

Community Screening for Pre-hypertension, Traditional Risk Factors and Markers of Chronic Kidney Disease in Ondo State, South-Western Nigeria

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Abstract

Background: Chronic kidney disease (CKD) has become an epidemic with many recognised risk factors. However, the role of pre-hypertension in CKD is yet to be fully studied in our environment. **Objectives:** We set out to determine the magnitude of pre-hypertension and traditional CKD risk factors. We also determined their relationships to proteinuria. **Subjects and Methods:** This was a descriptive, cross-sectional study conducted in two urban local government areas (Akure South and Ondo West) in Ondo State, Southwest Nigeria in March 2014. A total of 1,183 adults (M:F, 0.63:1) were studied. Their bio-data, history of cigarette smoking, alcohol intake, herbal usage, non-steroidal anti-inflammatory drugs (NSAIDs), diabetes and hypertension were obtained. A total of 1,183 adults (M:F, 0.63:1) blood pressure (BP) and anthropometry were determined. Urinalysis was conducted using Combi-Uriscreen® 10SL. Data were analysed using the Statistical Package for the Social Sciences version 20.0. **Results:** A total of 1183 adults (M:F, 1:1.6) were studied with a mean age of 44.7 ± 17.4 years. Their mean systolic BP, diastolic BP and body mass index were 129.6 ± 23.7 mmHg, 79.8 ± 14 mmHg and 26.2 ± 5.8 kg/m², respectively. Pre-hypertension was present in 32.3% of the subjects, while hypertension was present in 43.4% of the subjects; 6.2% gave history of diabetes, 4.5% smoked cigarette, 68.3% used herbs and 44.1% used NSAIDs. Proteinuria was present in 25.9% of the subjects, while haematuria was present in 1.7% of the subjects. BP and age showed significant association to proteinuria. **Conclusion:** Pre-hypertension and known risk factors of CKD are prevalent in the people of Ondo State, Nigeria. Individuals with persistent pre-hypertension should be routinely screened for CKD and referred to the Nephrologist for early intervention.

Keywords: Chronic kidney disease, nigeria, pre-hypertension, proteinuria, risk factors

INTRODUCTION

Chronic kidney disease (CKD) has become a global epidemic with a prevalence ranging between 16 and 26% in Nigeria and 13% in the United States of America (USA).^[1-3] In sub-Saharan Africa, current data show a progressive increase in the prevalence of CKD over the decades. For instance, Arogundade *et al.*^[4] showed that medical admissions due to CKD grew from 6 to 20% between 1989 and 2007.

Studies have shown that many people in the community are unaware of their CKD status and its associated risk factors such as hypertension and diabetes mellitus, many of which are modifiable.^[5-7] Of particular significance is the subject of pre-hypertension, which in the past was referred to as 'high

normal' blood pressure (BP), a deceptively innocuous description of a 'clinical time bomb', because emerging evidences have since established that even in the absence of diabetes mellitus and atherosclerosis, pre-hypertension is associated with a threefold greater risk of development of an end stage renal disease (ESRD) and a greater than twofold increase in the relative risk of cardiovascular disease.^[8,9]

Crews *et al.*^[10] showed a prevalence of CKD among those with pre-hypertension to be 17.3% as compared to 27.5 and

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13.4% among those with diagnosed hypertension and normal BP, respectively. The Ohasama study was more specific in demonstrating a relationship between pre-hypertension and CKD; in a prospective study of 2150 adults in Japan, the adjusted hazard ratio of CKD was significantly higher for pre-hypertension when compared to normotension in the general population [Hazard Ratio (HR): 1.49 vs 1, at 95% confidence interval (CI)].^[11] Added to this is the fact that pre-hypertension is found to be most commonly associated with other established risk factors for CKD such as obesity and metabolic syndrome.^[12,13]

A recent report from the USA showed that many individuals with multiple markers of CKD were unaware of their disease.^[14] Community screening for the risk factors is essential as a part of primary level of CKD care. This will enhance early detection of individuals at risk and slow progression of the disease.^[15] This relatively new concept of pre-hypertension is yet to be widely evaluated in our setting because our literature search revealed scanty output in terms of its relationship to CKD in Nigeria.^[16] We, therefore, set out to determine the magnitude of pre-hypertension, CKD risk factors and their relationships to proteinuria.

SUBJECTS AND METHODS

Study location

The study was conducted in two screening centres in Akure town, Akure South Local Government Area (LGA) and one centre in Ondo town, Ondo West LGA. These are two urban LGAs in Ondo State, South-Western Nigeria in March 2014. The estimated population figures from the 2006 Nigerian population census for Akure South and Ondo West were 353,211 and 283,672, respectively.

Study design

This was a descriptive, cross-sectional study of consecutive adults ≥ 17 years, in which we used a proforma designed by the Research Unit of the Kidney Care Centre, Ondo State, which had been previously tested on our out-patient clinic attendees to obtain clinical and laboratory information on our subjects who presented at a community screening exercise. Members of the Research Unit comprising of medical doctors, health information managers, dieticians, medical laboratory scientists and technicians and nurses were joined by our nursing assistants as data collectors. Pre-screening training on the use of research tools was conducted by the unit before the exercise.

All the subjects were recruited after an informed verbal consent. An interactive pre-screening public lecture was delivered, and the screening methods were explained to all the subjects in English language with interpretation into their local dialects where necessary. Their bio-data, history of smoking, alcohol intake, consumption of herbal concoction, use of non-steroidal anti-inflammatory drugs (NSAIDs), diabetes mellitus and hypertension were obtained. Their blood pressures were

measured on the right arms using the mercury sphygmomanometer (Accoson, Harlow, United Kingdom) with a standard cuff size and the subjects in sitting position after about 5 min of rest. Hypertension was classified according to the seventh Joint National Committee (JNC) Report on detection, evaluation and treatment of high BP (JNC 7) report.^[9]

History of hypertension was defined by a positive answer to the question, 'Have you ever been told by a doctor or other health professional that you have high blood pressure?' and/or use of antihypertensive. For those who replied 'No', hypertension was defined by a measured BP of $\geq 140/90$ mmHg. Pre-hypertension was defined by systolic BP of 120–139 mmHg and diastolic BP of 80–89 mmHg.^[9] Body weight was measured (after removal of footwear) with the subjects in light clothing to the nearest 0.1 kg using bathroom scale (High Performance Analytical Appliance (HANA), China). The scale was adjusted back to zero after each measurement. Height was measured with the subject standing without shoes on a firm, level surface at right angle to a vertical height bar. Readings were adjusted to the nearest 0.5 cm.^[17] Body mass index (BMI) was calculated using the formula, weight/height^2 . The waist and hip circumferences were determined by means of non-stretch measuring tapes using standard abdominal landmarks with the subjects in the erect position. Central obesity (defined as waist circumference ≥ 94 cm for European men and ≥ 80 cm for European women, with ethnicity specific values for other groups) was classified using the International Diabetes Federation criteria; the European values are currently adopted for Africans.^[18]

Spot urinalysis was performed using the Combi-Uriscreen® 10SL test strip on clean catch mid-stream urine. The subjects were pre-informed on the modality of collecting midstream urine specimen. The subjects with high BP, obesity and proteinuria were referred to our centre for further evaluation.

Ethical approval

Approval for the study was obtained from the Health Research Ethics Committee of the State Specialist Hospital, Akure, Ondo State; protocol number EA/005/2014.

Data analysis

Data were analysed using the Statistical Package for the Social Sciences version 20.0 software (SPSS Inc, Chicago, Illinois, USA). Descriptive variables such as age, gender, anthropometric measurements and BP were presented as frequencies, percentage and means (\pm standard deviation). The independent sample *t* test was used to determine significant differences between means of continuous variables. Test of association between discrete variables was determined by using chi-square test. The *P* value was regarded as significant at $P < 0.05$ at a CI of 95%.

RESULTS

A total of 1183 adults (age range: 17–120 years) were screened. There were 454 (38.4%) males and 729 (61.4%) females with a male-to-female ratio of 0.63:1. Their clinical parameters and mean (\pm standard deviation) values and mean difference across gender are shown in Table 1. Their mean age was 44.7 ± 17.4 years, mean systolic BP was 129.6 ± 23.7 mmHg and mean diastolic blood pressure was 79.8 ± 14 mmHg. Their mean BMI was 26.2 ± 5.8 kg/m².

Three hundred and seventy-six (32.3%) subjects were having a BP (BP) in the pre-hypertension range, while 505 (43.4%) were with BP in the hypertension range. Forty-eight (6.2%) were with a history of diabetes mellitus and 38 (4.5%) were with a history of cigarette smoking. Six hundred and eighty-nine (68.3%) were with a history of use of herbal concoction, while 267 (44.1%) used NSAIDs during their lifetime.

Three hundred and thirty (27.9%) subjects were overweight, while 274 (23.2%) were with a BMI ranging from mild to severe obesity; 14.3% were of mild obesity ($25\text{--}29.9$ kg/m²), 6.3% were of moderate obesity ($30\text{--}34.9$ kg/m²) and 2.6% were of severe obesity ($>35\text{--}39.9$ kg/m²). There was no report of morbid obesity. Central obesity (waist circumference above 94 cm) was found in 20.6% of the males. The waist circumference was above cut-off (80 cm) in 68% of the females.

Proteinuria ranging from 1+ to 3+ was found in 307 of the subjects suggesting an incidence rate of 25.9%, while 1.7% of the subjects were with haematuria. One hundred and eighty-one (15.3%) were with 1+ proteinuria, 108 (9.13%) were with 2+ proteinuria, and 18 (1.52%) were with 3+ proteinuria. Eight hundred and seventy-six (74.1%) were with normal to trace proteinuria.

Table 1 also shows BP classification for both genders according to JNC 7. Table 2 shows the association among age, hypertension, obesity and presence of proteinuria.

DISCUSSION

There was a high prevalence rate of hypertension (43.4%) among our subjects, which falls within the overall prevalence of 8 to 46.4% reported previously.^[19] Varying prevalence rates have been published by different authors probably due to differences in setting and methodology.^[1,20-22] The study locations, Akure South and Ondo West LGAs, are two of the most densely populated urban centres in Ondo State with shared characteristics ('white collar' jobs, pressure of work, westernised diet and sedentary lifestyle) similar to the subjects used in other urban studies. Pre-hypertension was found among 32.3% of our subjects. This is comparable to the global prevalence of 31 and 36.3% overall prevalence for disease-free USA subjects.^[23,24] Generally, pre-hypertension is asymptomatic. According to the United States Renal Data System, 28% of the general population studied were unaware of their hypertensive status.^[25] This implies that in probably over a few years, the number of residents and indigenes with clinical hypertension is likely to increase in Ondo State, if their pre-hypertension status is left unattended to.

Of even more interest is the observation in our study that pre-hypertension was found to have a significant association with proteinuria, an important marker of CKD. Schmieder *et al.*^[26] showed that glomerular hyperfiltration (directly related to increased proteinuria) occurs in humans in the early stage of hypertension during sympathetic nervous system activation. Previous studies have shown an association between pre-hypertension and increased risk of cardiovascular disease and ESRD.^[8,9] A recent meta-analysis of relationship between pre-hypertension and CKD (defined by an estimated glomerular filtration rate (eGFR) <60 ml/min/1.73 m² or proteinuria of $\geq 1+$ using a dipstick) showed that pre-hypertensive individuals have an increased risk of developing CKD.^[27] The Ohasama study showed that the adjusted population attributable fraction for CKD was similar

Table 1: Clinical parameters of subjects attending a community screening exercise

Parameters	Overall mean \pm SD	Male (n = 454)		Female (n = 729)		Mean difference	P value
		Mean	SD [#]	Mean	SD [#]		
Age (years)	44.7 ± 17.4	43.0	18.2	45.8	16.8	-2.791	0.01
SBP [#] (mmHg)	129.6 ± 23.7	124.2	16.7	118.3	17.5	5.887	0.02
DBP [†] (mmHg)	79.8 ± 14.0	79.3	11.4	74.6	13.5	4.745	0.01
WC [‡] (cm)	85.9 ± 12.2	85.9	12.2	89.8	13.6	-3.868	0.00
BMI [?] (kg/m ²)	26.2 ± 5.8	24.2	4.4	27.4	6.2	-3.156	0.00

Hypertension (JNC* 7) stage	Males		Females		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Normal	83	18.65%	201	27.92%	284	24.37%
Pre-hypertension	179	40.23%	197	27.36%	376	32.28%
Hypertension (stages 1 and 2)	183	41.12%	322	44.72%	505	43.35%
Total	445	100.00%	720	100.00%	1165	100%

[#]Standard deviation, [#]systolic blood pressure, [†]diastolic blood pressure, [?]body mass index, [‡]waist circumference, *Joint National Committee, P value is significant at values <0.05 at 95% confidence interval.

Table 2: Association between age, blood pressure, obesity and proteinuria using chi-square with trend

Parameters	Proteinuria		Chi-square	P value
	Yes	No		
Age group (n = 1149)				
17–44	116 (21.6%)	421 (78.4%)	24.551	0.000
45–64	95 (25.7%)	275 (74.3%)		
≥65	96 (39.2%)	146 (60.8%)		
JNC [‡] 7 hypertension stage (n = 1143)				
Normal	62 (21.9%)	221 (78.1%)	10.317	0.001
Pre-hypertension	88 (23.7%)	283 (76.3%)		
Hypertension	155 (31.7%)	334 (68.3%)		
Body mass index (n = 1147)				
Normal	159 (28.4%)	400 (71.6%)	1.161	0.557
Over weight	89 (27.0%)	241 (73.0%)		
Obesity	80 (31.0%)	178 (69.0%)		

[‡]Joint National Committee. Bold stands for P value significant at values <0.05 at 95% confidence interval.

for pre-hypertension, stage 1 hypertension and stage 2 hypertension.^[11]

The prevalence of pre-hypertension was 40.2% among males and 27.4% among females in our study. This result is similar to reports from various studies across the world. Gupta *et al.*^[24] showed a prevalence of 40.2% among males and 30.1% among females in urban middle-class subjects in India; the ATTICA (association between pre-hypertension status and inflammatory markers related to atherosclerotic disease) study showed higher prevalence of pre-hypertension of 43% in men and 35% in women while the 2001 Korean Nation Health and Nutrition Survey reported an age-adjusted prevalence of pre-hypertension of 41.9% in men, 25.9% in women.^[28,29] In a study of Japanese, the prevalence of pre-hypertension was 34.8% in males and 31.8% in females in Japanese.^[30]

Close to one-fourth (23.2%) of the subjects were found to be obese in this study, while 27.9% were overweight. In a recently published systematic review of four studies on the prevalence of obesity among adults in the country by Chukwuonye *et al.*,^[31] the prevalence of overweight ranged from 20.3 to 35.1%, while the prevalence of obesity ranged from 8.1 to 22.2%. Our figure on the prevalence of obesity is higher than current data in Nigeria. This observation is quite significant as the review by Chukwuonye *et al.* included selected studies published between 2001 and 2012. One may then presume that prevalence of obesity is on a higher trend in Nigeria, probably, because people in developing nations have continued to practice the Western lifestyle and foster an environment for the promotion of obesity and associated cardiovascular risks.

Also of note is that 68% of the women in this study were found to have central obesity, a figure that is far higher than previous reports from Nigerian subjects from communities with similar characteristics.^[32,33] Central obesity has recently been identified to directly cause glomerulosclerosis in the absence of hypertension or diabetes mellitus.^[34,35] The exact pathogenetic mechanism explaining the association between

obesity and CKD remains unclear to date, but studies of mice and humans suggest that adipokines may alter glomerular permeability to proteins, leading to proteinuria, which is a powerful predictor of progression of CKD.^[36,37]

Proteinuria ranging from 1+ to 3+ was found in 25.9% of the subjects. This figure is slightly lower than the results from an earlier study conducted by Arogundade *et al.*, who reported a prevalence of 29.7% in a market population in Ile-Ife, Southwest Nigeria in 2009.^[38] It has been argued that qualitative spot urine protein testing for the identification of CKD, which was used in our study, is less reliable than serum creatinine, eGFR, serum cystatin C and urinary albumin–creatinine-ratio (ACR). However, these other means are less realistic for community screening because of costs, logistics and availability of technical expertise. Moreover, quantitative proteinuria has been shown to correlate all be it roughly with urinary ACR.^[39]

Our study showed a significant association between grades of hypertension and presence of proteinuria. A study by Chen *et al.* identified hypertension as one of the independent risk factors for CKD.^[35] Glomerular capillary hypertension and associated hyperperfusion are established pathogenetic mechanisms of renal damage in CKD.^[40] Therefore, the more uncontrolled the BP, the higher the tendency for the subjects to develop early onset of CKD or progression of existing CKD to ESRD.

There was also a significant association between age and proteinuria, but there was no significant association between BMI and proteinuria in our study. The incidence of proteinuria has been found to increase with age and is significantly associated with the extent of loss of renal function and increased mortality.^[41,42] In one study, Gall *et al.*^[43] found a significant association between increasing age and abnormal urinary albumin excretion in type 1 diabetics. This has been attributed to loss of nephron mass loss, glomerulosclerosis and vascular changes whether there is kidney disease or not. For instance, in octogenarians

without diabetes or hypertension, the prevalence rate of microalbuminuria was as high as 18–25%, a figure that was similar to that found in individuals of the same age range with diabetes and/or hypertension.^[44] Haematuria was found among 1.7% of the subjects. This figure is lower than 3.1% reported by Oluyombo *et al.*^[1]

In conclusion, the prevalence of pre-hypertension and obesity appears to be high in Ondo State, Nigeria with a high probability to cause CKD. Further studies to confirm these findings would be required by using more specific markers of CKD such as serum creatinine, urinary ACR or serum cystatin C. The presence of high-risk behaviours among indigenes and residents could further predispose them to early onset CKD. It is, therefore, imperative to intensify the effort directed at improving community awareness of CKD and its risk factors. Community residents should be advised to undergo medical check-up at least once per year. Those identified to have pre-hypertension should be registered with qualified physicians for immediate care.

Limitations

This study is limited by possible information bias, because some aspects of the data collection are based on self-report. Definition of pre-hypertension and presence of proteinuria were based on singular measurements. Secondly, the study was performed during a community outreach, where a significant number of the subjects are likely to be those who are health conscious or those who want to receive some free medical attention.

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Conflicts of interest

There are no conflicts of interest.

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