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Original Article

Prevalence and Risk Factors of Chronic kidney disease in Maiduguri, northeastern Nigeria: A community-based study

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Abstract

Introduction: Chronic kidney disease is a public health problem of global concern, ranked 11th most common cause of mortality in the world. Its prevalence and risk factors are increasing. However, the disease remained poorly studied in northeastern Nigeria. **Objective:** This study aims to determine the prevalence and risk factors of chronic kidney disease in Maiduguri, northeastern Nigeria. **Methodology:** A total of 1,686 adult inhabitants were randomly selected from 10 wards of Maiduguri. Their socio-demographic and relevant clinical data were collected and entered into a well-structured questionnaire. Blood and urine samples were also collected from each participant. Glomerular filtration rates were estimated using the CKD-EPI equation. Participants who had eGFR < 60ml/minute were considered to have CKD. **Results:** Out of a total of 1,686 study participants, CKD was found in 366 participants (21.7%), out of whom 218(59.6%) were females ($\chi^2 = 17.598$, p= 0.0001). There were 90 (5.4%) study participants in stage IIIB, 79(4.8%) were in stage IV and 45(2.7%) were in stage V. Using multiple logistic regression analysis; risk factors for CKD among our study participants were: (1) Age (r = 0.971, p = 0.0001), (2) Female sex (r = 0.997, p = 0.0001), (3) BMI >25Kg/m^2(r = 1.498, p = 0.0005), (4) Hyperuricaemia (r = 0.997, p = 0.0001), and (5) Systolic hypertension (r = 1.608, p = 0.012). **Conclusion:** Chronic kidney disease is common among residents of Maiduguri, northeastern Nigeria. Further intervention studies are needed to evaluate the impact of controlling the identified risk factors on the prevalence of CKD in Maiduguri.

Keywords: *CKD, Maiduguri, Northeastern Nigeria, Prevalence, Risk factors*

Introduction

Chronic kidney disease is a worldwide public health problem and its impact on communities in less economically developed countries has been increasing.[1] According to the Global Burden of Disease Study 2019, chronic kidney disease is the 11th most common cause of mortality.[2] Chronic kidney disease is defined as functional and/or structural abnormality of the kidney lasting at least 3 months.[3] The increasing burden of chronic kidney disease has been attributed to the rising prevalence of risk factors such as obesity, hypertension, and diabetes mellitus.[4] In some parts of the world a substantial increase in the burden of CKD is found among people who had no known risk factor for CKD.[5]

In a meta-analysis by Kaze *et al*, the prevalence of CKD in Africa is estimated to be 15.8% in the general population and it was higher (32.3%) among patients with CKD risk factors such as diabetes mellitus, hypertension, and HIV.[6] Their study also found geographic variation in the prevalence of chronic kidney disease; from West Africa where the prevalence was estimated to be 19.8% to 6.1% in North Africa. In

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Nigeria, community studies have found a prevalence ranging from 11.4% to 26%.[4,6–10] This wide variation in the prevalence of CKD and its risk factors from one region to the other may be attributable to genetic and environmental differences. In many developed countries, CKD affects elderly people, however, majority of patients affected by CKD in Nigeria are young and middle-aged (20-50 years) who are in their most productive years. [11,12]

Chronic kidney disease is responsible for 41.5 million Disability-Adjusted Life Years (DALYs) worldwide in 2019.[2] Countries in sub-Saharan Africa have the lowest proportion of treated End Stage Kidney Disease (ESKD); Factors such as poverty, lack of awareness, and chronic lack of facilities for renal replacement therapy especially in rural areas have resulted in poor outcomes in CKD patients.[11] Many patients cannot access kidney replacement therapy (KRT) due to non-availability or inability to pay for services. In northeastern Nigeria, the protracted insurgency has made poor literacy rates and poverty levels worse.

Despite the growing body of research on CKD, there is a noticeable paucity of data specific to the northeastern region of Nigeria. Understanding the specific factors influencing CKD in northeastern Nigeria not only addresses a critical gap in current knowledge but also provides essential insights for tailoring preventive and management strategies in this region. This study aims to fill in this gap by providing a comprehensive assessment of CKD prevalence and associated risk factors in Maiduguri, northeastern Nigeria.

Materials and methods

Study Population

The study is a cross-sectional study conducted in Maiduguri the capital of Borno State in Northeastern Nigeria. A total of 1, 686 residents were included in the study. Study participants were selected from each of the 10 wards included in the study.

Study Protocol

Study participants' recruiment was carried out by trained research assistants under the supervison of the authors. Each consenting participant is dministered a well-structured questionnaire obtaining information on their socio-demographic characteristics such as age, sex, marital status, education, place of birth, duration of stay in area of residence, weight, and BMI. Blood pressures were measured from each study participant according to protocol. Hypertension is defined as blood pressure >140/90mmHg. Blood samples were also collected from each participant and measurements of creatinine, urea, uric acid, sodium, potassium, and random blood glucose were obtained. Urinary protein was evaluated using a dipstick, and the results were recorded as negative, 1+, 2+, or 3+. Glomerular filtration rates (eGFR) were estimated using the CKD epidemiology collaboration equation (CKD-EPI). Participants who had eGFR <60ml/minute were considered to have Chronic kidney disease. Participants were also categorized according to KDIGO CKD Classification: Stage I GFR>90ml/minute; Stage II GFR 60 - 89ml/minute; Stage IIIa GFR 45 - 59ml/minute; Stage IIIb GFR 30 - 44ml/minute; Stage IV GFR 15 - 29ml/minute; Stage V GFR <15ml/minute.

Statistical Analysis

Data were collected and entered into SPSS version 23 and analysed. Categorical variables were summarized as percentages whereas continuous variables were expressed as mean ±SD. Pearson Chi-squared (χ^2) test was used to determine the association between categorical variables whereas the Student t-test was used to determine the association between continuous variables. Multiple regression analysis was used to determine risk factors associated with the development of CKD. A p-value <0.05 was considered a significant association at a 95% confidence interval.

Ethical Considerations

Ethical approval was obtained from the Borno State Ministry of Health with approval number SHREC 112/2022. In addition, each study participant gave consent for the study by appending their signatures/thumbprint on the consent form.

Results

Socio-demographic characteristics of the study participants

A total of 1,686 adult (≥18 years) residents of Maiduguri were randomly selected for the study from 10 wards. There were 844 males and 842 females. Their ages ranged from 18 to 105 years with a mean age of 37.63±14.93 years and a mean eGFR of 85.72±33.23ml/minute/1.73m^2.

Table 1 Characteristics of the study participants.

Variables	Mean±SD	Median(IQR)	Observations
Age(Years)	37.63±14.93	87(18,105)	1,686
Sex Female	842(50.2%)		1,686
Male	844(49.8%)		
Duration of domicile(years)	22.28±14.62	81(1,82)	1,439
Weight(Kg)	60.97±17.02	106(35,141)	1,549
BMI(Kg/m^2)	22.66±6.01	35(15.0,50.7)	1,556
Systolic Blood pressure(mmHg)	129.04±24.37	140(70,230)	1529
Diastolic blood pressure(mmHg)	81.17±15.35	130(40,170)	1529
Packed cell volume	0.39±0.07	0.43(0.16,0.59)	1450
Random blood glucose(mg/dl)	102.29±27.69	431(70,501)	1394
Creatinine(µmol/l)	109.87±102.56	2,178(26,2204)	1686
eGFR	85.73±33.23	162(2,164)	1686
Urea(mmol/l)	4.91±2.57	23.3(1.9,25.2)	1686
Sodium(mmol/l)	139.03±3.57	35(122,157)	1641
Potassium(mmol/l)	5.53±3.24	3.1(2.7,5.8)	1686
Uric acid(mmol/l)	336.18±124.41	895(137,1032)	1686

eGFR=estimated Glomerular filtration rate, BMI= Body mass index

Prevalence of chronic kidney disease among study participants

366 study participants had eGFR <60ml/minute and 1,220 study participants had GFR >60ml/minute giving a prevalence of 21.7% as shown in figure 1.

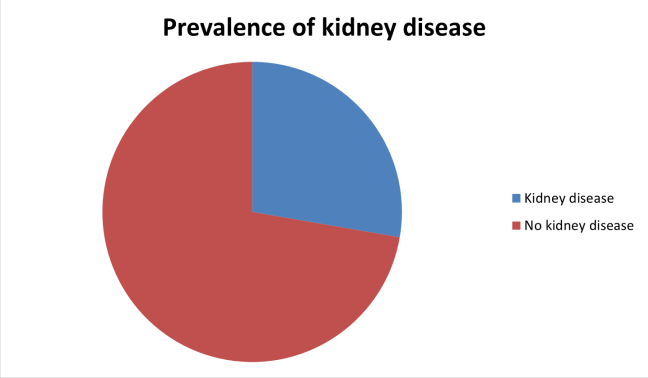

Figure 1: Prevalence of kidney disease among study participants

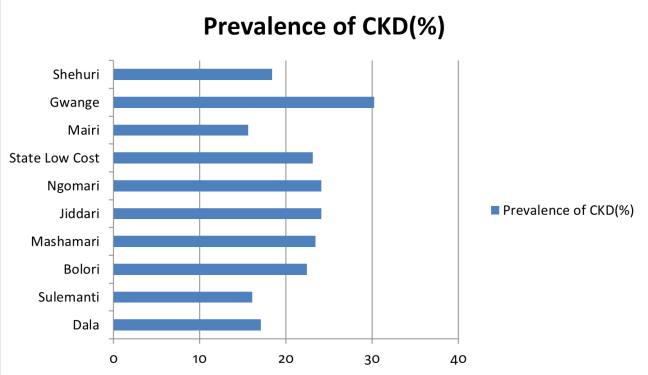

Figure 2: Prevalence of Chronic kidney disease across ten (10) communities in Maiduguri

Out of the 10 wards included in the study, Gwange ward (30.5%) has the highest prevalence of CKD. The distribution of CKD prevalence according to the communities studied is shown in Figure 2.

Comparison of Chronic kidney disease risk factors between study participants with CKD and those without.

The prevalence of CKD was higher among females (59.6% vs 40.4%; p<0.0001). Table 2 compares the characteristics of study participants with CKD and those without.

Comparison of clinical and laboratory features between study participants with and without CKD

Study participants who developed chronic kidney disease had a mean duration of stay in their area of domicile of 25.11±23.77 years compared with those without CKD 21.26±14.58 years (p=0.003). Table 3 compares the characteristics of the study participants with and without CKD.

Table 2: Prevalence of chronic kidney disease risk factors among study participants with and without kidney disease in Maiduguri

Variable		Kidney disease N=366(21.7%)	No Kidney disease N=1,220(78.3%)	
Age (Years)		42.98±16.01	36.13±16.13	p=0.001*
Sex	M	148(40.4)	696(52.7)	χ^2=17.598
	F	218(59.6)	624(47.3)	p=0.000*
Hypertension	Yes	103(28.0)	224(18.3)	χ^2 =27.999
	No	233(72.0)	997(81.7)	p=0.000*
Diabetes Mellitus	Yes	21 (5.7)	33(2.7)	χ^2 =13.961
	No	314(84.3)	1187(97.3)	p=0.007*
Use of NSAIDs	Yes	172(51.2)	564(46.2)	χ^2 =6.240
	No	164(48.8)	656(53.8)	p=0.101
Herbal drug use	Yes	129(38.6)	447(36.8)	χ^2 =4.421
	No	205(61.4)	769(63.2)	p=0.352
Family history of kidney disease	Yes	52(15.6)	188(15.4)	χ^2 =4.076
	No	282(84.4)	1029(84.6)	p=0.396
Use bleaching cosmetics	Yes	20(6.2)	61(5.0)	χ^2=0.586
	No	315(93.8)	1155(95.0)	p=0.746
History of PIH	Yes	32(14.8)	127(20.7)	χ^2=1.168
	No	184(85.2)	486(79.3)	p=0.883

NSAIDS=Non-steroidal anti-inflammatory drugs, PIH=Pregnancy-induced hypertension

Table 3: Comparison of clinical and laboratory characteristics between study participants with and without kidney disease

Variables	Kidney disease	No kidney disease	p
Age	42.69±16.15	35.69±14.38 *	0.001
Duration of stay(years)	25.11±23.77	21.26±14.58	0.003*
Weight (Kg)	61.62±14.61	60.79±15.07	0.317
BMI (Kg/M^2)	23.53±5.86	22.42±6.03	0.003*
Systolic blood pressure (mmHg)	133.31±27.56	127.84±23.28	0.000*
Diastolic blood pressure (mmHg)	83.42±16.00	80.54±15.11	0.002*
PCV	0.466±0.125	0.425±0112	0.582
RBG (mg/dl)	98.02±33.25	97.65±30.92	0.974
Sodium (mmol/L)	137.40±12.80	143.30±16.80	0.505
Potassium (mmol/L)	6.03±1.42	5.39±1.17	0.462
Urea (mmol/L)	8.39±9.62	4.99±8.14	0.000*
Creatinine (µmol/L)	219.78±176.42	79.00±20.63	0.000*
Uric acid (mmol/L)	374.33±167.56	325.48±106.97	0.000*
eGFR (ml/minute)	37.33±16.13	99.29±22.36	0.000*

BMI= Body Mass Index, PCV= Packed Cells Volume, eGFR= Estimated Glomerular Filtration Rate

Distribution of study participants according to KDIGO CKD Classification.

There were 833(50.4%) study participants with GFR >90ml/minute, 458(27.7%) were in GFR stage II, 148(9.0%) were in stage IIIA, 90(5.4%) in stage IIIB, 79(4.8%) were in stage IV and 45(2.7%) were in stage V. Figure 3 shows the distribution of study participants according to GFR:

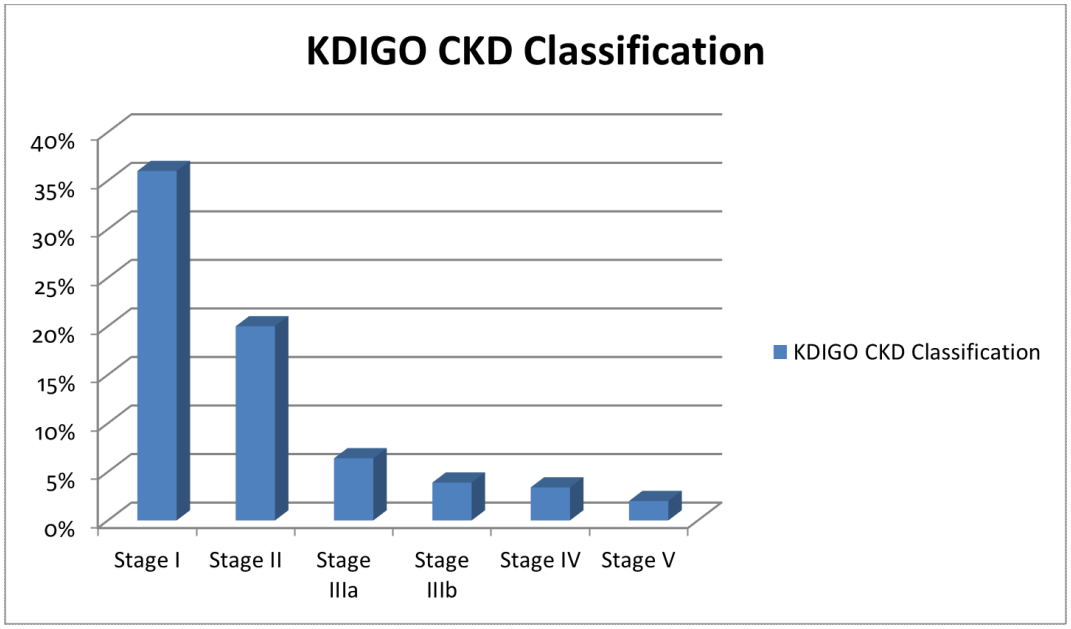

Figure 3: Distribution of study participants according to GFR stages

Distribution of the study population with and without CKD according to occupation.

Traders are the most common occupation group among the study participants. The distribution of their occupations is shown in Table 5

Table 4: Distribution of occupation among study participants with and without CKD

Occupation	CKD n= 362	No CKD n= 1,292	
Trader	85(23.5%)	281(21.7%)	
Housewife	67(18.5%)	189(14.6%)	$X^2 = 37.573$
Student	29(8.0%)	138(10.7%)	P = 0.002
Manual labourer	35(9.7%)	121(9.4%)	
Tailor	28(7.7%)	125(9.7%)	
Civil servant	25(6.9%)	128(9.9%)	
Unemployed	13(3.6%)	76(5.9%)	
Farmer	10(2.8%)	49(3.8%)	
Retired	10(2.8%)	20(1.6%)	
Driver	8(2.2%)	43(3.3%)	
Security	5(1.4%)	16(1.2%)	
Mechanic	2(0.6%)	9(0.7%)	
Teacher	2(0.6%)	23(1.8%)	
Fishing	1(0.3%)	3(0.2%)	
Footballer	0(0%)	2(0.2%)	
Butcher	0(0%)	1(0.08%)	

Multiple Regression Analysis of Chronic kidney disease Risk factors
Using multiple logistic regression analysis the following were found to be risk factors for development of CKD among the study participants: (1) Age (r = 0.971, p = 0.0001), (2) Female sex (r = 0.997, p = 0.0001), (3) BMI (r = 1.498, p = 0.0005), (4) Hyperuricaemia (r = 0.997, p = 0.0001), and (5) Systolic hypertension (r = 1.608, p = 0.012).

Table 5: Multiple Regression Analysis

Variable	B	Wald	df	p	Exp(B)	95% CI for EXP(B)	
						Upper	Lower
BMI	.404	7.781	1	0.005*	1.498	1.128	1.990
Sex	-.495	13.269	1	0.000*	0.997	0.467	0.796
Diastolic Hypertension	-.291	2.367	1	0.124	0.748	0.516	1.083
Systolic Hypertension	.475	6.337	1	0.012*	1.608	1.111	2.328
Diabetes Mellitus	-.144	.042	1	0.838	0.866	0.219	3.431
Hyperuricemia	-.003	36.233	1	0.000*	0.997	0.996	0.998
Age	-.029	56.624	1	0.000*	0.971	0.964	0.979
Duration of stay	-0.11	6.334	1	0.012	0.989	0.981	0.998

Discussion

Chronic kidney disease has become a leading cause of morbidity and mortality.[2] Its impact has been devastating to lives and livelihoods in developing countries due to poor infrastructure and lack of data about chronic kidney disease. This community-based study was conducted in northeastern Nigeria to evaluate the prevalence and risk factors of chronic kidney disease among residents of Maiduguri, the capital city of Borno state.

The mean age of the study participants, 37.63±14.93 years, is similar to studies conducted by Chiroma *et al*, Emem-Chioma *et al*, and Wachuku *et al*.[12] This finding is in contrast to mean ages from studies in China and other developed countries where study participants are older.[21-23]

Prevalence of CKD

The prevalence of CKD found in this study (21.7%) is higher than reported by Okwuonu *et al*[15] in Umuahia south-east Nigeria (7.8%), and Wachukwu *et al*[17] in Port-Harcourt, south-south Nigeria (12.2%). Ibitoba *et al*[8] in Ado-Ekiti southwest Nigeria (22.3%) found the prevalence of CKD to be similar to that of our study. However, Nalado *et al*[16] in Kano northwest Nigeria (26%), and Afolabi *et al*[18] in southwest Nigeria (31%) found a prevalence higher than what was found in this study. This high prevalence of CKD in Maiduguri may be due to the rising trend of non-communicable diseases such as hypertension, diabetes mellitus, and obesity. The influence of HIV infection, Hepatitis B and C infections may also play a role in the high prevalence of CKD found in our study. There may be a preponderance of yet-to-be-identified risk factors of CKD in the community contributing to the burden of CKD. The impact of genetic factors such as APOL1 risk alleles has not been evaluated in our environment. Among the 10 wards studied; Gwange ward which is inhabited by people of low socio-economic status has the highest prevalence of CKD (30%). Poverty and poor environmental sanitation are well-established risk factors of CKD.[19,24]

Comparison of study participants with and without CKD

In this study, CKD is significantly more commoner among females similar to findings from studies by Nalado *et al*[16] in Kano, Nigeria, and Olanrewaju *et al*[6] in a north-central study. However, Poudyal *et al*[17] in Nepal found a higher prevalence of CKD in males. Okwuonu *et al*[19] also found similar prevalence rates of CKD amongst males and females in a semi-urban community in south-east Nigeria. This study recruited about equal numbers of males and females in contrast with most other studies where more women were recruited. Our finding may be accounted for by the higher prevalence of CKD risk factors among females in many African communities.

Risk factors for CKD

Identified risk factors for CKD in the index study are age, female sex, hypertension, and diabetes mellitus. The mean age of the study participants with CKD is higher than those who did not have CKD. Several studies have identified advancing age, hypertension, diabetes mellitus, and obesity as risk factors for CKD.[15,20,24,25] The association of female sex and CKD may have resulted from pregnancy-induced hypertension (PIH) among our study participants. Autoimmune conditions are also common among women in general, although this study has not looked at their prevalence among our study participants, they may contribute to the burden of CKD in this study.

Our study has much strength. To our knowledge, this is the first population-based study in the Northeastern region of Nigeria. The study also used the CKD-EPI equation which has been validated as an epidemiological tool for GFR estimation. The study also controlled for sex and age to determine the effect of these factors on the development of CKD. This study, however, has some limitations. The cross-sectional design where participants' kidney functions were estimated using a single serum creatinine measurement. Therefore, the

prevalence may have been overestimated due to the non-exclusion of participants with transient elevation of serum creatinine.

Conclusion

This community-based study has demonstrated that kidney dysfunction is prevalent in north-eastern Nigeria. It is more common in women due to a preponderance of CKD risk factors such as hypertension, diabetes mellitus, pregnancy-induced hypertension, and obesity. Identified risk factors for CKD among our study participants included age, female sex, hypertension, and diabetes mellitus. Our findings should provide the basis for preventive measures for CKD in the north-eastern region.

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