Original Article

Prevalence of Chronic Kidney Disease and Its Risk Factors among Adults in a Semi-urban Community of South-East Nigeria

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Abstract

Background: Chronic kidney disease (CKD) is an increasingly prevalent problem worldwide. Treatment of end-stage kidney disease is beyond the reach of an average Nigerian. The prevention and early detection are imperative to reducing its burden. **Aim:** The aim of this study was to determine the prevalence of CKD and some of its risk factors among adults in a representative semi-urban Nigerian population. **Subjects and Methods:** A cross-sectional study involving 400 randomly selected adults. Participants were assessed using the WHO stepwise approach. Urinary protein-creatinine ratio (PCR) and estimated glomerular filtration rate (GFR) from serum creatinine, among other parameters, were analysed. A PCR ≥200 mg/g was regarded as significant proteinuria while GFR <60 ml/min/1.73 m^2 was regarded as reduced GFR. Participants with abnormal PCR and/or reduced GFR were re-evaluated after 3 months to document persistence of these abnormalities. CKD was defined as persistent significant proteinuria and/or reduced GFR for more than 3 months. **Results:** Data were complete for 328 participants. Persistent significant proteinuria was found in 5.8% while persistently reduced GFR was obtained in 4.6% of participants. Overall, the prevalence of CKD was 7.8%. The prevalence of some established CKD risk factors was old age, 36.3%; hypertension, 36.9%; diabetes mellitus, 7.9%; and family history of kidney disease, 6.4%. The predictors of CKD included old age (adjusted odds ratio = 3.2; confidence interval: 1.10–8.92; P = 0.02), hypertension: 3.5 (1.93–11.90; P = 0.001), family history of kidney disease; 4.5 (3.91–10.23; P = 0.01), generalised obesity 1.3 (1.20–6.21; P = 0.001) and central obesity 3.8 (1.13–12.68; P = 0.003). **Conclusion:** The prevalence of CKD and some of its risk factors were high. Effective control of the modifiable risk factors identified will assist in reducing the burden of CKD.

Keywords: Chronic kidney disease, diabetes mellitus, glomerular filtration rate, hypertension, proteinuria

Introduction

Chronic kidney disease (CKD) is defined as kidney damage or glomerular filtration rate (GFR) <60 ml/min/1.73 m^2 for more than 3 months with implications for health.[1] The incidence and prevalence of CKD have increased in the recent years in developed and developing nations and are consuming a huge proportion of health-care finances in developed countries while contributing significantly to morbidity, mortality and decreased life expectancy, particularly in developing countries.[2-5]

There is a paucity of data on CKD from West Africa subregion. In Nigeria, lack of a national registry network and a coordinated national programme on kidney disease have restricted efforts toward the effective planning and control of renal diseases. In addition, it has also affected equitable allocation of resources. Studies aimed at quantifying the magnitude of CKD and determining the risk factors have been conducted in different parts of Nigeria with varying results. Some of these studies were hospital-based, and the definition of chronicity of the disease was based on the duration of suggestive symptoms and radiological evidence of chronic disease process thus assessing advanced stages of CKD in most instances.[6-8] Among the studies that were community-based, most of the studies did not repeat the laboratory investigations after 3 months to confirm CKD based on the generally accepted definition.[9-13] The objective of this study was to determine the prevalence

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of CKD in a semi-urban community in Umuahia, Southeast Nigeria using a marker of kidney damage (proteinuria) and estimated GFR. In addition, the prevalence of some established risk factors for CKD and the predictors of CKD in the community were assessed. This study provides additional data for effective health planning and control of the disease in Nigerian population.

Subjects and Methods

Study design and area

This was a cross-sectional study conducted in Olokoro, a semi-urban community in Umuahia South Local Government Area of Abia State Nigeria.

Study population

Adults who were 18 years or older constituted the study population. A previous community-based study by Okoye *et al*. obtained a CKD prevalence of 27.2%.[12] The sample size for this study was extrapolated from that value with 95% confidence and 5% error margin using the appropriate formula for study population > 10,000[14] giving us 304 participants. This number was increased to 400 to make allowance for 10% possible non-responders and increase the scope of the study. Adults who were <18 years and those who did not give informed consent were excluded from the study. Furthermore, those with clinical suspicion of urinary tract infection, females who were pregnant or menstruating at the time of the study and non-permanent residents were excluded from the study.

Sampling method

A multistage systematic sampling technique was used. According to the National Population Commission (NPC) of Nigeria census of 2006, the estimated population of Olokoro community, projected to 2014, was 52,712.[15] There are 212 enumeration areas (EAs) in Olokoro, and these served as sampling units for the purpose of this study. Fifty-three EAs (representing 25% of the total EAs) were selected randomly by balloting. The population of adults from 18 years and above in the selected EA was estimated using the NPC figures of 2006 projected to 2014. This gave 4,108. Dividing this estimated population (4108) by the sample size (400) gave the sampling interval for systematic selection of participants which was approximately 1:10. Hence one in every ten adults was enroled for the study. Selected houses where every 10th adult was residing were given unique numbers for identification. The Kish conversion sheet was used to select the participant for the study in each household.[16] In situations where selected EAs were not contiguous, the first house in the next EA was regarded as a continuation of the previous EA and the selection procedure continued.

Study procedure

The methodology used in this study was based on the World Health Organization's recommended STEPS approach to chronic disease surveillance with some modifications.[17]

This is a simple, standardised method for collecting, analysing and disseminating data in WHO member countries. The STEPS approach focuses on obtaining core data on the established risk factors that determine the major disease burden and is designed to help countries build and strengthen their surveillance capacity. The STEPS Instrument covers three different levels or 'steps' of risk factor assessment. These steps are questionnaire, physical measurements and biochemical measurements. Estimation of serum creatinine and repetition of measurements was not part of the original STEPS instrument but was added in this study to correctly define the output variable of interest (CKD). Hence, this constituted a modification of to the original STEPS instrument.

The study was carried out in three phases. In the pilot phase, the study was pre-tested in ten percent of the sample size in a different EA. In the second phase, health talk was delivered at four different traditional meeting grounds in EAs selected for the study. Attendees were informed of the study and those residing in selected houses would be expected to willingly participate in the study.

A pre-tested semi-structured questionnaire was administered to each participant by a trained research assistant. Information about age, occupation, educational level, sex, marital status, religion, lifestyle (alcohol, smoking and consumption pattern of fruits and vegetables), family history of kidney disease, hypertension and diabetes, use of herbal medications, non-steroidal anti-inflammatory drugs and skin lightening cosmetics were obtained. Physical measurements obtained included blood pressure, weight, height, waist and hip circumference.

All participants provided mid-stream urine in plain bottles after education on the procedure for collection. Furthermore, 10 ml of blood was collected from each person in different sample bottles specific for the required test. Serum and urine creatinine were measured by Jaffe's alkaline picrate kinetic method.[18] In this method, creatinine reacts with alkaline picrate to produce a red coloured complex; the rate of red-coloured complex formation is directly proportional to the creatinine concentration. The concentration of albumin in urine was measured by sulphosalicylic acid colorimetric assay.[19] In this method, the sulphosalicylic acid (anion) precipitates the protein (cation) in a sample of urine. The turbidity formed is proportional to the concentration of the protein and is measured with a spectrophotometer at 500 nm. Analyses were done using the Selectra Jnr Auto Analyzer. All samples were analysed at the main laboratory of Federal Medical Centre Umuahia Abia State, which is about 25 km away from the different areas of sample collection.

In the third phase of the study, individuals with reduced kidney function or significant proteinuria were revisited after 3 months to detect persistence of these abnormalities. A subject was adjudged to have CKD if he/she had the following at two separate visits 3 months apart;[20]

i. Significant proteinuria (Protein/creatinine ratio ≥200 mg/g) and/or
ii. GFR <60 ml/min/1.73 m²

Participants with CKD were further classified into five stages as follows:

- Stage 1 - GFR ≥90 ml/min/1.73 m^2 with persistent significant proteinuria
- Stage 2 - GFR 60–89 ml/min/1.73 m^2 with persistent significant proteinuria
- Stage 3 - GFR 30–59 ml/min/1.73 m^2 with or without persistent significant proteinuria
- Stage 4 - GFR 15–29 ml/min/1.73 m^2 with or without persistent significant proteinuria
- Stage 5 - GFR <15 ml/min/1.73 m^2 with or without persistent significant proteinuria.

The study commenced on 1st June 2014 and ended on 11th September 2014.

Definition of terms

Old age was regarded as age ≥60 years in both sexes according to the World Health Organization's working definition for older persons in Africa.[21] Individuals with protein/creatinine ratio ≥200 mg/g were regarded as having significant proteinuria.[20] Obesity indices, hypertension and diabetes mellitus were defined according to standard criteria.[22-25] A participant was regarded to have family history of kidney disease if he/she has a first-degree relative (parent, child or sibling) who is suffering from kidney disease or died of a kidney disease.[26] For the purpose of this study, significant intake of herbal medications was regarded as any history of weekly intake of herbal preparation for 1 month or more either currently or in the past while analgesic abuse was regarded as a cumulative lifetime use of more than 5000 pills of analgesics.[27] This was calculated from multiplying the average number of pills consumed in a week by the duration of use in years.

The GFR was estimated from serum creatinine measurements using the modification of diet in renal disease formula (MDRD-4 parameter equation).[28] This formula has been shown to be a reliable alternative to measured creatinine clearance in Nigerian patients with CKD.[29] Reduced kidney function was regarded as estimated GFR <60 ml/min/1.73 m^2.

Ethical consideration

The study was approved by the Human Resource and Ethics Committee of Federal Medical Centre Umuahia Abia State Nigeria.

Data analysis

The data were analysed using the Statistical Package for Social Sciences software, version 21.0 (2012, IBM Corporation, Armonk, NY, USA). The Data were presented as means ± standard deviation for continuous variables and as proportions for categorical variables. The Chi-square test was used for the comparison of and to test associations between categorical variables with Fisher's exact test where cells contained <5 observations. The Student's *t*-test was used to compare the means of two groups. All $P < 0.05$ were regarded as statistically significant. Participants with CKD were compared with those without CKD across the domains of risk factors investigated to find out the significant variables or correlates. This was followed by multivariate analysis, where the significant variables (potential predictor variables) identified were included in a binary logistic regression to identify variables which are independent risk factors or predictors of CKD.

Results

A total of 328 participants completed the study; the remaining 72 participants who took part in the study did not complete either their questionnaire or investigations and were excluded from the analysis. Table 1 shows the sociodemographic characteristics of the participants. Mean age was 54.8 ± 12.8 years

One hundred and seventy-nine (54.6%) participants had a normal body mass index, overweight was found in 104 (31.7%) while obesity was found in 38 (11.6%) participants. Table 2 shows the prevalence of risk factors for CKD among the participants and their gender distribution.

Significant proteinuria was detected in 32 (9.8%) participants at first assessment while 19 (5.8%) had persistent proteinuria on re-assessment after 3 months. There were more females (13, 4.0%) with persistent significant proteinuria than males

Table 1: Sociodemographic characteristics of the participants

Characteristics	*n* (%)
Gender	
Female	189 (57.6)
Male	139 (42.4)
Age range (years)	
<20	7 (2.1)
20-29	9 (2.7)
30-39	24 (7.3)
40-49	84 (25.6)
50-59	92 (28.0)
≥60	119 (36.3)
Occupation	
Religious/community leaders	15 (4.6)
Student/unemployed	30 (9.1)
Pensioners	56 (17.1)
Traders/artisans	101 (30.8)
Farmers	126 (38.4)
Formal educational status	
None	40 (12.2)
Primary	128 (39.0)
Secondary	116 (35.4)
Tertiary	44 (13.4)
Marital status	
Single	22 (6.7)
Married	232 (70.7)
Widowed	65 (19.8)
Divorced/separated	9 (2.8)

Table 2: Prevalence and gender distribution of risk factors for chronic kidney disease

Variable	All (n=328), n (%)	Males (n=139), n (%)	Females (n=189), n (%)	χ^2	P
Old age (≥60 years)	119 (36.3)	51 (36.6)	68 (35.9)	0.02	0.895
Hypertension	121 (36.9)	41 (29.4)	80 (42.3)	5.66	0.17
Diabetes mellitus	26 (7.9)	10 (7.2)	16 (8.5)	0.18	0.67
Family history of kidney diseases	21 (6.4)	5 (3.6)	16 (8.5)	3.17	0.08
Generalised obesity (BMI)	38 (11.6)	16 (11.5)	22 (11.6)	0.98	0.90
Central obesity	74 (22.6)	21 (15.1)	82 (43.4)	29.7	0.001*
Significant consumption of herbal remedies	73 (22.3)	28 (20.1)	45 (23.8)	0.62	0.43
Significant cigarette smoking	20 (6.1)	20 (9.1)	0 (0.0)	28.9$^+$	0.001*
Significant alcohol consumption	33 (10.1)	31 (22.3)	2 (1.1)	39.9$^+$	0.001*
Analgesic abuse	40 (12.2)	12 (8.6)	28 (14.8)	2.86	0.09
Use of mercury-containing cosmetics	29 (8.8)	8 (2.4)	21 (6.4)	2.85	0.09

*Significant differences, $^+$Fischer's exact test used. BMI: Body mass index

(6, 1.8%). The prevalence increased with age from 0.6% in the 18–30 years age group to 3.0% in the >60 years age group (P = 0.009 for trend across group).

Reduced kidney function (estimated GFR <60 ml/min/1.63 m^2) was found in 44 (13.4%) participants at first assessment. Only 15 participants (4.6%) had persistently low GFR at re-assessment 3 months later. Slightly more than half of participants (54.3%) had GFR ≥90 ml/min.

Overall, CKD was found in 25 participants giving a crude prevalence of 7.6%. According to stages of CKD, there were 2.4% of the participants in stage 1, 0.6% in stage 2, 3% in stage 3, 1.2% in stage 4 and 0.3% in stage 5.

The predictors of CKD included old age (adjusted odds ratio = 3.2; confidence interval: 1.10–8.92; P = 0.02), hypertension: 3.5 (1.93–11.90; P = 0.001), family history of kidney disease; 4.5 (3.91–10.23; P = 0.01), generalised obesity; 1.3 (1.20–6.21; P = 0.001) and central obesity; 3.8 (1.13–12.68; P = 0.003) [Table 3]. Table 4 compares this current study with some other community-based studies on magnitude of CKD and its risk factors.

Discussion

The mean age of the participants in this study was higher than 29.5 years recorded from NHANES III study.[3] It is also higher than 40.29 ± 16 years obtained in a screening of CKD and its risk factors in Kano Nigeria[9] and 39.37 ± 14 years reported in a similar survey in Jos Nigeria.[10] This suggests that in terms of age, the sample in this study had a higher age when compared to those in other studies and perhaps, the general population.[30] The implication of this observation to this study is that some findings need to be interpreted with caution. Increasing age is a well-documented risk factor for hypertension and CKD.[31] The preponderance of the elderly population in this study might have contributed to the high prevalence of hypertension and CKD observed in this study. Diabetes mellitus was detected in 7.9% of the participants. This is comparable to 10.4% obtained in a similar survey in Jos Nigeria[10] and 5.9% obtained in Enugu Nigeria.[13]

The prevalence of CKD in this study was 7.6%. This is lower than 11% and 16% obtained in the AusDiab[5] and NHANES III[3] studies, respectively. It is also lower than the prevalence observed in some earlier studies in Nigeria[9,11,13] This may be because persistence of markers of CKD after 3 months was not demonstrated in some of these studies; hence, there may be overestimation of the prevalence of CKD in such studies. The prevalence of CKD observed in this study is similar to 6.3% observed in a study conducted in Shimoga district in Southern India[32] and 10.4% obtained by Afolabi *et al*. in South-western Nigeria.[33] Markers of CKD were also re-assessed in these studies and may account for this similarity in prevalence of CKD.

Old age is also a risk factor for CKD in both univariate and multivariate analyses in this study, and this is in agreement with earlier studies.[3,34] The implication of this is that as our population ages, there is need to intensify screening strategies for CKD to detect early stages of the disease for more effective intervention. Participants with hypertension had a 3.5-fold increased risk of having CKD than their normotensive counterparts. This is in keeping with previous reports from a survey of CKD and its risk factors among the Australian Aborigines,[35] NHANES III study among non-institutionalised adults in the USA[3] and a similar study by Okoye *et al.* in Benin City, Nigeria.[12]

The family history of kidney disease was identified as an independent risk factor of CKD in this study. Among the 21 participants with positive family history of kidney disease, 8 (38%) were found to have a CKD. This is higher than 14.6% reported from China[36,37] and 9.5% in KEAPS study conducted in Yorkshire, Northern England.[38] This suggests that genetic factors may be contributing significantly to the prevalence of CKD obtained in this study. This is not surprising because Ulasi *et al*.[39] had earlier documented that APOL1 genetic risk variants are common in the Igbo population of South-Eastern Nigeria and are also highly associated with non-diabetic CKD in this area. These APOL1 risk variants have been shown to be strongly associated with an increased risk for non-diabetic kidney disease including HIV nephropathy, primary non-monogenic focal and segmental glomerulosclerosis and

Table 3: Univariate analysis to determine the risk factors for chronic kidney disease among the study participants

Variable	CKD (*n*=25), *n* (%)	No CKD (*n*=303), *n* (%)	OR	95% CI	*P*
Age (years)					
≥60	13 (52)	102 (33.7)	4.19	1.75-10.03	0.001*
<60	12 (48)	201 (66.3)			
Sex					
Male	7 (28)	132 (43.6)	0.504	0.204-1.242	0.130
Female	18 (72)	171 (56.4)			
Hypertension					
Yes	17 (68)	104 (34.3)	4.07	1.70-9.74	0.001*
No	8 (32)	199 (65.7)			
Diabetes mellitus					
Yes	4 (16)	22 (7.3)	2.43	0.81-7.72	0.12
No	21 (84)	281 (92.7)			
Family history of kidney disease					
Yes	8 (32)	13 (4.3)	5.2	3.8-28.7	0.001*
No	17 (68)	290 (95.7)			
Generalised obesity (BMI)					
Yes	6 (24)	32 (10.6)	2.70	1.95-7.20	0.04*
No	19 (76)	271 (89.4)			
Central obesity					
Yes	9 (36)	94 (31)	2.1	1.3-5.8	0.03*
No	16 (64)	209 (68.9)			
Significant consumption of herbal remedies					
Yes	7 (28)	66 (21.8)	1.40	0.56-3.49	0.46
No	18 (72)	237 (78.2)			
Significant cigarette intake					
Yes	3 (12)$^{+}$	17 (5.6)	2.3	0.62-8.43	0.19
No	22 (88)	286 (94.4)			
Significant alcohol consumption					
Yes	3 (12)$^{+}$	30 (9.9)	1.2	0.4-4.4	0.73
No	22 (88)	273 (90.1)			
Analgesic abuse					
Yes	13 (52)	27 (8.9)	5.07	2.60-16.66	0.001*
No	12 (48)	276 (91.1)			
Use of mercury-containing cosmetics					
Yes	6 (24)	23 (7.6)	4.6	1.67-9.72	0.005*
No	19 (76)	280 (92.4)			

*Significant relationship, $^{+}$Fischer's exact test used. CKD: Chronic kidney disease, BMI: Body mass index, OR: Odds ratio, CI: Confidence interval

Table 4: Multivariate analysis to determine predictors of chronic kidney disease among the participants

Variables	AOR	95% CI	
		Lower	Upper
Old age	3.2	1.10	8.92*
Family history of kidney disease	4.5	3.91	10.23*
Hypertension	4.1	1.93	11.90*
Analgesic abuse	1.3	0.76	2.96
Generalised obesity	1.3	1.20	6.21*
Central obesity	3.8	1.13	12.68*
Use of mercury-containing cosmetics	1.5	0.11	3.10

*Significant relationship. AOR: Adjusted-odds ratio, CI: Confidence interval

hypertension-attributed nephropathy among African ancestry populations in the USA.[39]

Obesity is a major driver of the current epidemic of CKD and waist-to-hip ratio reliably reflects visceral fat in CKD patients.[40] Generalised obesity and central obesity were significantly associated with CKD in this study. This is in agreement with earlier studies.[41,42]

Male gender has been reported as a risk factor for CKD but this gender difference in association with CKD was not apparent in this study. This does not agree with the findings of many other studies, in which the male gender was reported to be a non-modifiable risk factor for CKD.[43,44] Some young males refused blood sampling and hence did not complete the study. This may have affected the result of this study in this regard. Non-completion of the study by males for various reasons had earlier been reported by Okoye *et al*. in Benin City Nigeria[12] and in a study of CKD in Beijing China.[45]

The available data did not identify diabetes mellitus as a risk factor for CKD in this present study. This is in agreement with earlier studies[11,12] in Nigeria and may be because the prevalence of diabetes among participants in this study is low. Thus, its effect on kidney function may not be appreciable compared to hypertension and old age.

This study did not show any significant relationship between CKD and cigarette smoking. There are some studies which showed that cigarette smoking is a risk factor for the development and progression of CKD[46,47] while others have not strongly linked it with kidney disease.[48,49] The reason for this apparent conflict may be because some studies that linked smoking to kidney function did so indirectly. Such studies established the link between smoking and microalbuminuria (a marker of glomerular damage) and hence indirectly linked it with CKD; this inference may not always be true. The relationship between smoking and CKD, therefore, deserves further study. Alcohol consumption was not found to have a significant association with CKD in this study. This is similar to studies by Stengel *et al*.[47] and Vupputuri and Sandler,[48] in which alcohol consumption was not associated with CKD. Some studies in Nigeria[12,13] did not also find any such association between alcohol consumption and CKD.

Limitations of the study

Few participants in this study did not report their age accurately; they estimated their ages based on events surrounding their birth. Furthermore, non-refusal of blood collection by some male counterparts reduced the number of participants that completed the study; however, allowance was made for such occurrences during the sample size estimation.

Conclusion

The prevalence of CKD and some of its risk factors were high in the community. The independent risk factors for CKD observed included old age, family history of kidney disease, hypertension, generalised obesity and central obesity. Based on the outcome of this study, we recommend the development of a well-structured health education programme in the community. Urgent attention needs to be paid to the risk factors for CKD and to instituting interventions to slow the progression of kidney diseases in this Nigerian community.

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Conflicts of interest

There are no conflicts of interest.

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