Original Article

Chronic kidney Disease Risk Factors in Workers of an Agricultural Research Institute in Southern Nigeria

Enajite I. Okaka, Bibiana O. Eiya[1], Afeaje B. Olokor, Ikponmwosa O. Iyawe, Chimezie G. Okwuonu[2], Oluseyi A. Adejumo[3], Odigie E. Ojeh-Oziegbe, Frank A. Imarhiagbe, Evelyn I. Unuigbe

Department of Medicine, University of Benin, [1]Department of Medical Biochemistry, University of Benin, Benin City, [2]Department of Internal Medicine, Federal Medical Centre, Umuahia, Abia, [3]Kidney Care Centre, Ondo, Ondo, Nigeria

Abstract

Background: The incidence and prevalence of chronic kidney disease (CKD) is on the increase worldwide. Treatment for end-stage kidney disease constitutes a huge burden on the economy of nations affected. Early identification, modification, and treatment of CKD risk factors are the best options. **Objective:** This study assessed common CKD risk factors in a population of workers in an organization. **Materials and Methods:** A cross-sectional survey that involved 242 workers in an agricultural research institute. CKD risk factors assessed were hypertension (HTN), hyperglycemia, abdominal obesity using waist–hip ratio (WHR), general obesity using body mass index (BMI), proteinuria, and serum creatinine. **Results:** The prevalence of HTN, elevated blood sugar, general obesity, abdominal obesity, proteinuria, and elevated serum creatinine were 47.1, 9.7, 14.2, 66.5, 5.9, and 20.4%, respectively. Older participants were more likely to have elevated blood pressure, BMI, WHR, and blood sugar serum creatinine. Being a known hypertensive was associated with elevated BMI, WHR, and blood sugar compared with those without a previous diagnosis of HTN. **Conclusion:** The presence of HTN and being middle aged to elderly was associated with higher CKD risk. Workers in organizations should have mandatory annual screening for CKD and its risk factors to aid risk modification, early detection, and treatment.

Keywords: *Hyperglycemia, hypertension, obesity, risk factors for chronic kidney disease*

Introduction

Chronic kidney disease (CKD) contributes significantly to global disease burden with a worldwide prevalence of about 10%.[1] However, CKD incidence and prevalence is on the increase, for deaths from CKD rose by 32.1% from 2005 to 2015.[2] End-stage renal disease (ESRD), which is the end result of all renal insults, constitutes a great burden to treat. The definitive treatment for ESRD either in the form of dialysis or kidney transplantation is expensive to initiate and maintain. In the United States, CKD treatment costs billions of dollars and is now likely to exceed $48 billion yearly.[3]

In Nigeria, the prevalence of CKD is not known, but several studies, mostly hospital based, suggest a range of 1.6 to 12.4%.[4] CKD sufferers in Nigeria are mostly from the young or middle-aged group who make a majority of the work force.[5] Thus, CKD has far reaching effects on the Nigerian economy. The main causes of CKD among Nigerians include chronic glomerulonephritis, hypertension (HTN), and diabetes mellitus.[6] Diabetes initially was not a common cause of ESRD among Nigerians, but it is now becoming a more prominent etiological factor.[7]

The treatment of CKD and ESRD is expensive and mostly unaffordable to Nigerians. The high mortality seen in Nigerian CKD patients is largely because of inadequate

Address for correspondence: Dr. Enajite I. Okaka, Renal Unit, Department of Medicine, University of Benin, Benin City, Edo State, Nigeria.
E-mail: enajite.okaka@uniben.edu

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treatment due to a paucity of funds. CKD can be asymptomatic until the victim gets to ESRD. Thus, regular health screening exercises, which test renal function and detect CKD risk factors, would aid early diagnosis of CKD.

As part of the World Kidney Day (WKD) activities of 2014, we set out to screen a group of workers in an agricultural research institute for the presence of CKD and its risk factors. Findings in this study would contribute to the knowledge of CKD risk and prevalence among Nigerians.

Materials and Methods

This study was a cross-sectional study carried out on WKD 2014 which held on Thursday, March 13th. The Hospital Ethics Committee gave ethical clearance for the study. Permission was requested from and granted by the management of the Nigerian Institute for Oil Palm Research, Benin City, for a screening of its workers on WKD 2014. Workers at the institute were informed of the proposed screening exercise.

Pregnant women and persons younger than 18 years of age were excluded from the study. A health talk was given to participants on CKD and its risk factors, after which, questionnaires were interviewer-administered and information on age, sex, history of HTN, and/or diabetes obtained. Height, weight, and blood pressure (BP) of participants were measured. Urine samples were obtained for urinalysis, whereas blood samples were collected for determination of random blood sugar (RBS) and serum creatinine.

Height was measured in centimeters (cm) to the nearest 0.5 cm using a stadiometer. Weight was measured in kilograms (kg) to the nearest 0.5 kg using standardized weighing scales. Body mass index (BMI) was calculated as weight (kg)/height squared (m^2). Participants were classified based on BMI according to the World Health Organization (WHO)'s guidelines as underweight (BMI < 18.5 kg/m^2), normal (BMI 18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), or obese (BMI ≥ 30 kg/m^2).[8]

BP was measured using mercury sphygmomanometers in the sitting position. The average of two BP measurements taken 5 min apart in the left arm was recorded for each participant. HTN was taken as the presence of systolic BP (SBP) ≥ 140 mm and/or diastolic BP (DBP) ≥ 90 mmHg.[9] Systolic HTN was defined as SBP ≥ 140 mmHg with a DBP < 90 mmHg, whereas diastolic HTN was defined as DBP ≥ 90 mmHg with a SBP < 140 mmHg. Participants who admitted to being known hypertensives were considered to have good BP control using a cutoff BP value of <140/90 mmHg. The prevalence of HTN in the study population was taken as the number of self-reported known hypertensives and persons found to have HTN during the study.

Waist–hip ratio (WHR) was determined using the waist circumference (measured at the midpoint between the lowest rib margin and the iliac crests) and the hip circumference (measured at the widest point around the buttocks). Abdominal obesity was taken as WHR > 0.85 for women and WHR > 0.9 for men.[10]

Urinalysis was done using meditest strips to check for the presence of protein, blood, or glucose.

RBS was done using glucose meters and strips (Accu-Chek, Roche diagnostics, Mannheim, Germany). Blood sugar levels ≥200 mg/dl were considered high and abnormal.

Blood samples obtained for determination of serum creatinine were centrifuged, serum obtained, and creatinine determined using the modified Jaffe's method. Serum creatinine ≥1.5 mg/dl was considered abnormal and suspicious of CKD.

Statistical Analysis

Data obtained were analyzed using IBM/SPSS Statistics version 21 (Armonk, New York, USA). Quantitative data were presented as means and standard deviation (SD), whereas qualitative data were presented as frequencies and percentages. Means were compared using the independent samples *t* test analysis for two groups, whereas analysis of variance (ANOVA) and Tukey HSD (Honest Significant Difference) was used to compare three or more groups and *post hoc* analysis, respectively. Statistical significance was taken at $P < 0.05$.

Results

The population screened consisted of 242 persons, 110 men (45.5%) and 132 women. The age distribution of participants was as follows: 83 (34.3%) less than 40 years of age, 115 (47.5%) 40 to 64 years, and 44 (18.2%) 65 years and above. Obesity was seen in 34 (14.2%), whereas 64 (26.3%) were overweight. Abdominal obesity based on high WHR was observed in 161 (66.5%) of participants. Twelve (5.2%) participants were known diabetics, whereas RBS was elevated in 24 (9.7%). Serum creatinine level was elevated in 38 (20.4%), whereas 14 (5.8%) participants had proteinuria [Table 1].

Sixty-eight (28.1%) participants were known hypertensives on treatment, whereas 174 (71.9%) were not known hypertensives [Figure 1]. Thirty-nine (60.9%) of the known hypertensives had good BP control [Figure 2]. Incident HTN was seen in 46 (19.0%) of participants without a previous diagnosis of HTN [Figure 3]. The prevalence of HTN among study participants was 114 (68 known and 46 incident hypertensives) out of 242 making 47.1%.

Mean parameters of study participants largely fell within normal range values [Table 2].

Table 1: Characteristics of the study population (N = 242)

Parameter	Frequency (%)
Gender	
Male	110 (45.5)
Female	132 (54.5)
Age groups (years)	
<40	83 (34.3)
40–64	115 (47.5)
≥65	44 (18.2)
Body mass index	
Underweight/normal	144 (59.5)
Overweight	64 (26.3)
Obese	34 (14.2)
Systolic hypertension	
Yes	78 (32.2)
No	164 (67.8)
Diastolic hypertension	
Yes	64 (26.4)
No	178 (73.6)
BP ≥ 140/90 mmHg	
Yes	86 (35.5)
No	156 (64.5)
Known hypertensive	
Yes	68 (28.1)
No	174 (71.9)
Abdominal obesity	
Yes	161 (66.5)
No	81 (33.5)
Random blood sugar	
Normal	218 (90.3)
Elevated	24 (9.7)
Proteinuria	
Yes	14 (5.8)
No	228 (94.2)
Serum creatinine (mg/dl)	
≥1.5	38/186 (20.4)
<1.5	148/186 (79.6)

BP = blood pressure

Mean parameters of male and female participants were compared using independent samples t test analysis. Males were significantly older than the females, whereas females were more likely to be overweight or obese [Table 3]. Mean SBP, DBP, WHR, and RBS were significantly higher in males. Mean serum creatinine level was not different between the sexes.

A one-way ANOVA between age groups was conducted to compare the effect of age on mean BMI, SBP, DBP, WHR, RBS, and serum creatinine level. Age had a significant effect on SBP (P = 0.000), DBP (P = 0.000), WHR (P = 0.000), RBS (P = 0.000), and serum creatinine (P = 0.034) [Table 4].

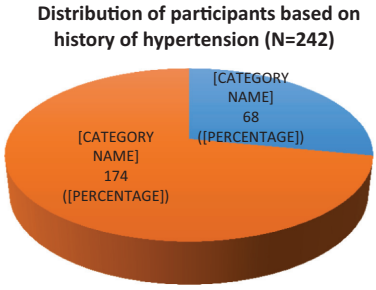

Figure 1: Distribution of participants based on history of hypertension (N=242)

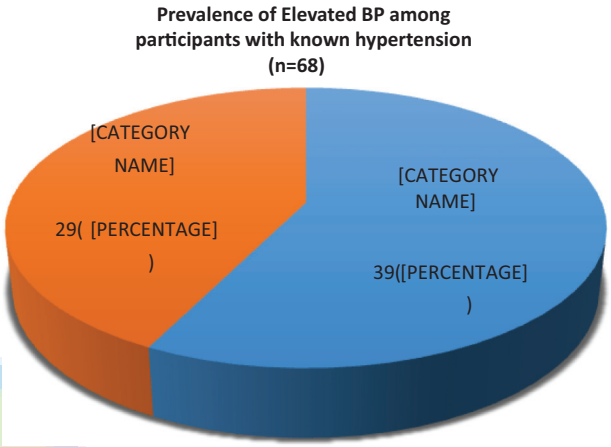

Figure 2: Prevalence of Elevated BP among participants with known hypertension (n=68)

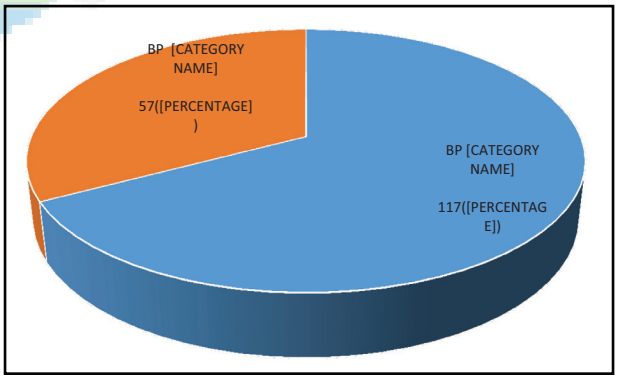

Figure 3: Prevalence of elevated BP in participants without reported history of hypertension (n=174)

Post hoc comparisons using Tukey HSD test

Mean SBP of study participants less than 40 years old (M = 120.6, SD = 16.5) was significantly lower than that of age group 40 to 64 years (M = 129.4, SD = 19.3) and age group ≥65 years (M = 85.6, SD = 24.1).

Mean DBP of participants aged <40 years (M = 74.8, SD = 11.3) was significantly lower than that of age group 40 to 64 years (M = 79.5, SD = 11.2) and age group ≥65 years (M = 85.6, SD = 15.6).

Mean WHR of participants <40 years of age ($M = 0.88$, SD = 0.07) was significantly lower than that of age group 40 to 64 years ($M = 0.91$, SD = 0.07) and age group ≥65 years ($M = 0.97$, SD = 0.06).

Mean RBS of age group ≥65 years ($M = 149.1$, SD = 72.7) was significantly higher than that of age group <40 years ($M = 107.6$, SD = 35.8) and age group 40 to 64 years ($M = 118.5$, SD = 49.8). There was no significant difference between mean RBS for age groups <40 and 40 to 64 years.

Mean serum creatinine level of participants aged ≥65 years (M=1.4, SD=0.7) was higher than that of age group 40 to 64 years ($M = 1.1$, SD = 0.4). There was no significant difference between mean serum creatinine of age group <40 years compared with age group ≥65 years.

This analysis result suggests that increasing age is associated with higher SBP, DBP, WHR, and RBS.

Comparison of mean parameters between participants previously diagnosed with HTN and those without such history was done using independent *t* test analysis. The known hypertensive patients were older, had higher BMI, SBP, DBP, WHR, and RBS compared to persons without a previous HTN diagnosis [Table 5].

Discussion

The CKD risk factors considered in this study were HTN, diabetes, abdominal obesity, general obesity, and proteinuria.

The prevalence of HTN among study participants was 47.1%. This value is high compared to 37.6% reported by Isara and Okundia[11] among rural dwellers in southern Nigeria. Possible reasons for the difference are that we included self-reported hypertensive patients in estimating HTN prevalence, which was not done in the aforementioned study. Secondly, study participants were

Table 2: Mean parameters of study participants

Parameter	Minimum	Maximum	Mean (SD)
Age (years)	21	80	47.52 (15.24)
BMI (kg/m^2)	15.63	43.75	24.86 (4.82)
SBP (mmHg)	88	200	128.83(20.84)
DBP (mmHg)	49	120	78.93 (12.67)
WHR	0.65	1.13	0.91 (0.07)
RBS (mg/dl)	68	335	120.22 (52.48)
Serum creatinine (mg/dl)	0.2	5.1	1.17 (0.62)

BMI = body mass index, DBP = diastolic blood pressure, RBS = random blood sugar, SBP = systolic blood pressure, SD = standard deviation, WHR = waist–hip ratio

Table 3: Comparison of mean parameters of participants according to gender

Parameter	Male	Female	*P* value
Age (years)	54.07 (14.9)	41.97 (13.1)	0.000
BMI (kg/m^2)	22.9 (3.2)	26.5 (5.3)	0.000
SBP (mmHg)	132.5 (20.7)	125.7 (20.4)	0.012
DBP (mmHg)	80.9 (12.7)	77.2 (12.4)	0.022
WHR	0.93 (0.07)	0.89 (0.07)	0.000
RBS (mg/dl)	129.41 (63.1)	112.8 (40.7)	0.020
Serum creatinine (mg/dl)	1.18 (0.49)	1.16 (0.07)	0.815

BMI = body mass index, DBP = diastolic blood pressure, RBS = random blood sugar, SBP = systolic blood pressure, WHR = waist–hip ratio

Table 4: Comparison of mean parameters of participants according to age groups

Parameter	<40 years	40–64 years	≥65 years	*P* value
BMI (kg/m^2)	24.99 (4.69)	25.04 (4.95)	24.23 (4.80)	0.630
SBP (mmHg)	120.62 (16.48)	129.38 (19.26)	143.37 (24.05)	0.000
DBP (mmHg)	47.78 (11.34)	79.50 (11.23)	85.61 (15.57)	0.000
WHR	0.88 (0.07)	0.91 (0.06)	0.97 (0.05)	0.000
RBS (mg/dl)	107.56 (35.76)	118.48 (49.78)	149.14 (72.70)	0.000
Serum creatinine (mg/dl)	1.16 (0.78)	1.08 (0.40)	1.41 (0.70)	0.034

BMI = body mass index, DBP = diastolic blood pressure, RBS = random blood sugar, SBP = systolic blood pressure, WHR = waist–hip ratio

Table 5: Comparison of mean parameters of participants based on previous hypertension diagnosis

Parameter	Known hypertensive	Not a known hypertensive	*P* value
Age (years)	54.73 (13.40)	45.07 (15.28)	0.000
BMI (kg/m^2)	26.72 (5.06)	24.12 (4.30)	0.000
SBP (mmHg)	142.11 (21.80)	123.96 (18.30)	0.000
DBP (mmHg)	85.16 (13.19)	76.43 (11.36)	0.000
WHR	0.94 (0.07)	0.90 (0.07)	0.000
RBS (mg/dl)	134.39 (64.01)	115.80 (47.86)	0.039
Serum creatinine (mg/dl)	1.19 (0.55)	1.17 (0.65)	0.843

BMI = body mass index, DBP = diastolic blood pressure, RBS = random blood sugar, SBP = systolic blood pressure, WHR = waist–hip ratio

urban dwellers as opposed to rural dwellers in the study by Isara and Okundia. A systematic review on the pattern of HTN among Nigerians showed HTN to be more prevalent among urban dwellers compared to residents in rural areas.[12] Ajayi *et al.*,[13] in south-western Nigeria, found an HTN prevalence of 33.1% among residents of an urban slum, whereas Gezawa *et al.*,[14] in their study in north-eastern Nigeria, found an HTN prevalence of 32.3%. A probable reason for the high HTN prevalence in the index study compared to the aforementioned is the sampling technique. Both Gezawa *et al.* and Ajayi *et al.* used a random sampling technique to recruit members of the community or local government, whereas participants at the research institute were invited for a health screening exercise with the possibility that persons with HTN and or diabetes were better motivated to participate in the study.

Male participants had higher mean SBP and DBP with HTN in 43.1% of them compared to female participants who had lower mean SBP and DBP and an HTN prevalence of 29.5%. Several reasons have been proposed for the preponderance of HTN in men compared to women. The sex hormones have been postulated to play a role, as postmenopausal women tend to have more HTN compared to men of similar age. This is supported by Ninios *et al.*[15] who reported a higher prevalence of HTN among elderly females compared to elderly males.

BP control among participants who self-reported a previous history of HTN was 39.1%. This value is high compared to 35%[16] and 24%[17] reported among hospital treated hypertensives in eastern and southern Nigeria, respectively. This may represent a better health seeking behavior and awareness of HTN among participants of the index study.

Obesity and overweight were seen in 14.2 and 26.3% of study participants, respectively, and was more prevalent among female participants and middle-aged to elderly participants. These prevalence values are within the range reported in a systematic review of obesity and overweight in Nigeria.[18] Female gender, increasing age, and high socioeconomic status has been reported to be associated with obesity and overweight among Nigerians.[19] The prevalence of abdominal obesity using WHR was 60%. This value is high compared to the 14.2% of participants with generalized obesity using BMI. WHR has been reported to be a poor predictive index of generalized obesity, and this may explain our finding.[20] Participants with diabetes made up 5.2% and RBS was above normal range values in 23 (9.7%) participants. Participants 65 years and above had higher mean RBS. This may represent part of the metabolic syndrome which tends to increase with advancing age.[21,22] Diabetes among Nigerians is on the increase with an increase in prevalence from about 2.2% in 1997[23] to 5% as at 2013.[24] CKD from diabetic nephropathy can be prevented if diabetes is diagnosed early and treated appropriately to prevent complications. Proteinuria was seen in few participants (5.9%). This may be explained by the low prevalence of diabetes among participants and hence diabetic nephropathy which is associated with proteinuria.

Serum creatinine was elevated in 38 (20.4%) participants and those 65 years and above had higher mean serum creatinine compared to younger participants. Serum creatinine is known to increase with age, whereas kidney function declines with age. There is no accepted consensus on reasons for age-related decline in kidney function. The question has been whether the decline in kidney function is physiological or due to comorbidities in the elderly. In a longitudinal study to determine age-related decline in renal function, a third of healthy elderly patients did not have any decline in renal function after a 10-year follow-up.[25] However, in a study that involved nondiabetic persons 65 years or older, showed that comorbidities like HTN and cardiovascular risk factors like cigarette smoking appear to contribute to the decline in renal function that occurs in affected elderly persons.[26]

This study was limited by its cross-sectional nature and possible recruitment bias as selection of participants was not random.

In conclusion, increasing age and being a known hypertensive was associated with more CKD risk factors. We recommend mandatory yearly CKD screening of middle-aged and hypertensive workers of organizations so as to ensure early detection and appropriate treatment of CKD and its risk factors.

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Conflicts of interest
There are no conflicts of interest.

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