Prevalence and risk factors of diabetic kidney disease in north eastern Nigeria

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Abstract

Diabetic Kidney Disease (DKD) is a leading cause of chronic kidney disease and end stage renal disease. In northeastern Nigeria the epidemiology and risk factors have not been fully studied. This study aimed at evaluating the prevalence and risk factors of DKD in Maiduguri, north eastern Nigeria. The study population consisted of adult diabetic patients recruited consecutively at the diabetic clinic of University of Maiduguri Teaching Hospital Maiduguri. Socio-demographic variables including age, sex, weight, BMI, as well as laboratory parameters, were obtained from each patient. Glomerular filtration rate was derived from CKD-EPI formula using serum creatinine. Two hundred and sixty-one diabetic patients were recruited. The prevalence of DKD among them was 42.9%. Classification based on eGFRshowed that 35(13.4%) patients had hyperfiltration; 48 (18.4%) stage I; 66 (25.3%) stage II; 68 (26.1%) stage III; 36 (13.8%) stage IV; 8 (3.1%) stage V. One hundred and seventeen (44.8%) had proteinuria. Low eGFR <60ml/1.73M^2 was associated with age >50 years (r=1.039, p=0.011); male sex (r=-0.899, p=0.008); hyperuricaemia (r=1.010, p=0.000); low PCV (r=1.276, p=0.000); HbA1C (r=1.127, p=0.030); proteinuria (r=2.011, p=0.004).This study has shown that chronic kidney disease is common among diabetic patients in northeastern Nigeria. Age, male sex, hyperuricaemia, low PCV, high HbA1C levels and proteinuria were found to be associated with development of DKD.

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Introduction

Diabetes Mellitus (DM) is a metabolic disorder of chronic hyperglycemia characterized by disturbances of carbohydrate, protein, and fat metabolism resulting from absolute or relative insulin deficiency.[1] According to the International Diabetes Federation (IDF), 463 million people worldwide are suffering from DM and it is projected to rise to 700 million by the year of 2045.[2] In Nigeria, the prevalence of DM is estimated to be 5.77%,[3] and with a population of 200 million people; 1 out of 17 adults are diabetic. Many patients succumb to long term complications of uncontrolled DM such as cardiovascular disease and chronic kidney disease.

Diabetic Kidney Disease (DKD) is the leading cause of Chronic Kidney Disease (CKD) and End-Stage Renal Disease (ESRD) worldwide, and it is defined by urinary albumin excretion greater than 300mg in a 24 hour urine collection, or urinary albumin-creatinine ratio of ≥ 30mg/g in a random spot collection, or by abnormal renal function manifesting as increased serum creatinine above normal, or an eGFR≤ 60mL/min/1.73m^2.[4,5]

DKD occurs in 20-40 % of patients with diabetes globally.[4,6-8] According to the US renal data system 2019, 29.1% of CKD patients had DM.[9] Wagnew *et al.* had estimated that the prevalence of DKD in sub-Saharan Africa is 41.1%[10] with some variation from one region to the other. Despite the similar prevalence of DKD between developed and sub Saharan African countries, hypertension and Chronic Glomerulonephritis (CGN) contribute more to the burden of ESRD than DKD in sub Saharan Africa.[11,12] The reason for this disparity is not well known, however it is thought that the African population is in demographic transition with DKD projected to assume greater significance in the future.

Factors that have been shown to be associated with DKD are late diagnosis, scarcity of screening and diagnostic resources, poor control of blood glucose and associated metabolic disorders as well as inappropriate treatment.[13-15]

In northeastern Nigeria where there is endemic poverty, poor health facilities and lack of education, the prevalence of DKD and factors that contribute to its development have not been studied. It is, therefore, imperative to study the prevalence and various factors that may play a role in the development of renal disease among diabetic patients in this part of the world. The findings of this study will establish the burden of DKD and provide baseline data upon which trends in the epidemiology of DKD can be studied. This study is aimed at defining the prevalence of DKD in a tertiary hospital in northeastern Nigeria as well as to determine the factors that are associated with its development.

Materials and Methods

This was a cross sectional prospective hospital-based study conducted at the Diabetes clinic of the University of Maiduguri Teaching Hospital, Maiduguri, north eastern Nigeria. The clinic serves as a regional referral centre in the north eastern region of Nigeria comprising of six states and occasionally receives patients from neighboring countries of Niger, Chad and Cameroon. The region has a projected population of 23.5 million people (13.5% of Nigeria's population). Two hundred and sixty-one consecutive consenting adult patients attending the outpatient clinic were recruited for the study from January 2019 to December 2019. Their socio-demographic characteristics, duration of diabetes, type of diabetes and biochemical parameters were obtained and recorded in a well structured questionnaire. Demographic parameters such as weight, height and waist circumference were measured for each patient. Blood pressure was measured on the right arm in the sitting position and the average of two readings was recorded. Blood specimen was collected after an 8 hour fasting for assay of electrolytes, urea, creatinine, serum lipids, glucose, glycated haemoglobin and uric acid. Early morning urine specimen was collected and immediately analysed using Medi-Test combi-9® (Macherey-Nagel, Germany) strip for protein, glucose and ketones. Urine samples were analysed within 30 minutes of collection with the test strips immersed into the urine for 1 second and read against the color codes on the container after 30 to 60 seconds. Serum creatinine was analysed with Roche Cobas C311® clinical chemistry analyzer using photometric system at wave length of 505. Glomerular filtration rates (eGFR) were calculated for each patient using the chronic kidney disease epidemiology collaboration formula with correction for black ethnicity (CKD-EPI equation). Patients who had eGFR ≤ 60mL/minute/1.73M^2 were considered to have chronic kidney disease (CKD). Patients were also grouped based on the KDIGO GFR staging. G1: GFR >90 mL/min/1.73 m^2; G2: GFR 60–89 mL/min/1.73 m^2; G3a: GFR 45–59 mL/min/1.73 m^2; G3b: GFR30-44, G4: GFR 15–29 mL/min/1.73 m^2, G5: GFR <15 mL/ min/1.73 m^2. Albuminuria level A1: <30mg/g, A2: 30-300mg/g, A3: >300mg/g. Patients who have GFR <60mL/min/1.73m^2 and/or albuminuria >30mg/g are considered to have chronic kidney disease. Hyperfiltration is defined as GFR >120mL/min/1.73m^2 and albuminuria <30mg/g in females and >130mL/min/1.73m^2 and albuminuria <30mg/g in males.

Statistical Analysis

Data collected were entered in a computer and analyzed using Statistical Package for Social Sciences (SPSS Chicago Il) version 21. Continuous variables were expressed as mean (±SD) and association between them is determined using student t test. Discrete variables were expressed as percentages and proportions and their association was determined using Chi squared test. Values <0.05 are considered significant. Results are presented as tables and charts where appropriate. Analysis for risk factors was done using binary logistic regression.

Results

Characteristics of the study population

Out of a total of 261 patients recruited into the study, there were 94 (36%) males and 167 (64%) females with a mean age of 49.60±11.49 years. Two hundred and forty-nine (95.4%) patients had Type 2 Diabetes with a mean duration of 7.00±6.45 years. Characteristics of the study population are shown in Table 1.

Table 1. Demographic and clinical characteristics of the study population.

Variables	All patients, n=261 (%)	Missing data, n (%)
Demographics		
Age mean±SD (years)	49.60±11.49	0 (0)
Sex	F 167 (64) M 94 (36)	0 (0) 0 (0)
Occupation		
Housewife	94 (36)	
Civil servant	88 (33.7)	
Trader	29 (11.1)	
Retired	24 (9.2)	
Student	9 (3.4)	
Farmer	7 (2.7)	
Uniformed personnel	6 (2.3)	
Clergy	4 (1.5)	
Anthropometrics		
Weight (Kg)	76.97±16.34	0 (0)
Waist Circumference (cm)		0 (0)
Male	93.21±16.76	0 (0)
Female	91.99±16.54	0 (0)
BMI (Kg/M^2)	27.75±5.88	
Diagnosis		
Type 1 DM	12 (4.6)	
Type 2 DM	249 (95.4)	
Laboratory Parameters		
FBG (mmol/L)	10.54±5.59	0 (0)
2HPP (mmol/L)	14.89±7.44	0 (0)
HbA1C (%)	9.67±6.16	0 (0)
Creatinine (µmol/l)	141.14±102.36	0 (0)
Urea (mmol/l)	7.93±7.57	0 (0)
eGFR	69.95±37.57	0 (0)
PCV	33.61±4.82	0 (0)

Prevalence of diabetic kidney disease

Out of the study population, 112 (42.9%) patients had kidney disease with eGFR <60mL/minute /1.73m^2 estimated using the Chronic kidney disease epidemiology collaboration equation (CKD-EPI). Patients who developed kidney disease were older with mean age 52.41±10.49 years (p=0.001). They also had higher systolic blood pressures and longer duration of DM (8.22±6.71, p=0.008). Out of 112 patients with kidney disease, 110(98.2%) patients had type 2 DM where as 2(1.8%) patients had type 1 DM. There was a higher prevalence of kidney disease among Type 2 dibetic patients than type 1diabetes (44.2% vs 16.6% χ^2=3.54, p=0.60). Other features are as in Table 2.

Stages of glomerular filtration rate (GFR) among the study population

Thirty-five (13.4%) patients had hyperfiltration with eGFR >120 mL/minute. Table 3 shows the distribution of the study population according to GFR.

Proteinuria

One hundred and seventeen (44.8%) patients had proteinuria on dipstick urine measurement with majority having 1+ proteinuria. Figure 1 shows the distribution of proteinuria according to GFRstage.

Risk factors for kidney disease

Evaluating for risk factors using binary logistic regression; age >50 years, male sex, hyperuricaemia >420mmol/L, proteinuria and low PCV <30%, were associated with development of kidney disease as shown in Table 4.

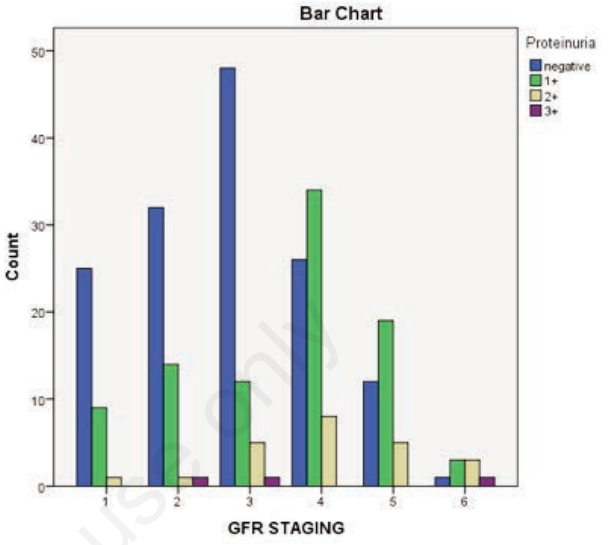

Figure 1. Distribution of proteinuria according GFR stage.

Table 2. Comparing demographic and laboratory characteristics of patients with and without kidney disease.

Variables	Diabetic with kidney disease, n=112 (%)	Diabetic without kidney disease, n=149 (%)	P value
Socio-demographics			
Age(years±SD)	52.41±10.49	47.49±11.79	0.001
Sex Male Female	 29 (25.9) 83 (74.1)	 65 (43.6) 84 (56.4)	χ^2=8.723, p=0.003
Weight (Kg)	77.11±13.13	76.86±17.97	0.903
BMI(Kg/M^2)	28.17±5.53	27.43±6.13	0.321
Systolic blood pressure (mmHg)	133.87±19.57	128.95±18.28	0.038
Diastolic blood pressure (mmHg)	80.72±11.63	80.63±11.68	0.950
Duration of diabetes (years)	8.22±6.71	6.09±6.12	0.008
Diabetes type			
Type 1	2 (16.6)	10 (83.4)	χ^2= 3.54, p= 0.060
Type 2	110 (44.2)	139 (55.8)	
Laboratory			
PCV (%)	30.81±4.73	35.70±3.71	0.000
FBG (mmol/L)	10.77±5.76	10.36±5.48	0.564
HbA1C (%)	10.47±8.76	9.07±2.89	0.071
Creatinine (µmol/L)	214.87±118.47	85.72±25.99	0.000
Urea (mmol/L)	11.06±6.19	5.57±7.67	0.000
Uric acid (mmol/L)	498.57±141.41	331.74±122.56	0.000
Total cholesterol (mmol/L)	4.93±1.25	5.03±2.98	0.734
HDL (mmol/L)	1.16±0.49	1.15±0.40	0.880
LDL (mmol/L)	3.11±1.09	3.03±1.00	0.523
Triglyceride (mmol/L)	2.04±0.99	1.67±0.99	0.003

Table 3. GFR staging of the study population.

GFR Stage	Frequency	%
Hyperfitration (>120mL/min)	35	13.4
I (90-120mL/min)	48	18.4
II (60-89mL/min)	66	25.3
III (30-59mL/min)	68	26.1
IV (15-29mL/min)	36	13.8
V (<15mL/min)	8	3.1

Table 4. Risk factors for kidney disease among diabetic patients.

Variables	Exponent B	Df	P value	95% CI for Exponent B
Age	1.039	1	0.011	1.009-1.072
Male Sex	-0.899	1	0.008	0.209-1.297
HbA1C	1.127	1	0.030	1.012-1.330
Uric acid	1.010	1	0.000	1.006-1.031
Proteinuria	2.011	1	0.004	1.614-2.753
PCV	1.276	1	0.000	0.689-1.835

Discussion

This study is the first in northeastern Nigeria that studied the prevalence and risk factors of DKD. We found that DKD is common among diabetic patients with a prevalence of 42.9% (95% CI=36.1-47.6).

Factors associated with DKD are older age, systolic blood pressure greater than 140mmHg, duration of diabetes greater than 8 years, hypertriglyceridemia, and hyperuricaemia > 420mmol/L.

The findings in our study is similar to a prevalence of 41.08% found by Alebiosu *et al.*,[16] who defined kidney disease by the presence of microalbuminuria. Ajayi *et al.*[17] defined CKD as eGFR ≤60mL/1.73m^2 found a prevalence of 38.54%. DKD is the leading cause of ESRD in developed countries of Europe and America. However, in Nigeria several studies have shown that the prevalence of DM among ESRD patients ranged from 3.7 to 13.1%.[18,19] It is yet to be determined why the contribution of DM to ESRD population in Nigeria is low compared to that of developed countries. With the changing trend in the epidemiology of ESRD, it is possible that DM will play an important role in ESRD in northeastern Nigeria.

Majority of our patient cohort had type 2 diabetes and 5% had type 1 diabetes. This finding is consistent with the studies by Duan *et al.*[20] The type of diabetes did not confer added risk for development of DKD in our study(p=0.060).

A female preponderance was found in our study population due to better health seeking behavior among females and preponderance of risk factors among them. However, our study showed that male sex is associated with development of DKD (OR 0.899, p=0.008, 95% CI 0.209-1.297).

Duration of diabetes greater than 8 years is associated with DKD in our study. This finding is consistent with studies by Duan *et al.*[20] DKD being a long term microvascular complication of diabetes, result from gradual accumulation of lipids and glycosylated proteins in blood vessels takes time to develop. It is therefore reasonable to conclude that prolong duration of diabetes will be a factor in its development.

Low PCV ≤30% is associated with development of DKD. Studies have shown that anaemia is associated with renal disease progression. This is probably due to erythropoietin deficiency. Early erythropoietin replacement may be useful in retarding this relentless progress to ESRD.

Hyperuricaemia has been found to be associated with the development of DKD and the impact of urate lowering drugs such as Allopurinol on renal disease progression are inconclusive.[21,22]

Our study showed a high prevalence of DKD in northeastern Nigeria, which is in keeping with the trend in most parts of the Nigeria. This is relevant in quantifying the burden and risk factors of DKD among our patient population. Early identification and prompt modification of the risk factors will reduce the burden of ESRD in northeastern Nigeria. Further studies will be needed to measure the impact of these interventions.

This study is limited by the cross sectional design, which lacks the ability to determine chronicity in CKD and being hospital based may be subject to selection bias. Dip stick urinalysis was also used to determine proteinuria due to non availability of ACR in our setting.

Conclusions

The results of our study demonstrated that the prevalence of DKD among diabetic patients in northeastern Nigeria is high. And there are modifiable risk factors associated with its development. The impact of DKD in the coming years will add to existing social and economic burden on our population. Early identification and mitigation of risk factors are urgently needed.

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