Research Article

Assessment of Iron Profile among Sudanese Patients with Chronic Renal Failure in Shendi Town

Elham Mansour E Mohammed[1], Hamza Ahmed Hassan[1], Ghanem Mohammed Mahjaf[2], Tibyan Abd Almajed Altaher[3], Mosab Nouraldein Mohammed Hamad[4]*

[1] Department of Haematology, Faculty of Medical Laboratory Sciences, Shendi University, Sudan
[2] Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Shendi University, Sudan
[3] Department of Clinical Chemistry, Faculty of Medical Laboratory Sciences, Shendi University, Sudan
[4] Head of Parasitology Department, Faculty of Health Sciences, Elsheikh Abdallah Elbadri University, Sudan.

Corresponding author:

Mosab Nouraldein Mohammed Hamad
Head of Parasitology Department, Faculty of Health Sciences, Elsheikh Abdallah Elbadri University, Sudan.

Corresponding Email: musab.noor13@gmail.com

***Abstract*:**

This is a descriptive cross-sectional case-control study conducted in Al-Mak Nemir University Hospital in Shendi town to evaluate the iron profile in patients with chronic renal failure during the period March to July 2018. The study included thirty patients who were diagnosed with chronic renal failure and the study group was compared with ten healthy volunteers as a control group. Blood samples were collected from the two groups, Iron profile parameters were measured, Data was collected using a structured face-to-face questionnaire, and the (SPSS) version (11.5) program was used for data analysis. The study revealed the patients with chronic renal failure were (73.3%) male and (26.6%) female, distributed as (66.7%) have (31-50) years old, (23.3%) have (51-70) years old, and (10%) have (71-100) years old. The iron profile indicated that the mean values of S. iron, S. ferritin, and TIBC, were (182.2667ug/dL), (267.4000ug/L), and (195.2333ug/dL) respectively. This study showed that chronic renal failure is responsible for significant changes in iron profile.

Keywords: Iron Profile, Blood samples, Serum Iron, Serum Ferritin, chronic Renal Failure.

Background:

Chronic kidney disease (CKD) is an emerging global public health problem **[1]**. The conditions that replaced malnutrition and infection as leading causes of mortality during the 20th century **[2]**. Age-standardized death rates due to CKD have expanded during the last 23 years. CKD has moved from the 36th reason of death in 1990 to the 19th causality in 2013 **[3]**. The worldwide expansion in CKD and kidney failure necessitating renal replacement treatment and the elevated rate of cardiovascular mortality and morbidity attributable to CKD are suspended to reach epidemic proportions over the next decade. CKD complications describe a significant burden on global healthcare resources and just a small number of countryside's have adequately robust economies to meet the challenge posed by this condition. Socioeconomic dissimilarities in healthy life and individuals of lower socioeconomic status (SES) have a more increased risk for mortality and morbidity compared with those of more elevated SES **[4]**. A change in the global approach to CKD from the treatment of end-stage renal disease (ESRD) to intensive primary and secondary prevention is therefore considered an absolute public health priority **[5]**. Africa is the second-largest continent in the world, with a population of above 1 billion; 961.5 million individuals live in sub-Saharan Africa and 195 million in Northern Africa **[6]**. Africa currently meets the double challenge of infectious illnesses and chronic diseases. Africa's chronic disease burden is secondary to various factors, including increased life expectancy, changing lifestyle practices, poverty, urbanization, and globalization **[7]**. The World Health Assembly endorsed the Global Action Plan for the Prevention and Control of Non-Communicable Diseases 2013–2020. One of its marks is to reduce early mortality from chronic diseases by 25% in 2025. These acts have the potential to create a significant consequence on the burden of CKD **[8]**. Unfortunately, the CKD problem remains underestimated in the entire continent due to a lack of epidemiological information from different African countries. There exists only a single systematic review conducted in sub-Saharan Africa, which concluded that CKD is a prevalent and potentially escalating disease across sub-Saharan Africa, with both communicable and non-communicable risk factors **[9]**. Strategies aimed at managing CKD epidemics in Africa critically depend on a reliable assessment of the burden of the problem and the establishment of affordable early detection programs. Previous studies reported the prevalence of CKD among the general population or the specific prevalence of this condition in diseases that are recognized as drivers of renal damage (e.g. diabetes mellitus). These estimations include varied across investigations due to differences in the methods of glomerular filtration rate (GFR) measurement, environment risk (general population vs. high-risk groups), or demographic characteristics (e.g., age, gender) **[10]**. In the UK, the incidence of ESRD has doubled over the last ten years and has now reached 101 patients per million population (pmp0 **[11]**. This is below the European and US averages of approximately 135pmp and 336pmp, respectively **[12]**. Studies that have supplied data on the prevalence of CKD provide the opportunity to plan nephrology service requirements and develop stronger working relationships with the primary care teams in the community. Investigations such as the National Health and Nutrition Examination Survey (NHANES), which provided information on an adult unselected population evaluated that 4.7% of US adults had CKD stage 3 or more elevated (defined as an estimated glomerular filtration rate

(eGFR) of <60ml/min/1.73m2). They also estimated that up to 11% of the general population (19.2 million) has some degree of CKD **[13]**. Similarly, a study of 112,215patients registered with general practices in Greater Manchester, Kent, and Surrey, UK, showed a prevalence of 4.9% **[12, 14]**. They also estimated that 5.9 million people may have stage 1 CKD with normal kidney function. In the Australian Diabetes, Obesity, and Lifestyle (AusDiab) study of 10,949 patients, a prevalence of 11.2% of CKD stages 3–5 was found, but this does not provide an estimate for the general population **[15]**. Renal diseases are associated with a variety of hemopoietic changes. Anemia parallels the degree of renal impairment and its most important cause is a failure of renal erythropoietin secretion. Other factors include chronic blood loss, hemolysis, and bone marrow suppression by retained uremic factors **[16]**. When kidneys are diseased or damaged, they do not make enough EPO. As a result, the bone marrow makes fewer red blood cells, causing anemia. When blood has fewer red blood cells, it deprives the body of the oxygen it needs. Other common causes of anemia in people with kidney disease include blood loss from hemodialysis and low levels of the nutrients in food such as iron, vitamin B12, and folic acid **[17]**.

Materials and methods:

Design of study:

This is a descriptive cross-sectional case-control study to evaluate the iron profile in chronic renal failure patients in Shendi locality in the River Nile State Sudan.

Duration of study:

From March to August July.

Study population:

A total of thirty samples were collected from the Study group of chronic renal failure patients and ten samples were collected from healthy individuals as a control group.

Scientific & Ethical considerations:

The consent of the selected individuals to the study was taken after being informed of all detailed objectives of the study and it is health the emphasis on the future.

Data collection:

Data was collected using a self-administrated pre-coded questionnaire which was specifically designed to obtain information that helped in the study.

Study area:

The study was conducted at Al-Mak Nemir University Hospital which located in Shendi town in Sudan. Shendi is a town in Northern Sudan, situated on the east bank of the Nile (150 km) northeast of Khartoum. Shendi is also about (45 km) southwest of the ancient city of Meroe. Located in the River Nile state, Shendi is the center of the Ja'aliin tribe and an important historic trading center. Its principal suburb on the west bank is Al-Matamma. A major traditional trade route across the Bayuda desert connects Al Matamma to Marawi and Napata, (250 km) to the Northwest.

Blood Sampling:

3 mL venous blood was collected using a sterile disposable plastic syringe after cleaning the venipuncture area with (70%) ethanol, the blood was collected in a plain container and separated by centrifugation to obtain serum.

Materials:

Chemical methods Were used to measure the iron profile (serum iron and TIBC) was done by using a Biosystem 350 semi-automated spectrophotometer. and serum Ferrtin (latex) causes agglutination of latex particles coated with anti-human ferritin antibodies. The agglutination of the latex particles is proportional to the ferritin concentration and can be estimated by turbidimetry.

Data analysis:

The collected data code in the master sheet and proceed for analysis using SPSS version

11.5. (Mean, standard deviation, *P.value* by using independent *T. test*).

Results:

A total of thirty blood samples were collected from chronic renal failure patients and ten samples were collected as control from a healthy individual including the frequency of sex 22 males (73.3%) and 8 females (26.7%) frequency of age groups (31-50) years old was 20 (66.7%), (51-70) years was 7.0 (23.3%) and (71-100) was 3.0 (10.0%) in the study group. According to duration of disease frequency from (1-4) years was 21 (70%), from (5-8) years was 6.0 (20.0%) and from (9-12) years was 3.0 (10.0%). Regarding dependency on blood transfusion 7 of the patients (23.3%) were transfusion-dependent and 23 of them (76.7%) were non-transfusion-dependent. According to the use of iron therapy, 25 of the patients (83.3%) used iron therapy and 5 of them (16.17%) were not use iron therapy. According to the presence of another chronic disease 14 of the patients (46.7%) were have no other chronic disease, 5 of them (16.7%) had diabetes mellitus and 11 (36.7) had hypertension. According to the study population, 30 participants (70%) were cases and 10 (25%) were control. The results of the present study showed that the mean of the serum iron, serum ferritin, and TIBC in the case group was (182.2667ug/dL), (267.4000ug/L), and (195.2333ug/dL) respectively and in the control group the mean values of the serum iron, serum ferritin, and TIBC were (133.1000ug/dL), (183.2000ug/L) and (291.4000ug/dL) respectively **(Table 1).** The mean of the serum iron, serum ferritin, and TIBC in males was (172.8182ug/dL), (258.5909ug/L), and (196.3182ug/dL) respectively and in the female, the mean of the serum iron, serum ferritin, and TIBC were (208.2500ug/dL), (291.6250ug/L) and (192.2500ug/dL) respectively (**Table 2**). The mean of the of the serum iron ,serum ferritin and TIBC for the age group (31-50) years old were (184.3000ug/dL), (273.4000ug/L) and (200.2000ug/dL) respectively , for the age group (51-70) years old the mean values of the serum iron ,serum ferritin and TIBC were (180.2857ug/dL) , (250.1429ug/L) and (158.7143ug/dL) respectively and for the age group (71-100) years old were (173.333ug/dL), (267.6667ug/L) and (247.3333ug/dL) respectively (**Table 3**) According to the duration of disease, the mean of the serum iron, serum ferritin, and total TIBC for a disease duration of (1-4) years was (177.4286 ug/dL),(266.7143ug/L), and (189.7619ug/dL) respectively, for the duration of (5-8) years the mean values of the serum iron, serum ferritin, and TIBC were (206.1667ug/dL), (284.0000 ug/L) and (197.5000ug/dL) respectively and for the duration of (9-12) years the mean values of serum iron, serum ferritin, and total TIBC were (168.3333ug/dL), (239.0000ug/L),and (229.0000ug/dL) respectively(**Table 4**).

Table (1) Comparison between Case and control in iron profile

Parameter	*Group*	*N*	*Mean*	*Std. deviation*	*P. value*
S. Iron	Case	30	128.2667	61.45306	0.020
	Control	10	133.1000	30.03868	
S. Ferritin	Case	30	267.4000	104.52936	0.022
	Control	10	183.2000	65.30578	
TIBC	Case	30	195.2333	85.32643	0.005
	Control	10	291.4000	94.24578	

Table (2) Correlation between iron profile and gender of patient

Parameter	*Gender*	*N*	*Mean*	*Std. deviation*	*P. value*
S. Iron	Male	22	172.8182	58.87164	0.166
	Female	8	208.2500	64.77378	
S. Ferritin	Male	22	258.5909	93.14743	0.454
	Female	8	291.6250	135.36083	
TIBC	Male	22	196.3182	97.68091	0.910
	Female	8	192.2500	39.03753	

Table (3) Comparison between iron profile and age of the patients

Parameter	Age (Years)	N	Mean	Std. deviation	P. value
S. Iron	31 – 50	20	184.3000	68.02871	0.958
	41 – 70	7	180.2857	50.96638	
	71 – 100	3	173.3333	53.16327	
	Total	30	182.2667	61.45306	
S. Ferritin	31 – 50	20	273.4000	103.88729	0.887
	41 – 70	7	250.1429	126.13013	
	71 – 100	3	267.6667	82.30634	
	Total	30	267.4000	104.52936	
TIBC	31 – 50	20	200.2000	80.15748	0.301
	41 – 70	7	158.7143	55.05365	
	71 – 100	3	247.3333	162.63558	
	Total	30	195.2333	85.32643	

Table (4) Correlation of study parameters and duration of the disease

Parameter	Duration Years	N	Mean	Std. deviation	P. value
S. Iron	1 – 4	21	177.4286	59.61004	0.567
	5 – 8	6	206.1667	61.35932	
	9 – 12	3	168.333	86.96168	
	Total	30	182.2667	61.45306	
S. Ferritin	1 – 4	21	266.7143	85.90643	0.839
	5 – 8	6	284.0000	153.03986	
	9 – 12	3	239.0000	155.04515	
	Total	30	267.4000	104.52936	
TIBC	1 – 4	21	189.7619	67.26067	0.768
	5 – 8	6	197.5000	118.86253	
	9 – 12	3	229.0000	100.25468	
	Total	30	195.2333	85.32643	

Discussion:

Chronic kidney disease (CKD) is an irreversible progressive reduction in renal function and an important source of long-term morbidity and mortality. It has been estimated that CKD affects more than 20 million people in the united estate **[18]**. Anemia commonly happens in individuals with CKD, when kidneys are damaged, they do not make sufficiently EPO as a result the bone marrow produces fewer red cells, inducing anemia. Other causes of anemia in CKD include blood loss from steps of hemodialysis, to prevent anemia needs frequent red blood cell transfusion and EPO therapy, blood transfused and EPO therapy to lead to iron overload **[19].** The result of this study denoted that the patients with chronic renal failure have increased levels of serum iron and serum ferritin and lowered levels of TIBC. The present study revealed an increase in serum iron and serum ferritin levels (p .value 0.020, p value 0.022) respectively. And lowered TIBC and (p value 0.005), were statistically significant differences in patients with chronic renal failure compared with the control group. The results of this current study agreed with the study done by Joseph W. EschbacH et al. who revealed high serum iron in hemodialysis patients **[20]**. and another study was done by Canavese C, Bergamo D, Ciccone G, et al. who reported that 30% of the patients were normal and 70% of iron was overloaded **[21]**. Also, the results of this study confirmed that there is no statistical correlation between the age of patients and serum iron (P.value 0.958), serum ferritin (P.value 0.887), and TIBC (P.value 0.301). and these results disagreed with a study done by Ashwag A. and Ibrahim K. Ibrahim at Al-Neelain University, Khartoum, Sudan which showed a significant correlation between the age of patients and TIBC, and agreed with the same study in that no statistical significance between the age of the patients and serum iron and serum ferritin**.** According to the patient's gender, there is no statistically significant correlation between the iron profile and patient's gender (p.value 0.166), (p.value 0.454), and (p.value 0.910) for serum iron, serum ferritin, and TIBC respectively. Regarding the duration of disease, this study confirmed that there was no statistically significant correlation between iron profile and duration of disease (p.value0.567), (p.value 0.839) and (p.value 0. 768) for serum iron, serum ferritin, and TIBC respectively, and this agreed with the study was done by Ashwag A. Mahgoub and Ibrahim K. Ibrahim showed, that no statistical significance between the age of the patients and serum iron and serum ferritin and there was no statistical significance between gender of the patients and duration of disease and iron profile **[22].**

Conclusion:

Serum iron and serum ferritin were higher in chronic renal failure patients when compared to healthy individuals in the control group. Total iron-binding capacity was lower in chronic renal failure patients

when compared to healthy individuals in the control group. Age, gender of the patients, and period of the disease do not affect the iron profile in chronic renal failure.

Acknowledgments:

The authors are thankful to Mr. Ahmed Mohamed Othman and colleague Nursing staff Hemodialysis unit at Al-Mak Nemir University Hospital, Shendi, Sudan, for their support during the study period.

Funding:

There was no specific grant for this research from any funding agencies.

References:

[1] Levey AS, Atkins R, Coresh J, et al. chronic kidney disease as a global public health problem: approaches and initiatives - a position statement from Kidney Disease Improving Global Outcomes. Kidney Int 2007;72:247–59.

[2] Zoccali C, Kramer A, Jager KJ. Epidemiology of CKD in Europe: an uncertain scenario. Nephrol Dial Transplant 2010;25:1731–3.

[3] Global, regional, and national age–sex specific all-cause and causes pecific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015;385:117–71.

[4] Bello AK, Peters J, Rigby J, et al. Socioeconomic status and chronic kidney disease at presentation to a renal service in the United Kingdom. Clin J Am Soc Nephrol 2008;3:1316–23.

[5] El Nahas AM, Bello AK. Chronic kidney disease: the global challenge. Lancet 2005;365:331–40.

[6] UN World Population Prospects: The 2015 Revision, Key Findings and Advance Tables: United Nations. 2015 http:// esa. un. org/ unpd/ wpp/ publications/ files/ key_ findings_ wpp_ 2015. pdf (accessed 8 Nov 2015).

[7] Ad-G A, Unwin N, Agyemang C, et al. Commentary Tackling Africa's chronic disease burden: from the local to the global. 2010.

[8] World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. 2013.

[9] Stanifer JW, Jing B, Tolan S, et al. The epidemiology of chronic kidney disease in sub-Saharan Africa: a systematic review and metaanalysis. Lancet Glob Health 2014;2:e174–81.

[10] Anothaisintawee T, Rattanasiri S, Ingsathit A, et al. Prevalence of chronic kidney disease: a systematic review and meta-analysis. Clin Nephrol 2009;71:244–54.

[11] The Renal Association, UK Renal Registry. The Sixth Annual Report (2004), available at: http://www.renalreg.com/ Front_Frame.htm

[12] Anandarajah S, Tai T, de Lusignan S et al., "The validity of searching routinely collected general practice computer data to identify patients with chronic kidney disease (CKD): a manual review of 500 medical records", Nephrol. Dial. Transplant. (2005);20(10): pp. 2,089–2,096.

[13] Coresh J, Astor B C, Greene T, Eknoyan G, Levey A, "Prevalence of chronic kidney disease and decreased kidney function in the adult US population: Third National Health and Nutrition Survey", Am. J. Kidney Dis. (2003);41(1): pp. 1 12.

[14] de Lusignan S, Chan T, Stevens P et al., "Identifying patients with chronic kidney disease from general practice computer records", Fam. Pract. (2005);22(3): pp. 234–241.

[15] Chadban S J, Briganti E M, Kerr P G et al., "Prevalence of kidney damange in Australian adults: the AusDiab Kidney Study", J. Am. Soc. Nephrol. (2003);14(90,002): pp. S131–138.

[16] Dodds A. Nicholls M. Haematological aspects of renal disease. Pub Med – index for medline. 1983; 11(4): 361-68.

[17] kidney disease: Improving Global Outcomes (KDIGO) Anemia Work Group. KDIGO clinical practice guideline for anemia in chronic kidney disease. Kidney International Supplements. 2012;2(4):279–335.

[18] National Kidney Foundation, 2002. k\DOQI Clinical Practice Guideline for Chronic Kidney Disease: Evaluation, Classification, and Stratification. American Journal of Kidney Diseases, 39, s1-s266.

[19] Eschbach and Adamason, 1994; Canavese et al., 2004; Chinnapu Reddy et al., 2013).

[20] Eschbach, J.W. and Adamason, J.W. 1994. Iron over Load in Renal Failure. New York Blood Center, 515.

[21] Canavese, C., Bergamo, D., Ciccone, G., et al. Harmful Iron over Load in Dialysis Patients. Kidney International (2004), 65, 1091-1098.

[22] Mahgoub A.A.O, Ibrahim Ik. Assessment Of Iron Profile Among Sudanese Patients With Chronic Renal Failure Undergoing Heamodialysis. 2017.August, 2017.