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Original Research Article

Prevalence and Pattern of Kidney Disease among Patients with Sickle Cell Anaemia at a Tertiary Health Facility in Northeastern Nigeria

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Abstract: ***Introduction***: Sickle cell disease is one of the most common genetic haemoglobinopathies. It is a major public health problem and kidney insufficiency is common among adult patients with the disease. The sickle haemoglobin leads to tissue hypoxia, causing acute tissue damage and chronic organ dysfunction including chronic kidney disease. ***Aim*****:** To assess the prevalence and pattern of kidney disease among sickle cell patients in UMTH, Maiduguri, Borno State. ***Method*****:** A hospital-based cross-sectional study conducted from January 2022 to June 2022 at the GOP and haematology clinics of the University of Maiduguri Teaching Hospital. Two hundred and forty (240) SCA participants receiving medical care at the outpatient sickle cell clinic were enrolled in the study. An equal number of age and sex-matched controls with Hb AA were also recruited. A structured questionnaire was administered to obtain demographic information, clinical history, blood pressure, and anthropometry. Blood and urine samples were taken for serumcreatinine and proteinuria determination respectively. The estimated GFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation. Data was analysed using International Business Machines-Statistical Package for Social Sciences (IBM-SPSS) version 21. P –value of < 0.05 was taken as significant. ***Results*****:** Kidney disease was present in 44.6% of participants with SCA and present in 15% of the controls. The prevalence of hyperfiltration (GFR >120ml/min) and reduced GFR <60ml/min were also significantly higher in the SCA compared with controls 17.5% vs 1.7% and 38.3% vs 12% respectively. (p-value < 0.001). Serum creatinine levels correlated positively with albuminuria (r = 0.178; p = 0.006), while PCV correlated negatively with albuminuria (r = -0.178; p=0.006). The significant predictors of kidney dysfunction were the presence of albuminuria and high diastolic BP, with odd ratio (confidence interval) 0.937 (0.019 - 0.981) (p = 0.002) and 0.971 (0.937 - 0.971) (p = 0.001), respectively. ***Conclusion*****:** This study has shown a high prevalence of kidney disease among patients with SCA compared to HbAA controls in Maiduguri, and prevalence and intensity increase with age. The presence of proteinuria and high diastolic BP were associated with kidney disease.

Keywords: Sickle Cell Anaemia, Kidney Disease, Northeastern Nigeria.

INTRODUCTION

Sickle cell anaemia (SCA) is one of the most common genetic haemoglobinopathies. It is inherited as an autosomal recessive pattern. More than 75% of the global burden of SCA occurs in sub-Saharan Africa, with nearly 90% of the world's SCD population living in Nigeria, India and the Democratic Republic of Congo [1]. Nigeria has the largest population of people with

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SCD, with the prevalence of sickle cell trait of about 25%, while SCA is reported to range between 2 and 3% of the general population [2, 3]. The Prevalence of SCD worldwide is 2 % [4]. SCA is characterized by red blood cell sickling, vaso-occlusion, haemolysis, acute anaemia and high morbidity and mortality. The sickle haemoglobin leads to tissue hypoxia, causing acute tissue damage and chronic organ dysfunction including SCA-associated nephropathy. There is often a delay in diagnosis in several parts of the Country, most patients are diagnosed after several visits to the hospital or clinic with acute illness. This means that organ impairment may set in long before the diagnosis, increasing the risk for the development of kidney disease and increased morbidity and mortality [4]. Kidney disease is one of the end organ damages associated with sickle cell anaemia. Sickle cell-related irreversible organ damage is the primary cause of death in patients with SCA [5]. Complications of chronic lung disease account for 20% of deaths in patients with SCA, followed by renal failure accounting for 14% [5, 6]. The haemodynamic changes that occur with chronic anaemia, renal hypoxia that results from recurrent vaso-occlusion and haemolysis-related endothelial dysfunction can lead to functional and structural changes which may progress to CKD [7-9]. The spectrum of clinical symptoms depends on the part of the nephron affected which can be divided into glomerular abnormalities, distal tubular functional abnormalities, proximal tubular abnormalities, haematuria, proteinuria and renal cell carcinoma.The major manifestations of sickle cell nephropathy are usually tubular and glomerular functional abnormalities. Previous studies [10-12]. Have revealed the enormous burden of chronic kidney disease (CKD) and SCN, with varying reports of the prevalence of SCN ranging from 5-15% of the total SCA population worldwide. Bukar *et al.*, [13], reported the prevalence of CKD in SCA to be 38.9%, while in a study in southwestern Nigeria, 22.5% of patients with SCA had abnormal creatinine clearance [10]. This matter is of great concern and there is dearth of information about the renal status of SCD patients in Nigeria. Substantial data on the issue as well as early detection and treatment amongst this target group will be of great help.

There is no known direct evidence of specific susceptibility genes or causative environmental factors for delaying the onset of SCN. However, glomerular lesions studied are associated with proteinuria, which is associated with an increased risk for decline in kidney function in adults with SCA. Short-term studies in adults demonstrate a reduction in proteinuria with ACE-Is or ARBs [14]. Hydroxyurea (HU) has also been found to reduce acute and chronic complications, organ damage, mortality, and albuminuria in adults and children with SCA [15]. Hydroxyurea alone is insufficient to reverse albuminuria in all SCA patients; thus, its role in the treatment of SCN is not well defined [16, 17]. It is therefore imperative to find measures for ameliorating SCA and its complications and those interventions that may be beneficial in slowing the progression of CKD due to other causes.

MATERIAL AND METHOD

This was a hospital-based cross-sectional study conducted at GOPD and Haematology Clinic(s) of the University of Maiduguri Teaching Hospital from January 2022 to June 2022. Two hundred and forty consenting adults with SCA who were in a steady clinical state and an equal number of age and sex-matched control groups with Hb AA were recruited. A structured questionnaire was administered to each participant to obtain information on demography and clinical history. SCA patients who had clinically suspected urinary tract infections, gross haematuria, infected with HIV or with a systemic condition that could result in a glomerulopathy not related to SCA (e.g. active hepatitis B or C infections, systemic lupus erythematosus, Hypertension, DM) were excluded. The blood pressure of the participants was measured with (a mercury-in-glass sphygmomanometer and stethoscope) by recommendations of the American Heart Association [15]. Repeated measurements were taken Within 5 - 10 minutes of rest and the mean value was recorded as the blood pressure. Height and weight were measured (to the nearest 0.1 m and 0.1 kg) without shoes in light clothing on a flat surface with a Stadiometer (ZT-120 health scale, China). Body Mass Index (BMI) was calculated using the formula; Weight (kg)/height (m^2). Overall obesity was defined as a BMI of≥30 kg/m^2, normal weight as 18.5–24.9 kg/m^2, underweight as <18.5 kg/m^2 and overweight as 25.0–29.9 kg/m^2.

Blood Sample Collection and Processing

Eight millilitres of venous blood were obtained from each participants. Five millilitres was placed in lithium heparin specimen bottles for serum electrolyte, urea and creatinine estimation. Plasma was separated immediately upon collection by centrifugation and after that stored in plain bottles at -20^{0}C for batch analysis using standard laboratory procedures in all cases; Serum Creatinine level determination using the standard hospital laboratory method of Jaffe's method (kinetic alkaline picrate). Serum urea level determination using the colorimetric test i.e. the diacetyl mono-amine oxidase method.

The sera were taken from the sample using a precision pipette and placed into standard cups. The autoanalyser was set to determine the various electrolytes in the patient's samples.

Three 3.0ml of venous blood were collected into a Potassium Ethylene diamine tetra acetic Acid (K-EDTA) bottle for Full Blood Count (FBC). FBC was carried out with an auto-analyser machine, Sysmex KX-21N (U.S.A). Glomerular filtration rate (GFR) was calculated using the CKD- EPI equation which has recently been suggested as the best option for the eGFR determination in SCD [22].

Urine Sample Collection and Processing

Participants provided early morning urine, collected into a clean, dry, sterile and wide-necked container. Urinalysis was carried out using the urinary dipstick, Combi-Uriscreen® 10SL (Germany) to assess for protein, leucocytes and nitrite. Female subjects were instructed to void fresh urine at times outside of their menstrual periods. In subjects with leukocyturia or a positive dipstick nitrite test, the presence of proteinuria was confirmed after treatment with antibiotics.

Statistical Analysis

Data obtained were manually entered into a computer and analysed using International Business Machines-Statistical Package for the Social Sciences (IBM-SPSS) version 21 statistical software by IBM Corporation. Values are expressed as mean ± SD or frequencies and proportions. Differences between groups were determined by unpaired t test, Chi-square, Fisher's exact test or ANOVA, where appropriate. Logistic regression was performed to determine the factors, which may be associated with kidney disease amongst different populations. P <0.05 was considered statistically significant.

Ethical Consideration

Ethical approval for the study was sought and obtained from the UMTH Health Research Ethics Committee with approval reference UMTH/REC/24/672. Informed written consent was obtained from each study participant.

RESULTS

Socio-demographic Characteristics of Study Participants

The age of the study population ranged between 18 and 50 years with a mean age of 23.93±5.93 years for the SCA group and 24.69±6.58 years for the controls (p-value = 0.313). The age group 21-30 years constituted the highest proportion of subjects 118 (49.2%). There were 131 (54.6%) males and 109 (49.4%) female in both groups.

The majority of the subjects were students in both the cases and control accounting for 180 (75%) and 106 (44.6%) of the study subjects. Table 1 shows the distribution of socio-demographic characteristics between cases and controls.

Table 1: Socio-demographic Characteristics of Study Participants

Characteristics	SCA Group n= 240(%)	Control Group n= 240(%)	X2	p-value
Mean Age (Mean±S.D)	23.93±5.93 years	24.69±6.58 years	0.313	
Age group				
≤ 20	91 (37.9)	80 (33.3)	3.559	0.313
21-30	118 (49.2)	119 (49.6)		
-40	27 (11.3)	31 (12.1)		
> 40	4 (1.7)	10 (4.2)		
Sex				
Male	131 (54.6)	131 (54.6)	0.001	1.000
Female	109 (45.4)	109 (45.4)		
Occupation				
Student	180 (75.0)	176 (73.3)	2.686	0.443
Civil Servant	19 (7.9)	24 (10.0)		
Housewife	14 (5.8)	8 (3.3)		
Others	27 (11.3)	32 (13.3)		
Level of Educational				
Informal	22 (9.2)	15 (6.3)	3.556	0.314
Primary School	3 (1.3)	5 (2.1)		
Secondary School	114 (47.5)	93 (38.7)		
Tertiary	101 (42.0)	127 (52.9)		

Clinical Characteristics of the Study Population

As shown in Table 2 below, the symptoms of kidney disease among the studied participants included facial puffiness 76 (31.7%) among the SCA Groups compared with 29 (12.1%) in the control group, this was significantly higher in SCA than the control group (p-value = < 0.001). Haematuria accounted for the lowest percentage (3.3%) and (0%) among the cases and controls respectively (p-value = 0.004).

On the other hand, vomiting was the predominant symptom among the control group 64 (26.7%), while it is seen in 13 (5.4%) of the cases, however, this was also not statistically significant (p-value = 0.843).

Other symptoms were nocturia 59 (24.6%) vs 33 (13.8%), polyuria 53 (22.1%) vs 25 (10.4%) and frothy urine 24 (10%) vs 13 (5.4%) respectively, which were more prevalent among the SCA compared to the

control group, although the differences were not statistically significant.

The mean weight and body mass index were significantly higher in the control group compared to the SCA (p-value = < 0.001). There was no significant difference in the mean systolic blood pressure (p-value = 0.982) and the mean diastolic blood pressure (p-value = 0.779) between the two groups. (Table 2)

Table 2: Clinical characteristics of the study population

Parameters	SCA Group n (%) Mean ±SD	Control Group n (%) Mean ±SD	p-value
Facial puffiness	76 (31.7)	29 (12.1)	< 0.001*
Leg swelling	48 (20.0)	33 (13.8)	0.068
Vomiting	13 (5.4)	64 (26.7)	0.843
Haematuria	8 (3.3)	0 (0)	0.004*
Nocturia	59 (24.6)	33 (13.8)	0.517
Polyuria	53 (22.1)	25 (10.4)	0.383
Frothy urine	24 (10.0)	13 (5.4)	0.878
Height (m)	163.01±7.53	163.29±8.01	0.698
Weight (kg)	47.69±8.29	52.82±10.00	≤ 0.001*
BMI (Kg/m^2)	17.91±2.66	19.85±3.43	≤ 0.001*
SBP (mmHg)	115.47±16.16	115.43±16.12	0.982
DBP (mmHg)	70.55±11.54	70.25±11.50	0.779

BMI (Body mass index), SBP (Systolic Blood pressure), DBP (Diastolic Blood pressure), m (metre), kg (kilogram), *(Significant p-value of< 0.05)

Classification of Study Participants According to GFR

Table 3. shows the classification of study participants according to the GFR group.

There was a significant difference in the prevalence of various stages of kidney function. (P = < 0.001). Glomerular filtration rate>90mls/minwas observed in 38.8% of the SCA group and 70.5% of the control,and 22.9% of the SCA group had GFRbetween60 to 89 mls/min, compared with17.5% of the controls. 25.4% of the SCA and 8.3% of the control had GFR between 30 to 59mls/min, 9.2% and .3% had GFR of 15-29 mls/min in the SCA group and the controls while 3.8% and 0.4% had GFR < 15mls/min in the SCA and control group respectively.

Table 3: Classification of the study participants according to GFR

GFR	SCA Group n (%)	Control Group n (%)	P value
GFR >90mls/min	93 (38.8)	169 (70.5)	< 0.001*
GFR 60-89mls/min	55 (22.9)	42 (17.5)	
GFR 30-59mls/min	61 (25.4)	20 (8.3)	
GFR 15-29mls/min	22 (9.2)	8 (3.3)	
GFR < 15mls/min	9 (3.8)	1 (0.4)	
Total	240 (100)	240 (100)	

GFR (Glomerular filtration rate), SCA (Sickle cell anaemia) *(Significant p value of< 0.05), chi-square test

Pattern of Kidney Damage/Injury among Study Participants

Table 4 shows the pattern of kidney damage among the studied participants.

Forty-two (17.5%) patients in the SCA Group had hyperfiltration (GFR >120ml/min), 92 (38.3%) had GFR<60ml/min, 12 (5%) had isolated microalbuminuria, 3 (1.3%) had isolated overt proteinuria, 31 (12.9%) had isolated GFR <60mls/min, 42 (17.5%) had a combination of microalbuminuria and reduced GFR, while 19 (7.9%) had both overt proteinuria and reduced GFR. The total number of patients with any degree of albuminuria, proteinuria and/or GFR<60mls/min among the SCA groupwas107, accounting for 44.6% of the patients, and 36 (15%) among the Control group.

Table 4: Pattern of kidney damage/injury among the study population

Markers of kidney injury	SCA Group n (%)	Control Group n (%)
Hyperfiltration	42 (17.5)	4 (1.7)
Albuminuria Overt Proteinuria	12 (5) 3 (1.3)	5 (2.1) 2 (0.8)
GFR < 60mls/min	31 (12.9)	14 (5)
Albuminuria + GFR < 60mls/min Proteinuria + GFR<60mls/min	42 (17.5) 19 (7.9)	10(4.2) 5 (2.1)

GFR Glomerular filtration rate

Prevalence of Kidney Disease among Study Participants

Out of the total 240 study participants with SCA, there were 107 patients with evidence of kidney dysfunction defined as Albuminuria, proteinuria and/or eGFR < 60mls/min. The prevalence of kidney disease amongst the SCA group is 44.6%, however the prevalence was 15% among the control group as only 36 out of 240 had evidence of kidney dysfunction. This is shown in figure 1. Below:

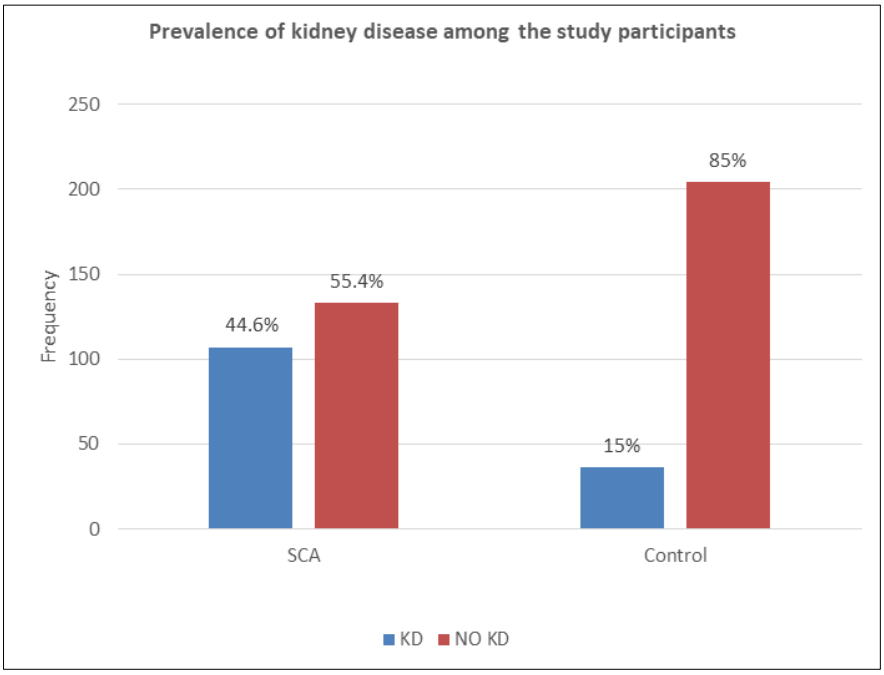

Figure 1: Bar chart showing prevalence of kidney dysfunction among the study participants

Comparison of Sociodemographic and Clinical Parameters between SCA with Kidney Disease (KD) and Without Kidney Disease (KD)

The mean value of the number of transfusions per year and mean diastolic blood pressure were significantly higher in those with KD than in those without the disease. P-values = 0.002 and < 0.001 respectively. The mean age of patients with KD was similar to those without KD, 23.5 ± 6.1 vs24.6 ±5.6years, (p = 0.158). There was no significant association between gender and development of kidney dysfunction, p-value = 0.870. There was also no significant difference between the mean values of frequency of VOC per year, number of febrile illnesses, systolic blood pressure, weight and body mass index among those with kidney dysfunction and those without the disease. (Table 5)

Table 5: Comparison of Sociodemographic and Clinical Parameters between SCA with Kidney disease (KD) And without Kidney disease (KD)

VARIABLE	KD n(%) MEAN±SD	NO KD n(%) MEAN±SD	p-value
Mean Age (yrs)	24.6 ± 5.6	23.5 ± 6.1	0.158
Age group < 20	28 (30.2)	63 (69.8)	0.163
21-30	49 (41.5)	69 (58.5)	
31-40	17 (63)	10 (37)	
>40	3 (75)	1 (25)	

VARIABLE	KD n(%) MEAN±SD	NO KD n(%) MEAN±SD	p-value
Sex			
Male	47 (51.1)	74 (50)	0.870
Female	45 (48.9)	74 (50)	
Vaso-occlusive crisis/yr	2.1 ± 2.2	2.5 ± 2.5	0.197
Number of transfusion/yr	3.1 ± 2.6	1.9 ± 2.4	< 0.001*
Number of febrile illness/yr	2.7 ± 1.7	2.4 ± 1.7	0.189
Weight (kg)	47.4 ± 8.7	48.1 ± 7.7	0.536
BMI (kg/m^2)	17.8 ± 2.8	18.0 ± 2.4	0.573
SBP (mmHg)	114..0 ± 15.9	117.7 ± 16.5	0.094
DBP (mmHg)	73.6 ± 12.3	68.6 ± 10.6	0.002*

KD (kidney disease), BMI (Body Mass Index), SBP (Systolic Blood Pressure), DBP (Diastolic Blood Pressure). yrs (years), *(Significant p-value of< 0.05)

Correlation between Albuminuria and Clinical and Biochemical Parameters in Patients with Sickle Cell Anaemia

There was a significant positive correlation between albuminuria and serum creatinine (p= <0.006, r= 0.178). There was also a significant negative correlation between albuminuria and PCV (p= <0.001, r = -0.251) as well as between albuminuria and estimated GFR (p= <0.001, r = -0.251).

There was no significant correlation between albuminuria and BMI (p= 0.503, r = -0.043), Systolic blood pressure (p= 0.003, r = -0.207) and Diastolic blood pressure (p = 0.956, r = 0.003). These are shown in table 6 below.

Table 6: Correlation between albuminuria and clinical and biochemical characteristics in patients with SCA.

Parameter	R	p-value
Age (years)	0.085	0.188
Body mass index (kg/m^2)	- 0.085	0.187
Systolic blood pressure (mmHg)	-0.043	0.503
Diastolic blood pressure (mmHg)	0.003	0.956
Packed cell volume (%)	-0.251	<0.001*
Serum creatinine (mg/dl)	0.178	0.006*
Estimated GFR (mls/min/1.73m^2)	-0.251	<0.001*

*(Significant p value of< 0.05)

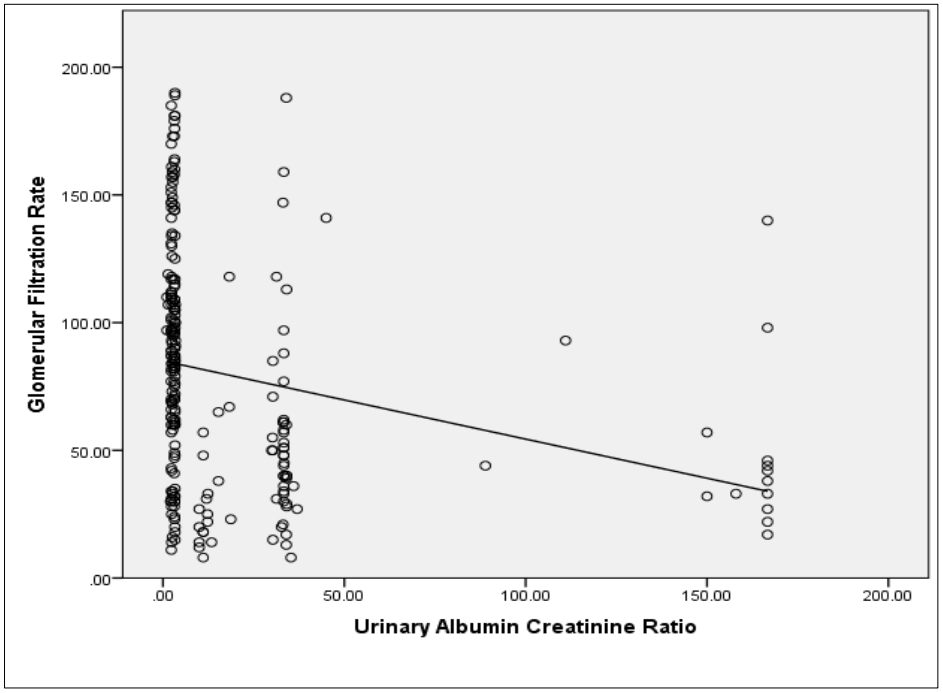

Fig. 2: Scatter plot showing Correlation between estimated GFR and albuminuria. r = - 0.251 p = <0.001

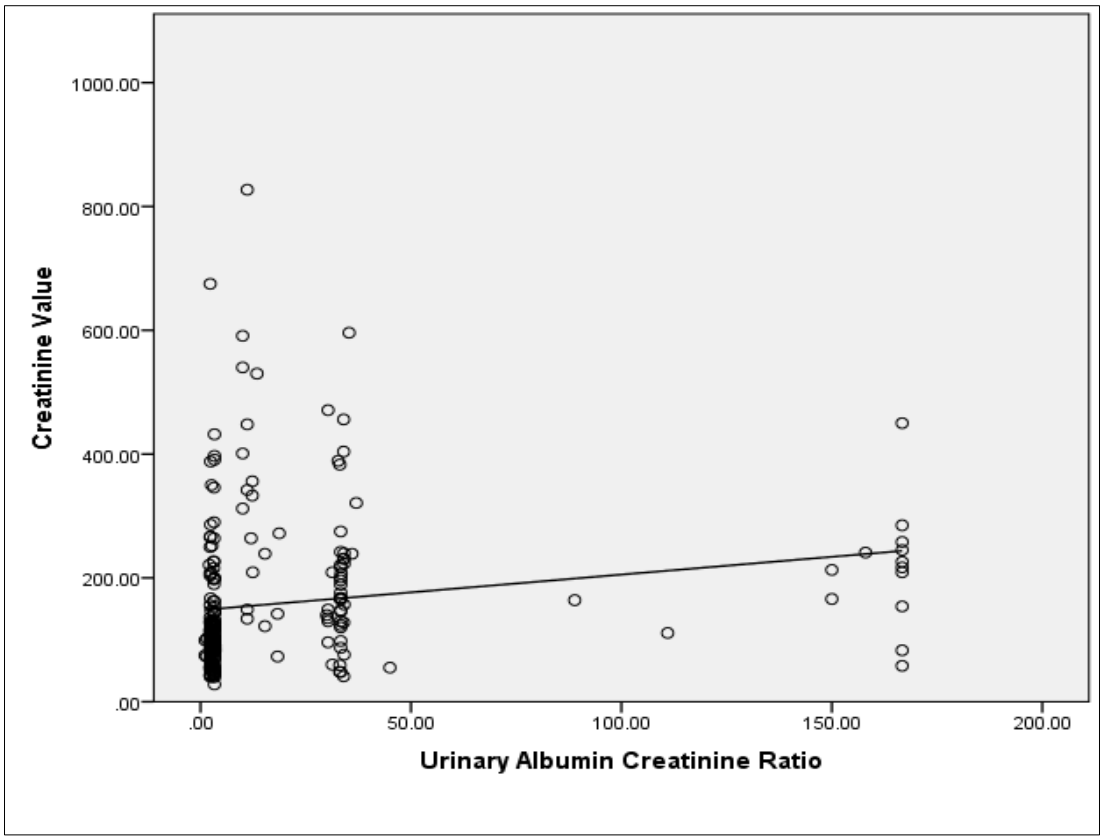

Fig. 3: Scatter plot showing Correlation between serum creatinine and albuminuria r = 0.178 p = 0.006

DISCUSSION

This was a cross-sectional descriptive study carried out at the University of Maiduguri Teaching Hospital, aimed at determining the prevalence and pattern of kidney disease among patients with Sickle cell anaemia. The mean age of the study population was 23.9 years for the SCA group and 24.7 years for the controls, with majority of the participants were in their third decade of life.

The body mass index (BMI), was found in this study to be significantly lower among Hb-SS and patients with kidney disease subgroups when compared with Hb-AA and those without kidney disease respectively. The lower BMI, which is a measure of the adiposity of an individual [18], is due to the chronicity of the disease, repeated crises and perhaps recurrent hospital admissions [19, 20].

Blood pressure in patients with SCA is generally well below those of age and sex-matched controls and there is no association between rising blood pressure and advancing age in SCA patients [21, 22]. The increased release of endothelial relaxing factor (nitric oxide) may be responsible for low blood pressure found among SCA patients [23]. The blood pressure profile found in this study was not significantly different between the two groups.

The prevalence of kidney dysfunction amongst the SCA group was 44.6%. This was significantly higher than the prevalence observed in sex and age-matched controls in this study where only 15% had evidence of kidney dysfunction. In addition, the prevalence of kidney disease seen in SCA patients in this study is higher than the prevalence of CKD in community studies carried out in different parts of the country [24, 25]. The prevalence of kidney disease in patients with SCA observed in this study was higher than 38.9% and 37.2% reported among patients with SCA in northern and southern Nigeria, respectively [10-24]. However, Ephraim *et al.,* [26], reported a prevalence rate of 68.4% among the adult population with SCA which is higher than that observed in the present study. The wide range of prevalence of SCN found in various studies may be due to the differences in methods of assessing eGFR and variations in population characteristics. The higher prevalence of kidney dysfunction among patients with SCA found in this study may be a reflection of the increasing prevalence of kidney disease in the general population.

Glomerular hyperfiltration is a common finding in patients with SCN.[27] This study found a prevalence of hyperfiltration of 17.5% among patients with SCA. This prevalence is lower than 26.8% and 30.6% reported previously by Bolarinwa *et al.,* South West and Bukar *et al*, from North Eastern Nigeria respectively [12, 13], Marouf *et al.*,[28], also reported a higher prevalence of 30.5% (MDRD) and 44.1% (Cockcroft-Gault) among Kuwaiti patients with SCA using different methods of

GFR estimation. The same study also found a lower rate of 10.2 % using calculated cystatin C clearance. The prevalence also differed from previous occurrence rates in reports from other parts of the world [12-30]. This might not be unrelated to the fact that this study focused only on adults with SCA and the different methods used in estimating GFR in the previous studies. The combined prevalence for stages 1 and 2 kidney disease was 44.2% which is lower than 66.7% [12], 53% [13], and 88.8% [31], rates previously observed. However, a lower prevalence of 34% was reported in a previous study in the same region as this study [13]. The prevalence rate for stage 3 renal disease was 25%, which is similar to 23.7% reported by Bukar *et al*., [13]. In contrast, Bolarinwa *et al*., [12], and Yusuf *et al*., [33], reported lower rates of 2.7% and 9.5% respectively, and Aneke *et al*., [32], reported a higher rate of 42% from their study. The study further showed a combined prevalence rate for stage 4 and 5 kidney disease of 13%, corroborating findings by Bukar *et al* of 15.2%, in contrast to previously reported rates of 1.4% and 5% from earlier studies [13-33]. These differences observed may be due to some unidentified factors such as environmental and social factors and different methods used in estimating GFR.

Kidney involvement tends to occur more in subjects who have frequent vaso-occlusive crises [34]. This often is compounded by the fact that patients with SCA commonly take NSAIDs intermittently to relieve of the painful crises which can cause a significant reduction in kidney blood flow and glomerular filtration rate and thus affect the kidney function. There was a positive association between transfusion and severity of albuminuria in this study. The need for recurrent transfusion in SCA may indirectly reflect the severity of the disease. This study, however, did not observe an association of frequent vaso-occlusive crisis and febrile illness with the progression of kidney dysfunction in contrast with previous reports [10-35]. It is possible that a large proportion of patients were diagnosed early and may have received care that reduced their risk of developing these complications.

This study found a positive correlation between albuminuria and serum creatinine on one hand and a negative correlation between albuminuria and GFR on the other. Thus, worsening albuminuria in this study was a pointer to worsening renal function and hence increasing albuminuria in SCA patients can predict progressive renal damage. This finding is in support of previous studies [36, 37].

There was no correlation between albuminuria and BP in this study. This finding is in contrast to reports by Thompson [37], and Guash *et al.,* [38], who found a positive correlation between albuminuria and BP. Similarly, a previous study reported a positive correlation between albuminuria and systolic BP [39]. Although there is an association between albuminuria and high BP in many kidney diseases, patients with SCA with kidney disease may exhibit a different pattern.The mechanism of kidney damage in SCA is multifactorial, therefore, the relationship between albuminuria and BP might not follow the typical patterns seen in other kidney diseases.

Our study is limited by the cross-sectional design with a single creatinine measurement to estimate GFR, this might have inadvertently included patient with acute kidney injury. Use of serum creatinine-based equations in a population of patients who underweight may affect the prevalence of kidney dysfunction.

CONCLUSION

Results from this study suggest that kidney disease is common in patients with SCA, and the prevalence and intensity increase with age. With the improvement in care and longevity of patients with SCA, the high prevalence of kidney disease in SCA is indicative of the fact that patients with SCA may be at risk for the development of progressive kidney insufficiency and later kidney failure. A multi-centre study is needed to further look in to risk factors and progression of kidney disease in patients with SCA. This study will add to existing studies on the burden of CKD, and provide the template for planning a national prevention framework for CKD.

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