensive evaluation and effective anemia therapy are essential.

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