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Research Article

Haemoglobin Level and its Predictors among Patients with Chronic Kidney Disease on Haemodialysis in Hargeisa Group Hospital, Hargeisa, Somaliland

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Abstract

Background: Chronic kidney disease (CKD) is defined as the presence of irreversible renal damage manifesting with reduction in the glomerular filtration rate. More than 800 million people are affected by chronic kidney diseases worldwide. CKD is more prevalent in older individuals and in people experiencing poorly controlled diabetes mellitus and hypertension. Most people with kidney disease will develop anemia, which happens early and grow worse as kidneys fail and can no longer make erythropoietin (EP). Evidence suggests that haemodialysis could lead to anaemia through the loss of blood, while there are also arguments that haemodialysis prevents anaemia through treating the underlying causes that precipitated it.

Purpose of the Study: This study was to assess haemoglobin level and associated factors among patients with chronic kidney disease on haemodialysis in Hargeisa Group Hospital, Hargeisa and Somaliland to generate evidence for practice.

Methods: An institution-based cross-sectional study was conducted for a period of four weeks from 30 June to 27 July 20222 at Hargeisa Group Hospital, Department of Haemodialysis. Sixty-five patients undergoing haemodialysis were included in the analyses using consecutive sampling technique. Descriptive statistics and multivariable linear regression analyses was done to isolate independent predictors of haemoglobin level after checking assumptions.

Results: Among 65 participants in the study, 67.3% were males and 32.3% were females. The mean (± SD) of age was 51.88 ± 8.91 years. The mean (± SD) haemoglobin level was 8.43 (± 1.30) with the values being 8.61 (1.23) and 8.03 (1.37), for males and females, respectively.

On multivariable linear regression analyses after adjusting for background variables, duration of chronic kidney diseases, age of the patients, having any scheduled physical activities before becoming sick, glomerular filtration rate and number of meals prepared from meat or meat products per week were significantly associated with hemoglobin level ($P < 0.05$). For one year increase in the duration of the chronic kidney diseases, hemoglobin level decreased by 0.01 (ß = -0.01, P = 0.004). Likewise, for one year increase in the age of the patient, hemoglobin decreased by 0.036 (ß = -0.0, P = 36, 0.038).

Conversely, having any scheduled physical activities before becoming sick increased hemoglobin level by 0.923 (ß = 0.923, P = 0.003), while a unit increase in the glomerular filtration rate increased hemoglobin level by 0.132 (ß = 0.132, P = 0.018). Likewise, an increase in the number of meals prepared from meat or meat products per week increased hemoglobin level by 0.444 (ß = 0.444, P = 0.045).

Conclusion: The results showed that haemoglobin level is low among patients on haemodialysis, which needs to considered in the treatment plan. The findings imply the need for treatment of anaemia as well as dietary and lifestyle modifications including encouraging physical activity specially for patients with longer diseases duration.

Keywords: *Demography; CKD; Haemodialysis; Clinical Profile*

Introduction

Chronic kidney disease (CKD) is a public health problem, and there is an alarming increase in prevalence worldwide. It is associated with significant adverse outcomes of kidney failure, heart failure and early death [1,2]. Chronic kidney disease (CKD) is defined as the presence of irreversible renal damage or a reduction in the glomerular filtration rate [3]. More than 800 million people are affected by chronic kidney diseases worldwide, which are more prevalent in older individuals and in people experiencing poorly controlled diabetes mellitus and hypertension [4].

CKD is one of the leading non-communicable diseases that cause death worldwide. It affects an increasing number of people over time and has further risen in importance among the various global causes of death. CKD affects individuals in different regions of the world unequally, likely because of differences in the demographic characteristics populations, their history of other noncommunicable diseases, comorbidities, and access to healthcare facilities [4]. Over the past three decades, the worldwide prevalence of chronic kidney diseases has risen to 29.3%, and CKD has become a worldwide public health concern. Although the prevalence of CKD has been a public health problem in developed countries, it is significantly emerging problem in developing countries, where the health care system is not sufficiently responsive to medical care [5]. It has currently become a problem that excessively affects individuals from low-income and middle-income countries, particularly in sub-Saharan Africa [6]. In many sub-Saharan African countries, chronic kidney diseases affect young adults less than fifty years of age and are mainly due to uncontrolled high blood pressure and glomerular diseases [7]. Because of the high cost of treatment and lack of adequate health facilities, many patients cannot afford optimal treatment for CKD [8]. HIV infection and genetic disorders also contribute significantly to the CKD burden, and primary chronic glomerulonephritis is seen most often [5].

Although recent studies showed an increasing prevalence of CKD across Africa, there has not been an Africa-wide effort to provide reliable estimates that could sufficiently inform health service planning and policy development to address the impact of chronic kidney diseases [6]. According to Muiru., *et al*. (2020), the prevalence of CKD in Somalia was not examined before, but CKD in sub-Saharan Africa was 6.8% in 2020 [9].

Anemia is a common problem among patients with CKD due to low erythropoietin level to make red blood cells, and blood testing and low levels of iron, uremic intoxication inhibiting erythropoiesis and lack of pre end stage renal disease (ESKD) nephrology care; lack of adequate anaemia treatment [10,11]. The relation between haemodialysis in patients CKD anaemia has been controversial. Evidence shows that haemodialysis aggravates anaemia due to loss of blood during haemodialysis [12]. Conversely, a recent review of evidence showed that haemodialysis prevents anaemia by eliminating putative uremic inhibitors that suppress erythropoiesis, reducing red cell destruction and increasing iron availability as well as by mechanisms restricting underlying inflammation and endothelial dysfunction that are crucial to both CKD and anaemia [13]. On the other hand, administration Iron for treatment of anaemia in CKD patients should be considered carefully and be evidence based. Iron is essential for nearly all infectious microorganisms, there is concern that iron administration may increase infection risk [14]. Furthermore, Iron may increase oxidative stress by participating in the Fenton reaction [15], aggravating the CKD.

Although haemodialysis is service is being given to CKD patients in Hargeisa Group Hospital, its association with anaemia has not been determined.

This study determined haemoglobin level and its predictors among CKD patients on haemodialysis in Hargeisa, Somaliland to generate evidence for improving patient care.

Methods

Study design, period, and setting

An institution-based cross-sectional study was conducted for four weeks from 30 June to 27 July, 20222 at Hargeisa Group Hospital, Department of Haemodialysis. The hospital was built in 1951 by the British Administration and currently has 400 beds with daily average visitors of more than two hundred and sixty patients with a catchment population of more than one million. It provides health care

services for other regions and districts of Somaliland. There are over seven hundred clinical and nonclinical staff members in six main departments. The most recently launched new haemodialysis unit treats varying numbers of patients [12].

Sample size: The sample size was calculated using the RAOSOFT Sample size calculator [13] based on assumption of: 5% margin of error, 95% confidence level and response distribution of 50%. The total number of people registered for haemodialysis at the time of data collection was 77.

Sampling technique: A consecutive sampling method was employed to select each study unit as the total number of cases on hemodialysis is small.

Data collection and measurements: Data were collected face-to-face by using structured interviewer-administered questionnaires and anthropometric measurements. A structured questionnaire was used to collect socio-demographic data, family history of chronic disease, presence of comorbidities, and risky lifestyle behaviour, and dietary practice was assessed using a semi quantitative dietary history method.

The anthropometric measures of weight and height were measured using standard techniques [14]. Body weight was measured on a digital anthropometric weighing scale. The scale was placed on a squamous flat floor surface. Weighing scales were validated with a known weight object every time and checked against zero reading after weighing every participant. All patients' weights were measured and taken to the nearest 0.1 kg. Height was measured using a portable stadiometer to the nearest 0.1 cm. Height was measured in all participants, with the weight distributed between the feet, and heels together, in an upright posture, with the head free of props and looking straight ahead at a fixed point at eye level. Based on weight and height, body mass index was calculated as weight in kg and height in meters squared. The most recent data on laboratory markers, serum albumin, serum creatinine, blood urea nitrogen (BUN), haemoglobin (Hb), and blood pressure, were taken from the files of each patient.

Statistical analysis: The collected data were manually checked for completeness and consistency. Then, the data were entered into SPSS software program version 23 for cleaning and analysis. The data were checked for missing values and outliers before analysis. Descriptive statistics were used to examine the frequency distributions of the study variables. A multivariable linear regression model was run to isolate independent predictors of Haemoglobin concentration among patients with chronic kidney diseases. Assumption for linearity, normality, homoscedasticity and albescence of multicollinearity were checked for the model. P value < 0.05 was used to declare statistical significance. Model fitness was assessed using adjusted R^2.

Results

Among 65 participants in the study, 67.3% were males and 32.3% were females. The mean standard (± SD) of age was 51.88 ± 8.91 years with the range being 30 - 65 years. Only 4.6% were in stage four, while 95.6% were in stage five. Nearly 91% of respondents were married, while only 9% were single. Regarding educational level, 38.5% did not attend formal education, whereas 61.5% had different formal education levels, such as primary, secondary, and tertiary levels. A total of 78% of the study participants were unemployed, whereas only 21.5% were employed (Table 1).

Disease-related characteristics of respondents: Nearly 70% of respondents reported that they had a family history of chronic diseases, 38.4% had a family history of hypertension only, 4.6% had chronic kidney diseases (CKD), and 26% had diabetes mellitus (DM) together with hypertension. Seventy-two percent of study participants reported that they had other chronic diseases before they suffered from chronic kidney debases (CKD), with 38.3% having hypertension, 32.3% having hypertension with diabetic mellitus and only 4.6% having diabetic mellitus only. In current status, all of the respondents reported that they had comorbid conditions. Of those with

Characteristics of study Participants	Frequency	Percent
Sex		
Female	21	32.3
Male	44	67.7
Age category		
≤ 40 years	11	17
> 40 years	54	83
Marital status		
Single	6	9.2
Married	59	90.8
Occupation		
Employed	51	78.46
Unemployed	14	21.5
Family size		
≤ 7	26	40
> 7	39	60
Educational level		
Formal Education	25	38.46
None formal education	40	61.53

Table 1: *Socioeconomic and demographic characteristics of CKD patients attending Hargeisa Group Hospital, Hargeisa, Somaliland, June 5 to 30 July 2022 (n = 65).*

hypertension (55.3%), 6.2% were diabetic, while 38.5% had both DM and hypertension. In terms of the duration of CKD among patients, 60% of patients had 2 years and above, while 40% had less than 2 years (Table 2).

Characteristics of study participants	Frequency		Percent
Family history of chronic diseases	**Female**	**Male**	
Yes	15	30	69.2
No	6	14	30.7
Type of chronic disease			
Hypertension only	8	17	38.4
CKD	0	3	4.6
DM and hypertension	7	10	26
Any chronic disease before current CKD			
Yes	15	32	72.3
No	6	12	27.7
Type of chronic disease before current CKD			
Hypertension only	6	17	35.3
DM and Hypertension	9	12	32.3
DM only	0	3	4.6

Status of chronic other chronic diseases in the patients			
Hypertension	11	25	55.3
DM	1	3	6.2
Both DM and Hypertension	9	16	38.5
Duration of CKD			
2 years and above	**11**	**28**	60
Less than 2 years	**10**	**16**	40

Table 2: *Disease-related characteristics of CKD patients attending Hargeisa Group Hospital, Hargeisa, Somaliland, June 27 to 30 July 2022 (n = 65).*

Risky lifestyle-related characteristics of CKD patients: Most of the male respondents had a history of tobacco smoking, while there was no history of tobacco smoking among females, but currently, nobody smokes tobacco. Ninety-two percent of respondents had less than twenty minutes of scheduled physical activities before, while only 8% had more than twenty minutes. Only 9.2% of patients had exercise plans set with their doctors, while others had no. In the current activity, 90% of study participants were sedentary. In dietary-related characteristics, 32.3% are still dependent on eating foods from restaurants, whereas 67.7% eat special foods prepared in their homes. Although most patients had a low conception of salts, only 3.8% consumed the right quantity of salt. Eighty-six percent of respondents consumed different fruits and vegetables most of the time. A total of 56.9% had experienced anorexia, 39.4% had a loss of appetite most of the time, and 43.1% had no anorexia (Table 3).

Characteristics of study participants	**Frequency**	**Percent**
History of tobacco smoking		
Yes	38	58.6
No	27	41.5
Scheduled physical activities before sick		
< 20 minutes	60	92
≥ 20	5	8
Exercise plan set with your doctor		
Yes	6	9.2
No	59	90.8
Current activity		
Sedentary	59	90.7
Low activity (<3 km)	6	9.3
Eating foods regularly from restaurant		
Yes	21	32.3
No	44	67.7
Eating meat and meat product		
Never	40	61.5
Once or twice week	25	38.5
Salt consumption		
Right amount	9	13.8
Too small amount	56	86.2
Doctor's advice to reduce salt consumption		
Yes	58	89.2
No	7	10.8

Consumption of fruits and vegetables		
Yes	56	86.2
No	9	13.8
Frequency of fruit and vegetable conception		
Most often	47	72.3
Rarely	11	16.9
Dietary plan set with doctor		93.8
Yes	61	6.2
No	4	
History of anorexia		
Yes	37	56.9
No	28	43.1
How often do you experience loss to appetite		
Most of the time	23	35.4
Rarely	14	21.5

Table 3*: Risk lifestyle-related characteristics of CKD patients attending Hargeisa Group Hospital, Hargeisa, Somaliland, June 30 to 27 July 2022 (n = 65).*

Anthropometric and biochemical markers: An increase in creatinine level indicates the impairment of kidney function. In the current study, the serum creatinine level of all patients was very high. The mean and standard deviation of creatinine were 8.5 ± 2.42. The level of haemoglobin that indicates the level of anaemia was very low, which means that many study participants were anaemic. Of 65 participants, only 18.5% were underweight, and only 4.6% were overweight, while the rest were normal after calculation of their body mass index (Table 3). The mean and standard deviation of diastolic and systolic pressure were 156.6 ± 21.6 and 112 ± 78.2, respectively (Table 4).

Variable	Frequency	Percent
Creatinine level g/dl		
> 1.4 < 8 g/dl	25	38.5
8 - 10 g/dl	27	41.5
>=10	13	20
Haemoglobin value (g/dl)		
For females		
≤ 12	17	81
> 12	4	19
For males		
≤ 13	38	86.4
> 13	6	13.6
Body mass index (BMI)		
< 18.5	12	18.5
18.5 - 30	50	76.9
> 30	3	4.6
Stages of CKD		
Stage four	3	4.6
Stage five	62	95.4

Characteristics	Value (mean ± SD)
Systolic blood pressure	156.6 ± 21.6
Diastolic blood pressure	112 ± 78.2
Blood urea nitrogen	131 ± 47.2

Table 4: *Anthropometric and biochemical marker characteristics of CKD patients attending Hargeisa Group Hospital, Hargeisa, Somaliland, June 30 to 27 July 2022 (n = 65).*

On multivariable linear regression model after adjusting for different background characteristics, duration of chronic kidney diseases, age of the patients, having any scheduled physical activities before you become sick, glomerular filtration rate, number of meals prepared from meat per week and eating fruits and vegetables were significantly associated with hemoglobin level (P < 0.05).

The duration of kidney diseases and age of the patents were negatively associated with hemoglobin level (P < 0.05), while having any scheduled physical activities before becoming sick, glomerular filtration rate and number of meals prepared from meat or meat products per week were positively associated with hemoglobin level.

As shown in table 5, for a unit increase in the duration of the chronic kidney diseases, hemoglobin level decreased by 0.01(ß = -0.01, P = 0.004). Likewise, for one year increase in the age of the patient, hemoglobin decreased by 0.036 (ß = -0.0, P = 36, 0.038).

Conversely, having any scheduled physical activities before becoming sick increased hemoglobin level by 0.923 (ß = 0.923, P = 0.003). Similarly, a unit increase in the glomerular filtration rate increased hemoglobin level by 0.132 (ß = 0.132, P = 0.018). Likewise, an increase in the number of meals prepared from meat or meat products per week increased hemoglobin level by 0.444 (ß = 0.444, P = 0.045).

Model	Unstandardized Coefficients		P	95.0% CI	
	B	Std. Err		Lower Bound	Upper Bound
Duration of chronic kidney diseases(yrs.)	-0.010	0.003	0.004	-0.017	-0.003
Age of the respondent (yrs.)	-0.036	0.017	0.038	-0.069	-0.002
Sex of respondent (Female)	-0.132	0.318	0.679	-0.770	0.506
Having any scheduled physical activities before becoming sick	0.923	0.300	0.003	0.322	1.525
Type of protein content diet commonly used	0.291	0.200	0.151	-0.110	0.692
Glomerular filtration rate	0.132	0.054	0.018	0.023	0.242
Nutritional related functional impairment	-0.138	0.206	0.504	-0.550	0.274
Number of meals prepared from meat or meat products per week	0.444	0.217	0.045	0.010	0.878
Having current Chronic diseases	0.166	0.087	0.063	-0.009	0.340

Table 5: *Multivariable linear regression model predicting haemoglobin level of patient with chronic kidney diseases in Hargeisa Group Hospital, Somaliland*

Maximum VIF: 1.935, CI: Confidence Interval.

Discussion

The findings showed that that patients on haemodialysis have low haemoglobin level showing that anaemia is the most prevalent problem, which is consistent with the report of another study in China. CKD patients on haemodialysis are vulnerable to anaemia due

to several reasons including: low production of erythropoietin [16], poor dietary intake of nutrients [17], blood loss during dialyses or investigation, uremic intoxication inhibiting erythropoiesis [17] and poor care and treatment of anaemia [18]. The results imply for the need strict monitoring of the haemoglobin level of patients on dialyses and their anaemia for better clinical outcomes [19]. A study showed that anaemia is associated with an increased risk of CKD progression, cardiovascular events, and all-cause mortality [20], implying that it needs timely medical attention.

Further multivariable linear regression analyses showed that the duration of CKD is one of the predictors negatively associated with haemoglobin level of patients. This could be because the longer duration of the diseases, the more consequences it generates on the health and nutritional status of the subjects. Evidence shows that main mechanisms for the health and nutrition consequences of CKD are linked to vitamin dysregulation, especially of B-group vitamins, vitamin C and D, oxidative stress, metabolic acidosis and low-grade inflammation, which is commonly true among haemodialysis (HD) adult patients due not only to the hemodialysis procedures themselves, but also to numerous CKD-related comorbidities [21].

It was also found out that as age of the respondents' increased, there was a decrease in haemoglobin level. This could be associated with the fact that renal function declines as age increases [22] compounding the negative effect of CKD on the haemoglobin level. Aging leads to microanatomical structural changes of the kidney resulting in a decreased number of functional glomeruli from an increased prevalence of nephrosclerosis (arteriosclerosis, glomerulosclerosis, and tubular atrophy with interstitial fibrosis) and compensatory hypertrophy of remaining nephrons [23].

This study showed that having any scheduled physical activities before becoming sick to chronic kidney diseases increased haemoglobin level. This may be due the fact that regular exercise has been proven to have a positive impact on managing hypertension, diabetes, and cardiovascular disease, which decreases their complications on the kidney. Conversely, lack of physical activity may increase the risk of developing these life-threatening conditions. The benefits of exercise on overall health are well-documented and should not be overlooked [24].

In individuals with CKD who engage in regular exercise experienced an improved quality of life, physical functioning, sleep quality, and report fewer limitations in physical activity. Additionally, they are less impacted by pain or poor appetite [25].

Haemoglobin level in patients with chronic kidney diseases increases as glomerular filtration rated increase. A recent study showed that the glomerular filtration rate affects the rate of haemoglobin level which means that there is a positive correlation between haemoglobin level and glomerular filtration [25]. An increase in number of meals prepared from meat or meat products increases haemoglobin level [26]. This could be due to the reason that meat is an excellent source of many nutrients like, iron, vitamin-B which are necessary for formation of haemoglobin.

Conclusion

The results showed that haemoglobin level was low among patients on haemodialysis, which needs to be considered in the treatment plan. The findings imply the need for treatment of anaemia as well as dietary and lifestyle modifications including encouraging physical activity specially for patients with longer diseases duration. Patients' kidney function needs to be regularly monitored to prevent such complications as low haemoglobin level.

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