Prevalence of chronic kidney disease in a Nigerian family practice population

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Keywords: prevalence; chronic kidney disease; family practice; population; Nigeria

Abstract

Background: Chronic kidney disease (CKD) is a global public health problem, with a greater burden and prohibitive cost of care particularly in developing countries. This study determined the prevalence of chronic kidney disease and identified its associated risk factors in patients attending the Family Practice Clinic, Wesley Guild Hospital, Ilesa, Nigeria.

Method: Consecutive newly-registered patients who attended the Family Practice Clinic of Wesley Guild Hospital, Ilesa from August 2005 to January 2006 were recruited and studied. Relevant data were collected by using an interviewer-administered questionnaire, and determining the spot urinary ACR (albumin-creatinine ratio) of the subjects by using Microalbustix™ reagent strips and using their serum creatinine concentration. The glomerular filtration rate (GFR) of each subject was estimated using the Modification of Diet in Renal Disease (MDRD) formula. A repeat urine test was done three months after the initial screening to identify subjects with persistent microalbuminuria.

Results: The age of the study subjects ranged from 20 to 74 years, with a mean age of 50.52 + 13.03 years. There were 68 males and 182 females in the sample population, showing a male to female ratio of 1:2.7. One hundred and thirteen of the 250 subjects (45.2%) were found to have pathologic albuminuria at the initial screening, while 31 (12.4%) had persistent albuminuria three months later. Also, 51 subjects (20.4%) had estimated low GFR at the initial screening and 26 (10.4%) had persistent low GFR three months later. Significant risk factors for CKD in the study subjects were increasing age, elevated blood pressure, history of diabetes mellitus (DM), habitual intake of analgesics and herbs, and an abnormal waist to hip ratio ($p < 0.05$). The association between persistent abnormal ACR and low GFR did not reach statistical significance ($p = 0.053$). Habitual analgesic intake ($p = 0.002$) and age group ($p = 0.0027$) were true predictors of CKD among the study subjects.

Conclusions: The prevalence of CKD in the study population was high and its association with modifiable risk factors was demonstrated. Family physicians have a unique opportunity to identify and address these factors in their patients. Routine screening for CKD in family practice clinics is indicated to reduce the burden of renal disease in the population.

SA Fam Pract 2009;51(2):132-137

Introduction

The kidneys are vital excretory organs and are central to fluid, electrolyte and acid-base homeostasis in humans.[1] Damage of the kidneys has serious implications for systemic functions, growth and existence. Irreversible damage that compromises the ability of the kidneys to sustain bodily functions, normal growth and life as occurs in end stage renal disease poses great challenges of renal replacement strategies and other management modalities.[1]

World Health Organization (WHO) statistics reveal that the death rate from intrinsic kidney and urinary tract disease was one million in the year 2002, ranking twelfth on the list of major causes of death.[2] The prevalence of chronic kidney disease (CKD) in the community was grossly underestimated in the past. The prevalence of impaired kidney function was estimated to range between 10% and 20% of the adult population in most countries worldwide.[2,3] However, a recent study suggests that the incidence of CKD is increasing globally.[4] The National Kidney Foundation estimates that 20 million Americans have chronic kidney disease and at least a further 20 million people have an increased risk.[4,5]

In developing countries like Nigeria, the prevalence of preventable renal diseases is not known. Akinsola et al. reported that renal failure constituted 8% of hospital admissions.[6] However, Abioye-Kuteyi et al. reported a prevalence of 19.9% of undetected renal diseases in a rural populace in Nigeria,[7] while Nwankwo et al. reported an incidence of 45.5% of impaired kidney function among hospitalised hypertensive patients in Maiduguri.[8]

In sub-Saharan Africa, and indeed also in Nigeria, hypertension and diabetes mellitus are among the leading causes of end-stage renal disease.[9] By 2020, the burden of diabetes and cardiovascular disease will have increased by 130% in Africa alone, with concomitant increases in the prevalence of CKD and end-stage renal disease (ESRD).[10]

According to the definition provided by the Kidney Disease Outcome Quality Initiative (K/DOQI),[4] the presence of chronic kidney disease should be established based on the occurrence of kidney damage and the level of kidney function, regardless of the specific diagnosis of diseases and conditions causing the damage. The diagnosis of chronic

kidney disease is based on the evidence of kidney damage and/or reduced kidney function lasting at least three months.[4,5] Initial evidence of kidney damage or a reduction in kidney function can be detected through routine blood or urine testing. The most common indicators of kidney damage are proteins in the urine (proteinuria or albuminuria), blood in the urine (haematuria) and raised levels of urea or creatinine (a waste product of protein metabolism) in the blood.[1,2] However, the reliable marker of kidney damage is the persistence of albumin in the urine.[2] The ratio of albumin to creatinine (ACR) obviates the need for 24-hour urine collection to assess proteinuria, and it correlates well with kidney function.[11] In resource-poor countries like Nigeria, this is a useful screening tool to detect CKD, especially in family practice clinics. Furthermore, there is sparse information on the magnitude of CKD in this environment, hence this study aimed to determine the prevalence of CKD and to identify associated risk factors in the Nigerian adult population.

Patients and methods

This was a cross-sectional study of incidental screening for CKD in patients attending the Family Practice Clinic of the Wesley Guild Hospital Unit (WGH) of the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC) in Ilesa, south-west Nigeria. Although the clinic is situated within a teaching hospital, it offers primary care services and operates a 'walk-in' policy, as no referrals are required before patients are attended to.

Sampling method

The study was carried out in three stages. In the first stage, newly registered patients in the clinic were selected consecutively and requested to undergo urine microscopy. The questionnaire was administered to subjects who qualified for the second stage of the study, and they also underwent urine and blood testing. In the third stage, subjects with albuminuria had to undergo repeat blood and urine testing three months after the initial testing to determine those with persistent albuminuria.

Ethics clearance and consent

Ethics clearance was obtained from the OAUTHC Research and Ethical Committee. Informed written consent was obtained from each subject. Confidentiality and privacy were ensured by not indicating the names of the subjects on the questionnaire, and only the investigators had access to the data.

Instruments

Data were collected using the following instruments (this section was rearranged in chronological order):

i) A semi-structured, interviewer-administered questionnaire. The socio-demographic information of each subject was collected, and the past medical history of hypertension, diabetes mellitus and renal diseases was obtained. Current history of nocturia, dysuria, haematuria, frothiness of urine and facial/leg swelling was obtained. A family history of hypertension and diabetes mellitus was also taken. Other information sought in the questionnaire consisted of cigarette smoking, alcohol intake, analgesics use, use of herbal concoctions, as well as the frequency, dosage and duration of use of these substances. Analgesics that were enquired about specifically included aspirin-containing preparations, indocid, butazolidin and paracetamol. For the purpose of this study, analgesic abuse was taken as a cumulative lifetime use of more than 5 000 pills of analgesics.[12] This was calculated from multiplying the average number of pills consumed in a week by the duration of use in years.[12] Smoking 20 cigarettes daily for more than one year was considered significant, while the consumption of ≥ 60 g of alcohol in a week by men and ≥ 30 g by women was taken as significant.

ii) Bayer Microalbustix™ reagent strips for determining the albumin-creatinine ratio in the urine [serial number: 04960872; patent number: 5187104]. Freshly voided spot mid-stream urine was collected from each consenting subject and sent for microscopy. Any subject with more than two white blood cell counts per high-power field in the urine was excluded from the study. The spot urine of subjects eligible for the second stage of the study was tested with Microalbustix™ reagent strips according to the specified procedure. A repeat urine test with the same reagent strip was carried out at three months for subjects who had initial albuminuria.

iii) A stadiometer was used to measure the height of the subjects, while the weight of each subject was measured to the nearest 500 g using a weighing scale (Waymaster Model, patent pending in England). The body mass index [BMI = weight/height^2] was calculated for subjects. They were classified using the WHO classification of obesity.[13] Overweight was regarded as a BMI of between 25 and 29.9 kg/m^2, while obesity was taken as a BMI greater than 30 kg/m^2.

iv) The resting blood pressure of each subject was measured with an Accosson® mercury sphygmomanometer using standard techniques. Elevated blood pressure was taken as being equal to or greater than 140/90 mmHg.

vi) A non-stretching tape was used to measure the waist circumference of each subject at the level of the umbilicus, and the hip circumference at the level of the greater trochanter. The waist-to-hip ratio (WHR) was calculated for each subject. Abdominal obesity was taken as a WHR > 0.9 in males and > 0.85 in females.

v) A stopwatch was used to time the readings of the albumin and creatinine tests. The albumin test was read at 50 seconds after dipping and the creatinine test at 60 seconds, and then the albumin-creatinine (ACR) ratio was calculated.

The serum creatinine concentration of all the subjects was analysed by using the standard spectrometric method. The value of serum creatinine obtained from the laboratory was used to calculate the glomerular filtration rate (GFR) of each subject, using the modified MDRD formula: GFR = 186 x (Cr)-1.154 x (Age)-0.203 x 0.742 (if female) x 1.210 (if black).[5]

Subjects with an estimated GFR of less than 60 ml/min/1.73m^2 at the first visit underwent a repeat serum creatinine test at three months and the GFR was re-estimated according to NKF diagnostic criteria for CKD.[4,5] All the subjects with persistent GFR < 60 mL/min/1.73m^2 were classified as having CKD, irrespective of the presence or absence of kidney damage. The rationale for including these individuals is that a reduction in kidney function to this level of GFR or lower represents a loss of half or more of the adult level of normal kidney function, which may be associated with a number of complications.[5] Subjects who had albuminuria at the first visit underwent a repeat albumin-creatinine ratio (ACR) test at three months. Subjects with persistent abnormal ACR were classified as having CKD, irrespective of the level of GFR. The rationale for including subjects with a GFR ≥ 60 mL/min/1.73 m^2 is that GFR may be sustained at normal or increased levels despite substantial kidney

damage, and these subjects are at increased risk of the two major outcomes of chronic kidney disease, namely loss of kidney function and development of cardiovascular disease.[5]

Interpretation of urinary albumin and creatinine tests[11]

Albumin-to-creatinine ratio

An albumin level of less than 30 mg albumin/g creatinine (3.4 mg albumin/mmol creatinine) was regarded as representing a normal ACR. Microalbuminuria is indicated at a ratio of 30 to 300 mg/g (3.4 to 33.9 mg/mmol) (abnormal ACR), and clinically overt albuminuria at a ratio of > 300 mg/g (> 33.9 mg/mmol) was regarded as macroalbuminuria.

Exclusion criteria

Subjects who had undergone strenuous exercise, those with urinary tract infections or acute illness with fever, and those who refused to give consent were excluded from the study. Subjects who were on ACE inhibitors prior to the study were also excluded from the study.

Data analysis

All data collected were fed into a computer and analysed using the Statistical Package for Social Sciences (SPSS) for Windows software version 11.14 Means, modes, medians, standard deviations and proportions were determined as applicable. The proportions and ratios were compared using the Pearson's Chi squared ($\chi 2$) test. A p value equal to or less than 0.05 was taken as statistically significant.

Results

Out of 1 250 patients recruited in the first stage of the study, 250 participated in the second stage, while 113 subjects underwent repeat blood and urine testing in the third stage of the study. The mean age of the respondents was 50.52 ± 13.03 years, and the median age was 53.0 years. Their socio-demographic characteristics are shown in Table I.

Table I shows that the majority of the study subjects were 45 years and older (70.4%), female (72.8%) and of Christian faith (90.8%). It also shows that the majority of subjects were married (76.8%) and that 67.6% were self-employed.

Figure 1 shows that 54.8% of the 250 subjects had normoalbuminuria, 111 (44.4%) had microalbuminuria and two (0.8%) had macroalbuminuria at the initial screening.

Table I: Socio-demographic distribution of study subjects

Characteristics	n	%
Age group		
15–24 years	11	(4.4)
25–34 years	22	(8.8)
35–44 years	4	(16.4)
≥ 45 years	176	(70.4)
Total	250	(100.0)
Sex		
Female	182	(72.8)
Male	68	(27.2)
Total	250	(100.0)
Religion		
Christianity	227	(90.8)
Islam	23	(9.2)
Total	250	(100.0)
Marital status		
Single	18	(7.2)
Married	192	(76.8)
Separated	6	(2.4)
Widowed	34	(13.6)
Total	250	(100.0)
Highest education level		
No formal education	56	(22.4)
Primary education	64	(25.6)
Secondary education	51	(20.4)
Tertiary education	79	(31.6)
Total	250	(100.0)

Figure 2 shows that 28% of 113 subjects had persistent albuminuria, in contrast to 45.2% who had albuminuria at the initial screening.

Figure 1: Bar chart showing distribution of study subjects by urinary ACR at the beginning of the study (n = 250)

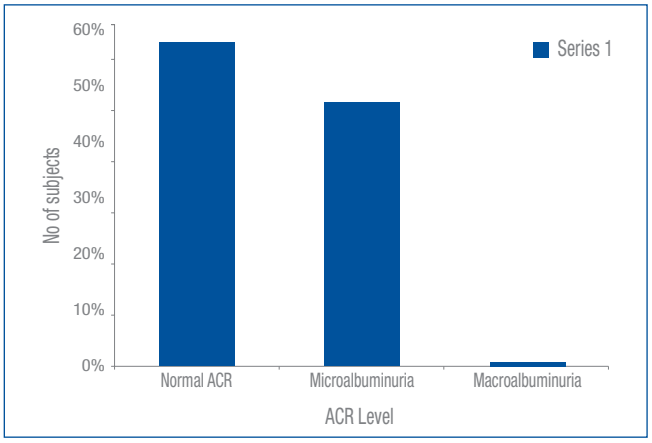

Figure 2: Pie chart showing distribution of subjects with persistent urinary ACR at three months (n = 113)

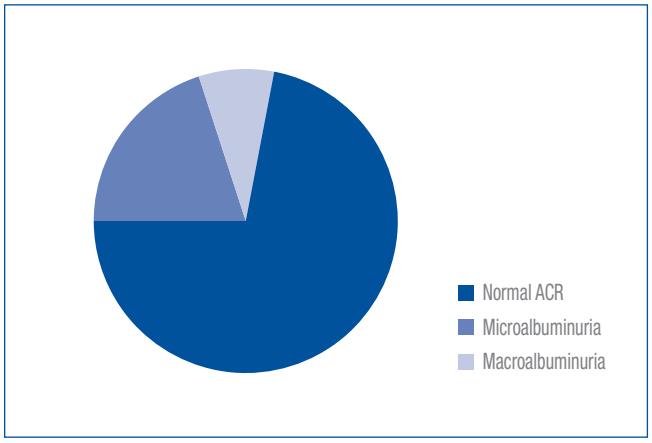

Table II: Distribution of study subjects by estimated GFR at the beginning of the study

	Estimated GFR at the beginning of the study		Estimated GFR at three months	
	Freq	%	Freq	%
CKD present (GFR < 60)	51	20.4	26	50.9
CKD absent (GFR > 60)	199	79.6	25	49.1
Total	250	100.0	51	100.0

Table III: Distribution of subjects with persistent low GFR by persistent abnormal ACR

	Abnormal ACR	Normal ACR	Total
CKD present (GFR < 60)	22(61.1)	4(26.7)	26
CKD absent (GFR > 60)	14(38.9)	11(73.3)	25
Total	36(100.0)	15(100.0)	51

$\chi^2 = 3.749$, df = 1, p = 0.053*, * = Yates' correction applied

Table II shows that 51 subjects (20.4%) had a low GFR at the initial screening, compared to 26 (50.9%) who had persistent low GFR at three months.

As shown in Table III, 22 subjects (61.1%) with persistent albuminuria had a persistent low GFR. However, this did not reach statistical significance.

Table IV shows that there is a significant association between abnormal ACR and age above 55 years, elevated systolic blood pressure, elevated diastolic blood pressure, history of diabetes mellitus (DM), habitual use of analgesic and herbal medications, as well as abnormal waist-to-hip ratio, while gender, BMI, family history of HT/DM, alcohol intake and cigarette smoking were not significantly associated with abnormal ACR in the study subjects.

Table V shows that habitual analgesic intake and the age of the subjects are strong predictors of abnormal ACR in the study subjects.

Discussion

In this study, 10.4% of the subjects had a persistent low GFR, compared to 12.4% with persistent albuminuria. There is overwhelming evidence that microalbuminuria is a reliable marker of kidney damage because it is detected much earlier than an increase in serum creatinine in CKD.[4,5] However, both figures are similar to 11.8% and 11% reported by McCellan et al.[15] in the USA and Kissmeyer et al.[16] in the UK respectively. The latter studies similarly used microalbuminuria as the marker of kidney damage. A relatively higher prevalence of 19.9% was reported by Abioye-Kuteyi et al.[7] among rural dwellers and 45.5% was reported by Nwankwo et al.[8] The occurrence of endemic urinary tract diseases may explain the relatively high prevalence of chronic kidney disease among the rural dwellers in the study by Abioye-Kuteyi et al., while the very high prevalence reported by Nwankwo et al. may be because the study was conducted among highly selected hypertensive patients who were more likely to have end-organ damage than patients attending a

Table IV: Distribution of subjects by ACR and risk factors for renal disease

Characteristics	Subjects with normal ACR n = 137 %	Subjects with abnormal ACR n = 113 %	χ^2	df	p
Systolic blood pressure					
Normal	109 (79.6)	61 (54.0)	18.621	1	**<0.001**
Elevated	28 (20.4)	52 (46.0)			
Diastolic blood pressure					
Normal	110 (80.3)	64 (56.6)	16.376	1	**<0.001**
Elevated	27 (19.7)	49 (43.4)			
Habitual analgesic intake					
No	106 (77.4)	63 (55.8)	13.215	1	**<0.001**
Yes	31 (22.6)	50 (44.2)			
Habitual use of herbal medication					
No	83 (60.6)	49 (43.4)	7.369	1	**0.007**
Yes	54 (39.4)	64 (56.6)			
Waist-hip ratio					
Normal	27 (19.7)	0 (8.8)	5.790	1	**0.016**
Abnormal	110 (80.3)	103 (91.2)			
History of DM					
No	133 (97.1)	102 (90.3)	5.099	1	**0.024**
Yes	4 (2.9)	11 (9.7)			
Age group					
Less than 55 years	84 (61.3)	55 (48.7)	4.009	1	**0.045**
55 years and above	53 (38.7)	58 (51.3)			
BMI					
Non-obese subjects	95 (69.3)	75 (66.4)	0.251	1	0.616
Obese subjects	42 (30.7)	38 (33.6)			
Sex					
Male	40 (29.2)	28 (24.8)	0.610	1	0.435
Female	97 (70.8)	85 (75.2)			
Family history of HT					
No	80 (54.8)	61 (15.9)	0.874	2	0.646
Yes	23 (16.8)	18 (15.9)			
Don't know	34 (24.8)	34 (24.8)			
Family history of DM					
No	99 (72.3)	75 (66.4)	1.016	2	0.602
Yes	4 (2.9)	4 (3.5)			
Don't know	34 (24.8)	34 (30.1)			
Excessive cigarette smoking					
No	119 (86.9)	97 (85.8)	0.055	1	0.315
Yes	18 (13.1)	16 (14.2)			
Chronic alcohol ingestion					
No	108(78.8)	87(77.0)	0.122	1	0.727
Yes	29(21.2)	26(23.0)			

Table V: Linear regression of significant factors for abnormal ACR in the study subjects

	Beta coefficient	T	Significance
Habitual analgesic intake	0.193	3.088	0.002
Age group	0.150	2.227	0.027
Habitual herbal consumption	0.093	1.515	0.131
Waist-hip ratio	-0.094	-1.398	0.163
Diastolic BP	0.044	0.0386	0.700
Diabetes mellitus	0.056	0.903	0.177
Systolic BP	0.152	1.290	0.1988

Key: The beta coefficient is obtained by transforming the dependent and independent variables to standard (Z scores) before running the regression. It eliminates all units so that all variables can be compared directly. T represents 't statistics', which determines the relative importance of each variable.

family practice. Nevertheless, the prevalence of persistent albuminuria in this study and its implications for health make an urgent intervention imperative. Regular albuminuria screening not only allows the trends in individuals and communities to be monitored, but also forms the basis for a secondary renal prevention strategy.

The composition of the study population, by virtue of the genetic similarities to African-Americans, may partly explain the high prevalence of impaired kidney function obtained in this study.[17] The study population was made up of black indigenous people from Nigeria. The predisposition of the black race to chronic kidney disease has been reported by several authors.[18,19] The results of the third National Health and Nutrition Examination Survey (NHANES III) indicated that the African-American has a substantially higher risk of chronic kidney disease than his white American counterpart.[19] Contributory factors to the racial or ethnic disparity in the prevalence of CKD are best understood as a complex interaction between socio-cultural, genetic and environmental factors.[20] Socioeconomic factors, such as poverty and a low income, with the consequent limited access to health care, and poor urban housing have also been reported to contribute to the incidence and prevalence of chronic kidney disease.[21]

The findings of this study show that the majority of subjects with persistent low GFR had persistent abnormal ACR, though the difference was not statistically significant. This finding suggests that subjects who have persistent low GFR are likely to have persistent albuminuria, which is indicative of progressive renal disease. This phenomenon underscores the importance of incidental albuminuria screening for renal disease, especially in the study of unselected family practice patients. It becomes relevant because CKD has a long, silent but progressive course that may be masked by other conditions, such that only purposive screening can ensure early detection and the opportunity to improve the patients' outcome.[22]

This study found a significant association between increasing age and CKD. This is consistent with findings from other studies. Mulder et al. reported a substantial reduction in kidney function with ageing.[23] It was earlier elucidated by Rowe et al. that kidney function declines naturally with increasing age.[24] As CKD was commoner in subjects older than 55 years, the recommendation to screen people in this age group is an important strategy for the detection of chronic kidney disease.

As expected, there was a significant association between CKD and a history of hypertension in the subjects in this study. Similar associations were found between elevated systolic and diastolic blood pressures. This corresponds with the findings of several studies. Chadban et al. reported that the prevalence of kidney disease was fivefold greater among patients with high blood pressure compared with normotensives.[25] This is attributed to the early development of end-organ damage and late presentation for medical care in patients with hypertension. Nwankwo et al. also pointed to growing evidence for the existence of genetically determined and environmentally induced factors responsible for a higher risk of damage to the kidneys, especially in developing countries like Nigeria.[26]

Similarly, a significant positive association was found between CKD and a history of diabetes mellitus in the study subjects. Chadban et al. reported that the prevalence of kidney disease was three times higher in those with diabetes mellitus than in those without diabetes mellitus.[25]

The reasons cited for this trend include an increase in the prevalence of diabetes in the population and improved survival of patients with type 2 diabetes mellitus. A similar trend of increasing prevalence of diabetes mellitus has also been reported from Nigeria by Alebiosu et al.[27] Changes in lifestyle brought about by urbanisation and modernisation, as well as genetic factors, were cited as the perpetuating factors in the increasing prevalence of DM.[28] In Nigeria, the rapid increase in type 2 diabetes mellitus is implicated as a major contributor to the rising incidence of CKD in recent years.[28]

An abnormal waist-to-hip ratio but not BMI was found to be significantly associated with CKD in this study. This agrees with the findings of studies supporting waist-hip ratio or waist circumference as a better cardiovascular risk predictor than BMI.[29] This is because waist-hip ratio is a measure of the relative accumulation of abdominal fat, while waist circumference is a measure of absolute abdominal fat as well as total body weight. The adoption of western diets has been identified as being responsible for the emerging trend of obesity in developing countries like Nigeria, and obesity is an important acquired risk factor in the development of type 2 diabetes mellitus, which consequently increases the burden of CKD.[29]

The findings of this study showed a strong association between CKD and habitual analgesic intake. Various authors have cited the habitual consumption of analgesics or analgesic abuse as contributing to the increasing prevalence of chronic renal disease in Nigerian communities.[13,30] However, the association in this study may be explained by the likelihood of other risk factors, like hypertension or diabetes mellitus, which may act in concert with analgesic abuse to cause albuminuria.

Similar reasons may explain the significant positive association found between CKD and habitual herbal ingestion in this study. The unbridled proliferation of herbal practitioners has led to the sale and consumptions of herbal products that have potential nephrotoxic effects, and this has been implicated in the increasing prevalence of end-stage renal disease.[13,21]

Alcohol consumption was not found to be a risk factor for CKD in this study. This is in agreement with the findings of Vupputuri and Sandler, who reported finding no significant association with alcohol consumption in a study examining the effects of lifestyle on the development of CKD.[31] Similarly, Stengel et al. reported that alcohol consumption was not associated with CKD in a non-concurrent cohort study of 9 082 adults.[30]

In this study, tobacco smoking was not associated with CKD, in contrast with findings that identified smoking as a major cardiovascular risk factor that promotes the progression of kidney disease.[30] Tobacco smoking is perceived in Nigerian communities as an antisocial habit with which the subjects possibly may not want to be identified. This may explain the high negative response rate for tobacco smoking among the study subjects.

Gender differences did not have a significant association with CKD 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.[30,32] A possible reason for the lack of association may be due to the higher proportion of females than males in this study.

Unlike earlier studies that reported an association between CKD and a family history of hypertension and diabetes mellitus,[25,33] no such association was found in this study. This may be due to a high negative response rate arising from the subjects having inadequate health information about their families.

This study also demonstrated that urgent attention needs to be paid to the risk factors for chronic kidney disease and to instituting interventions to slow the progression of renal disease. This need is driven by the high prevalence of persistent albuminuria and low GFR found in this study, and the possibility of using family practice clinics to identify people who may be at risk of CKD.

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