ORIGINAL ARTICLE

Kidney disease and its risk factors among Nigerians: Report of the World Kidney Day 2022 National Screening Programme

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ABSTRACT

Background: The burden of chronic kidney disease (CKD) is great in low- and middle-income parts of the world compared to high-income regions. Determining CKD prevalence is crucial to drive and support evidence-based advocacy for policies that alleviate the burden of CKD in the most affected regions and countries. Using the World Kidney Day (WKD) vehicle, we estimated the prevalence of kidney dysfunction and its risk factors in a nationally representative sample in Nigeria.

Methods: This was a cross-sectional study of Nigerians from all six geopolitical zones of the country, involving 36 public and private medical facilities, which served as screening centres for the communities they serve during the WKD 2022 activities. Awareness campaigns, health education, and screening for kidney dysfunction and its risk factors were undertaken. Estimated glomerular filtration rate (eGFR) was calculated using the CKD–EPI formula, while freshly voided urine was obtained for dipstick urinalysis. An eGFR <60 mL/min/1.73 m^2 was considered to indicate kidney dysfunction. A random effects model was used to obtain the pooled prevalence of kidney dysfunction after the conversion of the individual proportions using the Freeman–Tukey transformation.

Results: A total of 4,313 participants were screened, whose mean age was 43.07 ± 13.35 years; the overall proportion of females was 60.4%. The pooled prevalence of kidney dysfunction was 13.7% (95%CI 11.1–16.5%), while 46.7%, 7.4%, 24.1% and 19.8% of the participants manifested hypertension, diabetes mellitus, obesity, and proteinuria, respectively.

Conclusion: There is a high prevalence of kidney dysfunction among adult Nigerians, and hypertension, DM, and obesity were the leading risk factors for the condition identified in the population.

Keywords: CKD, kidney dysfunction, Nigeria, risk factors, screening.

Received 30 January 2023; accepted 20 November 2023; published 06 May 2024.
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DOI: doi.org/10.21804/27-1-5740

INTRODUCTION

Chronic kidney disease (CKD) has become a condition of public health importance with a significant adverse impact on global health [1,2]. In 2017, the global prevalence of CKD was 9.1%, which affected about 697.5 million people [1]. About 2.6 million deaths attributable to CKD and CKD-related cardiovascular disease were reported in the same year [2]. Over the last three decades, the global all-age prevalence and mortality rates of CKD increased by about 30% and 40%, respectively [2]. CKD, currently the eigth leading cause of death, is projected to rank as the fifth leading cause of death globally by 2040 [3]. It is associated with rising mean annual societal cost and productivity loss [4]. The annual average total health cost per patient with end-stage kidney disease (ESKD) is between US$20,110 and US$100,593 [4]. CKD is associated with a significant reduction in the quality of life of the sufferers and their care partners [5].

The burden of CKD is great in low- and middle-income parts of the world compared to high-income regions [6]. The factors that contribute to the relatively high burden of CKD in these areas are lack of awareness of the disease, rural–urban migration, increased exposure to environmental toxins, high burden of infections, genetic predisposition, and prioritised focus on communicable diseases [7]. Sub-Saharan Africa (SSA) is one of the regions with an especially high CKD population, with a CKD prevalence of 13.9% [6,8]. Nigeria contributes significantly to this high regional prevalence [6,9], which ranged between 11.4–26% in different population-based studies conducted [9-12].

The diagnosis of CKD in Nigeria is almost a death sentence, with patients having abysmal outcomes [11-14]. These consequences arise partly because most patients present late, cannot afford the cost of dialysis beyond a few sessions, and the cost of transplantation is beyond the reach of most patients [14-16]. CKD also has adverse economic implications for the patients, their caregivers, and the nation at large, as it often affects the young and middle-aged groups who are at an economically productive age [15,16]. The financial burden of care also has devastating economic effects on patients and their dependants.

Although several studies have been conducted on the prevalence and risk factors for CKD in Nigeria, many of them are fraught with limitations. These include small sample sizes and are mostly restricted to specific regions, making them unrepresentative of the country's diversity. Presently, there is a paucity of data reflecting the national prevalence of CKD and its associated risk factors. This is regrettable because such knowledge is crucial to drive and support evidence-based advocacy for policies that will ameliorate the burden of CKD in Nigeria.

It is against this background that the Nigerian Association of Nephrology seized the occasion of World Kidney Day (WKD) 2022, tagged "Kidney Health for All", to conduct a nationwide CKD screening programme across all the six geopolitical zones of the country. The WKD is celebrated every second Thursday in March across the globe, to create awareness about kidney health and diseases and to attract the support of stakeholders within and outside the health sector with the overall aim of reducing the burden of CKD. The WKD also affords the nephrology community, patients' associations, and other stakeholders in various countries the opportunity to carry out population-based screening for CKD and its associated risk factors. The screening conducted in Nigeria during WKD 2022 aimed to determine the national prevalence of kidney dysfunction and its associated risk factors. This article, therefore, presents the corresponding findings from Nigeria's national screening, and provides valuable information that grounds the evidence needed to advocate reduction of the burden of CKD and to implement policies for improved kidney health in the country.

METHODS

This was a cross-sectional study of Nigerians from all six geopolitical zones of the country. Thirty-six centres represented 3, 2, 7, 3, 12, and 7 centres in the north-east, north-west, north-central, south-east, south-west, and south-south geopolitical zones, respectively. As part of the WKD 2022 celebrations, health education and awareness campaigns were conducted in various communities across the country. In addition, all consenting adults who volunteered to be screened for kidney disease risk factors were enrolled in the study. Adults aged 18 years and above were recruited, whereas individuals with a prior diagnosis of CKD were excluded. A uniform, semi-structured pretested questionnaire was used to collect data from the participants – the information obtained included biodata, knowledge of kidney disease and its risk factors, as well as relevant past medical history. Literate participants completed the required details, and explanations were offered by the researchers as required. The questionnaires were administered also to illiterate participants.

Anthropometric measurement of height and weight was conducted and subsequently used to calculate the body mass index (BMI) of each participant. A single blood pressure measurement was taken in a sitting position after the participant had rested for 5 minutes. Blood samples were collected to measure serum creatinine using isotope dilution mass spectrophotometry-traceable techniques. The

2021 Chronic Kidney Disease Epidemiology Collaboration equation (CKD–EPI) [17], which does not take race into account, was used to calculate the estimated glomerular filtration rate (eGFR). A needle prick blood sample was used for random blood glucose estimation using validated glucometers. A freshly voided urine sample was used to check for proteinuria, haematuria, and glycosuria except for menstruating participants. Elevated blood pressure was defined as blood pressure greater than 140/90 mmHg or a previous history of use of blood pressure-lowering medication. Elevated blood glucose was self-reported and/or a random plasma glucose of greater than 200 mg/dL.

All data collected at each centre were sent to the study coordinator for final collation and analysis using Stata 17.0 (StataCorp, Texas). We used a strict definition of eGFR <60 mL/min/1.73 m^2 only to indicate kidney dysfunction. The one-way ANOVA was used to compare normally distributed continuous variables across the six geopolitical zones of the study. The chi-squared test was used to compare frequencies across the six groups.

Univariate and multivariate logistic regression was undertaken to report the effect estimate of each of the traditional risk factors on the occurrence of kidney dysfunction. Variables with a P value of the Wald statistic of ≤0.25, or those known known to be associated with CKD, were incorporated into the final multivariate model. The Pearson goodness-of-fit test was used to assess the final multivariable model, and a receiver operator characteristic (ROC) curve was used to assess the utility of the final multivariate model.

Because significant heterogeneity was expected across the groups, we employed the "estimate and pool" two-stage technique of individual participant meta-analysis [18] to obtain the pooled prevalence of kidney dysfunction. The first stage estimated the prevalence of kidney dysfunction in each of the six regions. In the second stage, we used the random effects model [19] to obtain the pooled prevalence of kidney dysfunction after the conversion of the individual proportions using the Freeman–Tukey double arcsine transformation [20] to minimise the effect of extreme prevalence on the overall estimate.

Ethical considerations

This study adhered to the Declaration of Helsinki principles, and all participants gave written informed consent.

RESULTS

A total of 4,313 participants in 36 sites were involved in the screening programme, whose locations are illustrated in Figure 1. The North-Central region recruited 1,306 participants (30.3%, 9 sites); North-East 329 (7.6%, 3 sites]; North-West 432 (10.0%, 2 sites]; South-East 388 (9.0%, 3 sites]; South-South 840 (19.5%, 7 sites] and the South-West 1,018 (23.6%, 12 sites] (Figure 2).

Table 1 summarises the sociodemographic, anthropometric, and clinical characteristics of the study population across the six geographical regions. The mean age of the screened population was 43.07 ± 13.35 years, with the North-West having a significantly younger subjects than all the other regions. The proportion of females in each zone ranged from 47.9% to 72.2%, with an overall proportion of 60.4%. About half (51.4%) of those screened had a tertiary level of education.

Prior knowledge of kidney disease

Only 4.7% of the study participants had prior knowledge of having kidney dysfunction, and 10.9% had been involved in a kidney disease screening previously. About 5.4% reported a history of a relative who had CKD.

Elevated blood pressure

The mean systolic and diastolic blood pressure (SBP and DBP) were 128 ± 20 mmHg and 81 ± 12 mmHg, respectively. The prevalence of elevated blood pressure was 46.7% (95% CI 45.2–48.2%). There was no sex predilection for elevated blood pressure (45.9% for females, 47.9% for males, P = 0.19). The prevalence of elevated blood pressure increased with higher age [28.8% for the age group less than 20 years; 30.8% for the 20–40 years group; 54.9% for the 40–60 years age group, and 68.4% among those greater than 60 years; the P value for trend <0.001). Of those with elevated blood pressure, 51.4% were previously diagnosed with hypertension and on regular blood pressure-lowering medication. Newly diagnosed elevated blood pressure was found in 958 (30.2% of those reporting not being previously diagnosed with hypertension).

Elevated blood glucose

The prevalence of elevated blood glucose was 7.4% (95% CI 6.7–8.2%); 7.7% for females and 7.1% for males, P = 0.49. This prevalence also increased with age [1.5% for the age group less than 20 years; 2.3% for the 20–40 years group; 8.1% for the 40–60 years group, and 21.6% among those greater than 60 years; the P value for trend <0.001)].

Obesity

The prevalence of obesity was 24.1% (95% CI 22.8–25.4%). Females were more likely to be obese (29.5% versus 15.9%, P < 0.001). Obesity prevalence increased up to the age of 60 years before declining [9.1%, 17.2%, 31.3%, 20.3% for age groups less than 20 years, 20–40, 40–60, and above 60 years, respectively, P < 0.001]. Those who were at least overweight constituted 60.6% of the study population.

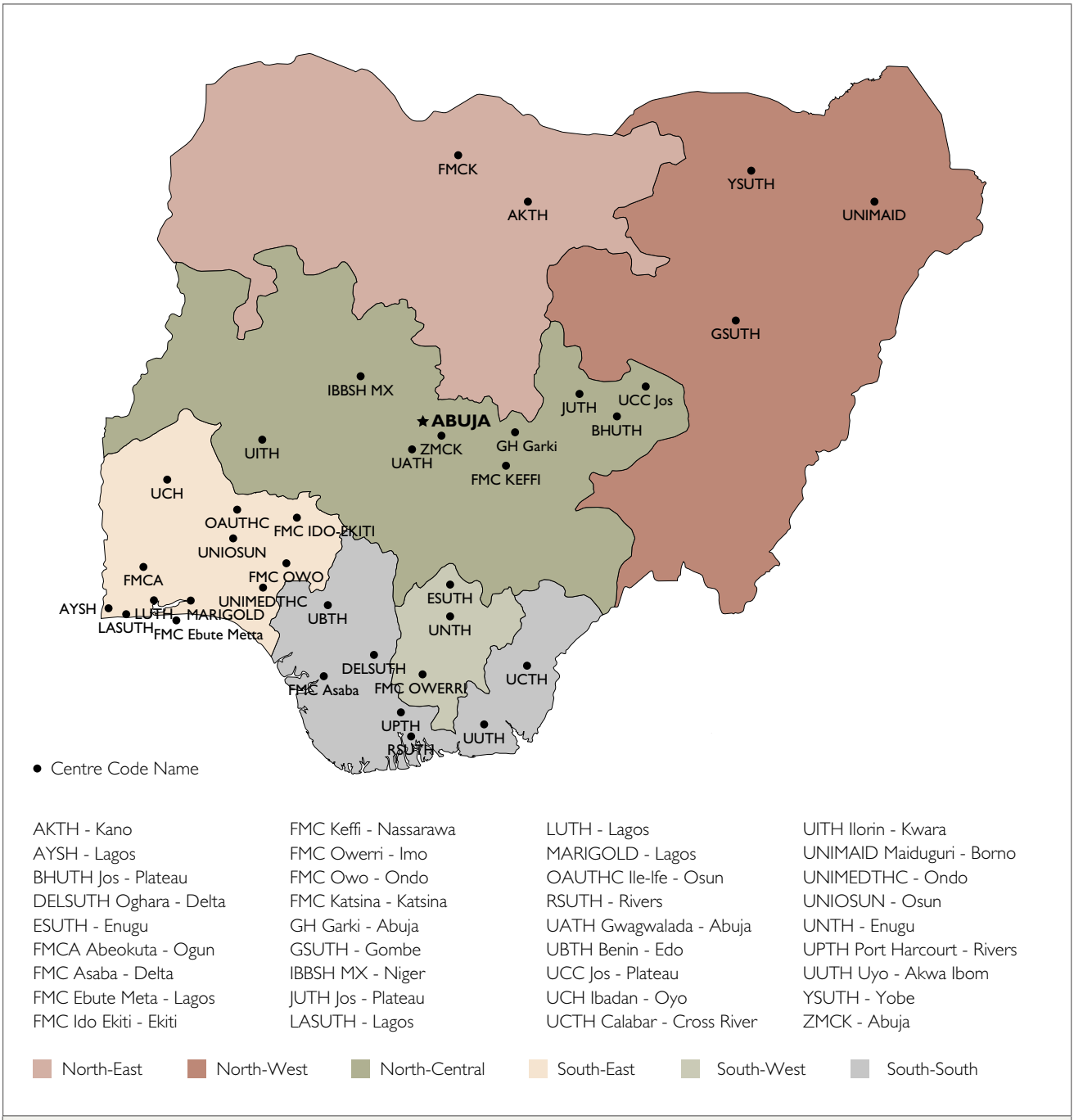

Figure 1. Geographical Distribution of Screening Centres in Nigeria.

Proteinuria

Dipstick proteinuria was positive in 856 [19.9% (95% CI 18.7–21.1%)]. There was no sex predilection with the prevalence of proteinuria (19.8% for females and 20.0% for males, P = 0.84).

Prevalence of kidney dysfunction

There was a wide geographical variation in the kidney dysfunction prevalence across the geopolitical zones (North-Central 12.0%; North-East 17.4%; North-West 12.7%; South-East 7.1%; South-West 18.3%; and South-South 13.4%).

For the 3,201 patients (74.2% of the participants) who had serum creatinine measured, the pooled proportion of those with eGFR less than 60 mL/min/1.73 m^2 was 13.7% (95% CI 11.1–16.5%), I2 = 75.3%, P = 0.001 (Figure 3). There was a higher proportion of females with reduced eGFR (17.4% versus 10.4%, P < 0.001). There was also a stepwise increase in the proportion of kidney dysfunction across the age groups [1.9%, 6.1%, 15.3%, and 34.3% for those less than 20 years, 20–40 years, 40–60 years and greater than 60 years, respectively, P < 0.001 for trend]. eGFR 30–60 mL/min/1.73 m^2 was found in 11.8%, eGFR of 15–30 mL/min/1.73 m^2 was recorded in 1.2%, whereas 0.9% had eGFR less than 15 mL/min/1.73 m^2.

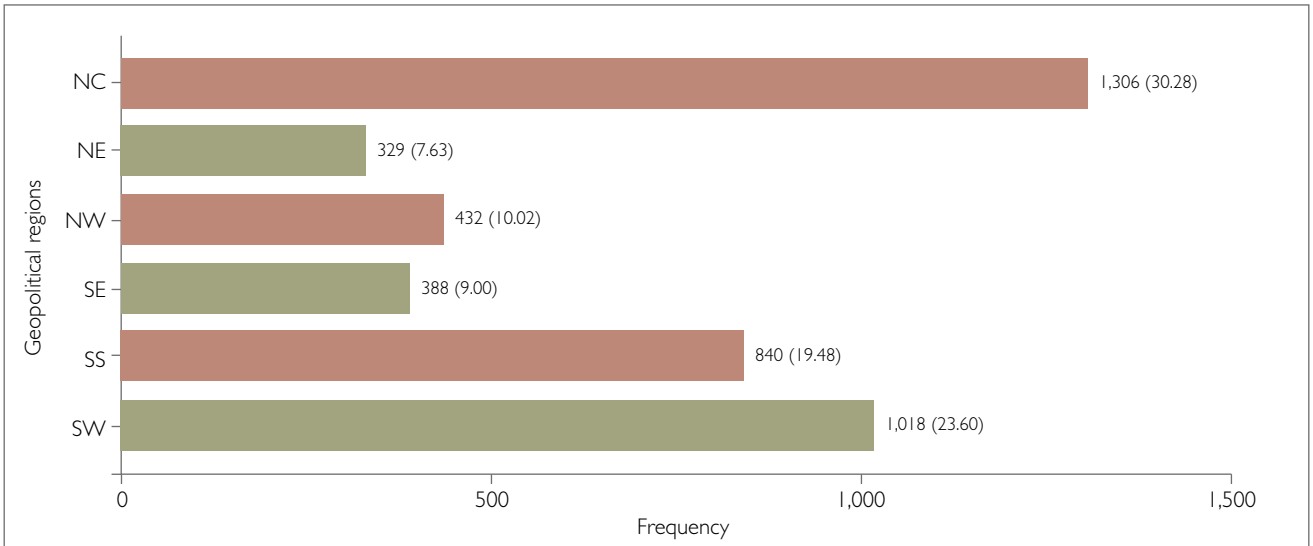

Figure 2. Distribution of participants across the six geopolitical regions in Nigeria.
Geopolitical regions: NC, North-Central; NE, North-East; NW, North-West; SE, South-East; SS, South-South; SW, South West.

Table 1. Sociodemographic, anthropometric and clinical characteristics of study population by geopolitical region.

	Total (N=4,313)	NC (n=1,306)	NE (n=329)	NW (n=432)	SE (n=388)	SS (n=840)	SW (n=1,018)	P
Age (years)	43.07±13.35	41.71±11.93	41.38±14.07	38.83±13.91	41.49±14.90	44.33±11.91	46.70±14.10	<0.001
Female sex n (%)	2603 (60.35)	702 (53.75)	202 (61.40)	207 (47.92)	214 (55.15)	543 (64.64)	735 (72.20)	<0.001
Tertiary education level (n = 2,895)	1487 (51.36)	314 (52.16)	86 (33.86)	61 (61.62)	177 (47.07)	425 (63.06)	424 (47.64)	<0.001
Prior HTN (n = 4190)	1014 (24.20)	265 (20.29)	97 (29.48)	72 (23.30)	105 (27.06)	211 (25.12)	264 (25.93)	0.001
HTN	1694(41.83)	445 (38.16)	97 (29.48)	156 (50.49)	191 (49.23)	364 (43.33)	441 (43.32)	<0.001
Regular BP medication	576 (14.22)	179 (15.35)	63 (19.15)	0 (0.00)	40 (10.31)	132 (15.71)	162 (15.91)	<0.001
Diabetes mellitus	320 (7.42)	71 (5.44)	28 (8.51)	32 (7.41)	32 (8.25)	72 (8.57)	85 (8.35)	0.05
BMI (kg/m^2)	26.73±5.82	26.92±5.57	26.03±6.61	25.01±6.04	26.57±5.34	27.08±5.52	27.21±6.05	<0.001
Obesity	1038 (24.07)	344 (26.34)	72 (21.88)	78 (18.06)	76 (19.59)	215 (25.60)	253 (24.85)	0.002
Obesity + overweight	2615 (60.63)	814 (62.33)	163 (49.54)	183 (42.36)	242 (62.37)	535 (63.69)	678 (66.60)	<0.001
Tobacco use	186 (4.31)	28 (2.14)	18 (5.47)	22 (5.09)	25 (6.44)	35 (4.17)	58 (5.70)	<0.001
Regular alcohol use	698 (16.18)	105 (8.04)	10 (3.04)	14 (3.24)	101 (26.03)	334 (39.76)	134 (13.16)	<0.001
Dipstick proteinuria	856 (19.85)	223 (17.08)	71 (21.58)	18 (4.17)	131 (33.76)	164 (19.52)	249 (24.46)	<0.001
$eGFR_{CKD-EPI}$ (n = 3,195)	90.34±29.00	91.33±27.21	78.64±23.90	93.77±29.58	105.26±26.90	86.23±24.77	92.21±35.20	<0.001

Abbreviations: HTN, Elevated blood pressure; BMI, body mass index; eGFRCKD-EPI, estimated glomerular filtration rate using the 2021 CKD–EPI equation.
Geopolitical regions: NC, North-Central; NE, North-East; NW, North-West; SE, South-East; SS, South-South; SW, South-West.

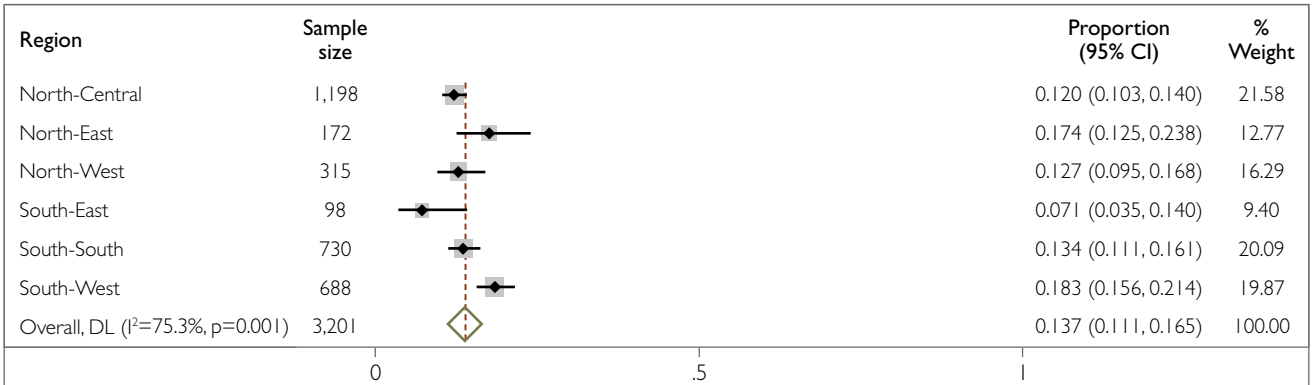

Figure 3. Pooled estimate of kidney dysfunction prevalence across Nigeria.
Note: Weights are from random effects model.

The proportion of individuals with either a positive dipstick or eGFR less than 60 mL/min/1.73 m^2 was 29.6% (95% CI 27.9–31.3%) with a female predilection [32.3% versus 25.4%, P < 0.001]. Table 2 shows the prevalence of kidney dysfunction in relation to each of the traditional CKD risk factors measured. Kidney dysfunction prevalence was highest among those with elevated blood glucose levels, with the obesity group having the least kidney dysfunction prevalence.

Independent association with kidney dysfunction

The factors independently associated with kidney dysfunction include increasing age, being female, having elevated blood pressure, and blood glucose. The relationship between increasing BMI, using alcohol or tobacco did not achieve statistical significance (Table 3).

DISCUSSION

CKD disproportionately affects individuals of African descent. The excess burden of CKD has been attributed to the presence of the high-risk Apolipoprotein 1 gene (APOL1) and the high prevalence of other modifiable and non-modifiable risk factors for CKD [21]. Despite the availability of many relevant epidemiological data in Nigeria, most of these data are from single-centre or regional studies and, therefore, are not representative of the country's aggregate data. The study reported here documents the findings from the WKD 2022 screening for CKD and its risk factors across the six geopolitical zones in Nigeria. They reveal a high prevalence of CKD and its common risk factors.

The prevalence of hypertension in this study was 46.7%, which is higher than reports from previous single-centre or regional studies on hypertension in different parts of Nigeria. Sola et al. [22] in Abuja reported an overall prevalence of 22.7%, whereas Okubadejo et al. [23] in Lagos and Ulasi et al. [24] in Enugu reported 32.8% and 22.8%, respectively. The disparity suggests that a single-centre or regional-based study on hypertension may not reflect the true overall prevalence of hypertension in the country. The trends observed from most studies suggests that prevalence of hypertension varies from one community to the other. To buttress this observation in the index study, most systematic reviews and meta-analyses of Nigerian studies on hypertension reported prevalence rates that are similar to what is reported here. Ogah et al. [25] and Akinlua et al. [26] reported a pooled prevalence of 8–46.4% and 9.5–51.6%, respectively, in the meta-analyses among the Nigerian studies of hypertension at various times.

The prevalence of elevated blood pressure significantly increased with age from 30.8% in those below 20 years to 68.4% in those above 60 years. This supports the previously established linear relationship between age and the prevalence of elevated blood pressure [27]. The greater prevalence of elevated blood pressure in older age groups may partly explain higher cardiovascular disease compared to the younger population. The high prevalence of elevated blood pressure in those of greater age has been attributed to some age-related physiological changes such as loss of proximal arterial compliance, loss of baroreceptor sensitivity, increase in the responsiveness of the sympathetic nervous system, and sympathetic overdrive and high sodium retention [27,28]. Furthermore, an elevated blood pressure prevalence of 30.8% in individuals younger than

Table 2. Kidney dysfunction prevalence in select risk factor groups.

Risk factor	Prevalence (95% CI)(%)
Elevated blood pressure	19.2 (17.2–21.4)
Elevated blood glucose	32.2 (26.6–38.8)
Obesity	15.8 (13.3–18.6)

Table 3. Univariate and multivariate logistic regression models for independent association with kidney dysfunction.

	Univariate model Odds ratio (95% CI) P value	Multivariate model Odds ratio (95% CI) P value
Age (years)	1.06 (1.05–1.06) <0.001	1.05 (1.04–1.06) <0.001
Female Sex	1.77 (1.41–2.20) <0.001	1.78 (1.40–2.26) <0.001
Elevated blood pressure	2.24 (1.82–2.75) <0.001	1.41 (1.13–1.77) 0.003
Elevated blood glucose	3.40 (2.54–4.55) <0.001	1.96 (1.43–2.69) <0.001
BMI (kg/m^2)	1.03 (1.01–1.04) 0.002	1.01 (0.99–1.02) 0.59
Tobacco use	0.55 (0.29–1.02) 0.06	0.71 (0.36–1.38) 0.31
Alcohol use	0.68 (0.50–0.91) 0.01	0.74 (0.53–1.02) 0.07

Pearson's goodness-of-fit P value = 0.96. Area under the ROC curve for the final model = 0.74.

20 years is high and may explain the rise in cardiovascular morbidity and mortality in the younger population. The changing epidemiology of elevated blood pressure in a young population mirrors the rising risk factors for elevated blood pressure in the young; such factors include obesity, cigarette smoking, sedentary lifestyle and drug abuse [29].

Diabetes mellitus (DM) is the leading cause of ESKD worldwide, and its prevalence has been on the rise, especially in low- and middle-income countries. A recent systematic review of studies on the prevalence of DM in Nigeria by Uloko et al. [30] estimated the overall pooled prevalence to be 5.7%, showing an increase in the nationwide prevalence of 2.2% reported in 1992 [31]. In this index study, we found the prevalence of elevated blood glucose to be 7.4%, which increased significantly with the age of participants. The higher prevalence of DM observed in our study could be attributed to increased surveillance and improved care of DM, rapid urbanisation, and economic growth. Other risk factors contributing to the prevalence of DM reported in other studies include poor dietary patterns, sedentary lifestyles, rising obesity, and increasing age, among other traditional factors [32]. The growing prevalence and incidence of DM worldwide also mirrors the increasing burden of cardiovascular disease and end-stage kidney disease [33].

Obesity has become a global epidemic with increased adoption of a sedentary lifestyle, poor dietary habits, and urbanisation, which has contributed to the growing burden of obesity and its complications. We observed an obesity prevalence of 24.1%, which increased with age until 60 years. Obesity does not only increase the risk of kidney disease in the general population but also raises the risk of progression in individuals with pre-existing kidney disease [34]. The impact of obesity on the burden of cardiovascular and renal disease cannot be over-emphasised and, therefore, health education on ways to prevent obesity should be promoted.

Proteinuria is an important marker of kidney damage, and its measure correlates with the severity of kidney damage. In our study, a prevalence of 19.9% was observed among the participants. This is higher than 12.4% reported by Nwachukwu et al. [35] among the adult population in Port Harcourt and 13.0% observed in Kampala, Uganda, by Lunyera et al. [36]. The finding in our study is similar to the 19% reported by Ulasi et al. [9] among the adult population in South-Eastern Nigeria. The assessment of proteinuria in our study was performed by using a dipstick, which is relatively available in the LMICs; its low sensitivity often leads to underestimation of kidney damage and makes early detection impossible as compared to testing for microalbuminuria [37]. The fact that urinalysis was carried out once by participants and urinary tract infection was not excluded may have overestimated the prevalence of proteinuria.

The prevalence of kidney dysfunction in this study was 13.7%, which supports previous reports of high prevalence of CKD among the Nigerian population. The prevalence in this study is similar to the 13.9% and 15.8% reported in sub-Saharan Africa by Stanifer et al. [8] and Kaze et al. [38], respectively, in two different systematic reviews and meta-analyses. The high burden of CKD in the population has been attributed to the high frequency of the high-risk variants of the Apolipoprotein 1 gene, environmental factors, infections, nephrotoxins and the high prevalence of elevated blood pressure and DM [21].

The high prevalence of kidney dysfunction and common risk factors of CKD provided an estimate of the burden of kidney disease among the adult Nigerian population based on nationwide data. The availability of accurate data on the true burden of CKD has policy implications. This will allow for evidence-based advocacy, adequate planning, the institution of appropriate management plans for those affected, and preventative strategies for the general population. In addition, such data will also guide policy, allocation of resources and nephrology research for the nation.

The study is not without limitations, which include the fact that the majority of the participants were from urban regions, so that the findings may not reflect the outlook in rural communities. In addition, the markers of kidney damage were measured only once and may therefore overestimate the true prevalence of proteinuria and reduced eGFR. Serum creatinine was analysed at individual participating centres and may be prone to inter-laboratory variability. Another important limiting factor is the use of dipstick to record proteinuria instead of the urinary albumin–creatinine ratio, which has better sensitivity for detecting albuminuria. A single blood pressure measurement is likely to overestimate the prevalence of hypertension. Similarly, random blood glucose alone will underestimate diabetes mellitus prevalence. Again, being a kidney disease screening programme, which was publicised prior to the screening undertaken at kidney centres, it is possible that individuals with increased risk of CKD came in to have free tests. This may have created a selection bias, causing kidney dysfunction prevalence to be overestimated. Overall, this estimate of the burden of kidney dysfunction across the country will serve as an advocacy tool for increased investment in public health intervention measures to prevent kidney dysfunction and slow down CKD progression when diagnosed early.

Acknowledgement

The authors would like to acknowledge the financial contributions by the Nigerian Association of Nephrology. The authors also wish to thank all the participants who

willingly consented to participate in the study. We also thank all the members of the NAN WKD working group listed in the supplementary data.

Conflict of interest

The authors have no conflicts of interest to declare.

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