Original Article

Prevalence and correlates of prehypertension and hypertension among adults in Delta State, Nigeria: a cross-sectional community-based study

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SUMMARY

Background: There are indications that prehypertension precedes hypertension. Like hypertension, it is associated with increased cardiovascular risk.
Objective: To determine the prevalence, awareness and correlates of prehypertension and hypertension among adults in Delta State, Nigeria.
Methods: This was a cross-sectional study. We recruited adults aged ≥18 years from two communities in Delta State, Nigeria, using the multi-stage sampling technique. The study instrument was a modified WHO-STEPS questionnaire. Prehypertension and hypertension were defined using the JNC-7 criteria. Ethical approval was obtained before the recruitment of participants.
Results: Of the 852 adults studied, the mean (±SD) age was 42.64 (±16.07) years, females (55.9%) and urban dwellers (55.8%). The prevalence of prehypertension and hypertension were 42.5% and 29.3%, respectively; both were higher among urban dwellers. The peak age-group for prehypertension and hypertension were 25-34 and 35-44 years, respectively. Awareness of hypertension was low; 12.0% (102/852). Blood pressure category significantly correlated with age, body mass index, place of residence, level of education, employment status and fruit intake.
Conclusion: The prevalence of prehypertension and hypertension in this study were high. Based on the premise that prehypertension is a precursor of hypertension and occurred more among youths, the higher prevalence of prehypertension gives an inkling to rising prevalence of hypertension.

Keywords: Prehypertension, hypertension, adults, Nigeria, WHO STEPS
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INTRODUCTION

Noncommunicable diseases (NCD) are a growing source of public health concern worldwide. Cardiovascular disease (CVD) is the foremost contributor to NCD-related morbidity and mortality among adults.[1] Several factors interplay in the aetiopathogenesis of cardiovascular disease, of which hypertension is a significant player. Hypertension develops from complex and inter-related aetiologies and risk factors. While a few are non-modifiable, others are lifestyle-related and thus modifiable.

Hypertension accounts for about half of the deaths from heart disease and stroke, and indeed 12.8% of total all-cause deaths globally.[2] Several studies have demonstrated the benefits of prevention, early diagnosis and adequate control of hypertension.[3-5] However, the global distribution of hypertension burden is inequitable as most of the deaths occur in low- and middle-income countries.[2, 6] Whereas there is a decline in the prevalence of hypertension in many developed countries because of improved awareness and better treatment and control, the opposite appears to be the situation in low- and middle-income countries like Nigeria.

In a systematic review and meta-analysis of selected data from population-based studies between 1980-2013, Adeloye et al. showed that the pooled awareness rate of hypertension in Nigeria was only 17.4%.[7] In another systematic review by Ogah et al., the pooled prevalence of hypertension in Nigeria increased from 8.6% to 22.5% between 1970-1979 and 2000-2011, respectively.[8]

The reported change in the prevalence rate of hypertension may be attributable to the upsurge in the aetiological risk factors for hypertension as well as the cut-off values used to define hypertension.

The definition of hypertension based on arbitrary blood pressure readings has evolved over the years. In the 1980s, the definition of hypertension was systolic blood pressure (SBP) of ≥160mmHg or diastolic blood pressure (DBP) of ≥95mmHg.[9] In 2003, the report of the seventh Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-7) redefined hypertension as SBP ≥140mmHg or DBP ≥90mmHg and normal blood pressure as SBP <120mmHg and DBP <80mmHg.[10] More recently, in 2017, the American Heart Association /American College of Cardiology further reduced the cut-off value for hypertension to SBP ≥130mmHg and DBP ≥80mmHg but retained the JNC-7 definition of normal blood pressure.[11]

The gap between normal blood pressure reading and hypertension has also been differently defined and named. According to 2003 JNC-7 SBP of 120-139mmHg or DBP of 80-89mmHg is defined as prehypertension while the 2017 AHA /ACC guideline defines the gap as elevated blood pressure, 120-129mmHg (SBP) or 80mmHg (DBP). The prevalence and significance of prehypertension among adults are understudied, unlike hypertension. However, there are indications that prehypertension precedes hypertension and is associated with increased cardiovascular risk.[12]

Although several other studies have reported the prevalence of hypertension, its risk factors, socio-demographic correlates and barriers to care in Nigeria, there are only a few studies on prehypertension among adults in Nigeria. This paper, therefore, aims to describe the prevalence and correlates of prehypertension and hypertension among apparently healthy adults in Delta State, Nigeria.

METHODS

The study design is cross-sectional, descriptive and population based. The study population was from among adults aged 18 years and above living in Delta State, Nigeria. Administratively, there are three senatorial districts in the State: Delta North, Delta South and Delta Central, and twenty-five Local Government Areas.

Recruitment of respondents was by multi-stage sampling method. Firstly, simple random sampling using balloting was used to select two out of the three Senatorial Districts in the State: Delta Central and Delta South. One study site was selected from each of the chosen senatorial districts using a non-probability convenience sampling method. A rural community, Jesse was selected from Delta Central while Warri, an urban metropolis was selected from Delta South. The study sites are 47 kilometres apart. Whereas Jesse is sparsely populated and majorly agrarian, Warri is densely populated and the commercial hub of Delta State, especially as it relates to the oil and gas industry.

Furthermore, the eligibility criteria for recruitment were consenting apparently healthy adults aged at least 18 years who have lived in the study sites for at least one (1) year. Study participants were recruited using a two-stage cluster sampling method. Jesse, the rural study site, has seven clans which were considered as natural clusters. Adults who met the eligibility criteria were recruited from households within the natural clusters. Warri, the urban study site, has twelve (12) wards. Each ward was considered as a cluster. Because of their relatively large sizes, four (4) wards were randomly selected from the sampling frame of twelve wards. Each of the selected wards was a cluster. Adults within the households in the selected clusters who met the inclusion criteria were recruited until the sample size was reached. Visitors to the study sites and adult residents who had lived less than 1-year in the study sites were excluded from the study. Also, visibly pregnant women were excluded from the study as their anthropometric indices may result in skewed data.

Using the pooled prevalence of hypertension of 22.5%,[8] and assuming a 95% confidence interval, 5% error margin (α) and a 10% non-response, the calculated minimum sample is two hundred and ninety-five (295) per study site. Before the commencement of the study, trained research assistants pre-tested the study instrument on 20 adults from Oghara, Delta State, a non-participating community. The World Health Organization STEPwise approach to chronic disease risk factor surveillance (WHO STEPS) questionnaire[13] was modified by removing the section on biochemical measurements and adapted for use in this study.

The questionnaires were administered by the interviewer, and assessed socio-demographic profile, risk factors, awareness of the personal history of hypertension and care for hypertension. All the respondents had physical measurements of their anthropometry and blood pressure.

Each participant had their weight in kilograms and the height in metres measured after removing their footwear, head-dressing and heavy outer clothing with the Prestige HM0016D (India) stadiometer. The quotient of the weight and the square of the height defined the body mass index (BMI) in kg/m^2. Overweight and obesity were BMI of 25.0-29.9kg/m^2 and ≥30.0kg/m^2, respectively irrespective of gender.[14]

A non-elastic tape was used to measure the waist circumference in centimetres. The waist circumference was measured twice in the horizontal plane at a level midway between the lower rib and the iliac crest, and the average calculated to minimise errors. Central obesity was defined as waist-to-height ratio (WHtR) ≥0.5.[15]

Blood pressure measurement was obtained using the Omron® BP-785 Intellisense automated sphygmomanometer in the right hand of seated respondents after at least 10 minutes rest. Blood pressure measurements were done thrice at an interval of 1 minute, and the average systolic and diastolic blood pressures calculated in mmHg. Classification of blood pressure readings was according to the JNC -7:[10]

Normal: SBP <120mmHg and DBP <80mmHg
Prehypertension: SBP 120-139mmHg, or DBP 80-89mmHg
Stage 1 Hypertension: SBP 140-159mmHg, or DBP 90-99mmHg
Stage 2 Hypertension: SBP ≥160mmHg, or DBP ≥100mmHg

Respondents who self-reported a history of hypertension as diagnosed by a healthcare professional were also classified as having hypertension, irrespective of their current blood pressure readings or use of anti-hypertensive drugs.

Definition of terms:
Ever smoked: This refers to respondents who have smoked cigarette ever; irrespective of their current smoking status.

Alcohol use: This refers to respondents who have ever drunk any alcoholic beverage (wine, spirit or beer); irrespective of the quantity drank.

Fruit intake: A portion of fruit is likened to one (1) medium-sized orange; irrespective of the type of fruit.

Added Salt: This refers to the practice of adding table salt to already cooked food; irrespective of the quantity and frequency of practice.

The independent variables were coded as either present or absent.

Ethical approval (DELSUTH/HREC/2015/002) was obtained from the Health Research Ethics Committee (HREC) of the Delta State University Teaching Hospital, Oghara prior to commencement of the study.

The conduct of this study was in line with the tenets of the Helsinki Declaration. Eligible persons were informed that participation in the study was voluntary, and they reserve the right to either decline or opt-out of the study at any time. Respondents who had either hypertension or prehypertension were encouraged to visit the nearest healthcare facility if they do not already have a healthcare provider.

The data from the questionnaire were checked for completeness, entered and analysed using the Statistical Package for Social Sciences (SPSS) version 22.0 (SPSS Inc, Chicago, IL, USA) software. Categorical variables were reported as frequencies, percentages, and charts while means and standard deviation were used to summarise continuous variables. The differences between categorical and means of continuous variables were tested using Chi-square and Independent t-test, respectively. Correlation was tested using the Spearman rank test. The level of statistical significance for bivariate analyses was set at $p < 0.05$.

RESULTS

Of the 866 adults recruited for the study, 14 (1.62%) had unusual blood pressure readings documented and were excluded from statistical analysis. There were slightly more females than males in a ratio of 1.3:1. The mean (±SD) age of the study population was 42.64 (±16.07) years. About 60% of the study population were aged less than 45 years.

Majority of the study population were urban dwellers (55.8%), Urhobos (68.0%), Christians (87.9%), married (58.5%), had at the most secondary level of education (45.0%), and self-employed (66.7%). Table 1 shows the urban-rural differences in the socio-demographic and biophysical characteristics of the study population. The mean age of urban dwellers was significantly lower than their rural counterparts. The mean blood pressures, systolic and diastolic, were significantly higher among urban dwellers, as shown in Table 1.

A diagnosis of hypertension before this study was reported by 102 (12.0%) of the respondents. Of the respondents who were aware of their hypertensive status, 85 (83.3%) were urban dwellers, 59 (57.9%) were aged between 35-54years, and 53 (52.0%) were males. The association between awareness of hypertension was statistically significant for the place of residence (p<0.001) and age (p<0.001) but not for sex (p=0.187).

Table 1 Sociodemographic and biophysical profile of the study population

Variable	Category	All N = 852 (%)	Urban n=475 (%)	Rural n=377 (%)	p-value
Sex	Male	376 (44.1)	188 (39.6)	188 (49.9)	0.003
	Female	476 (55.9)	287 (60.4)	189 (50.1)	
Age (years)	18-24	96 (11.3)	44 (9.3)	52 (13.8)	<0.001
	25-34	202 (23.7)	130 (27.4)	72 (19.1)	
	35-44	210 (24.6)	156 (32.8)	54 (14.3)	
	45-54	149 (17.5)	82 (17.3)	67 (17.8)	
	55-64	91 (10.7)	48 (10.1)	43 (11.4)	
	≥65	104 (12.2)	15 (3.2)	89 (23.6)	
	Mean (±SE)	42.64 (0.55)	39.08 (0.56)	47.13 (0.98)	<0.001
Marital Status	Single	168 (20.6)	115 (25.2)	53 (14.8)	<0.001
	Married	477 (58.5)	296 (64.9)	181 (50.4)	
	Previously married*	82 (10.1)	17 (3.7)	65 (18.1)	
	Co-habiting	88 (10.8)	28 (6.1)	60 (16.7)	
	N/A	37	19	18	
Highest Level of Education	None	78 (9.5)	7 (1.5)	71 (19.3)	<0.001
	Primary	163 (19.8)	38 (8.3)	125 (34.1)	
	Secondary	371 (45.0)	205 (44.9)	166 (45.2)	
	Tertiary	212 (25.7)	207 (45.3)	5 (1.4)	
	N/A	28	18	10	
Religion	Christianity	715 (87.9)	437 (96.3)	278 (77.4)	<0.001
	Islam	7 (0.9)	2 (0.4)	5 (1.4)	
	ATR**	83 (10.2)	10 (2.2)	73 (20.3)	
	Others***	8 (0.9)	5 (1.1)	3 (0.8)	
	N/A	39	21	18	
Ethnicity	Urhobo	579 (68.0)	244 (51.4)	335 (88.9)	<0.001
	Itsekiri	27 (3.2)	24 (5.1)	3 (0.8)	
	Ijaw	38 (4.5)	32 (6.7)	6 (1.6)	
	Igbo	100 (11.7)	93 (19.6)	7 (1.9)	
	Hausa	12 (1.4)	8 (1.7)	4 (1.1)	
	Yoruba	29 (3.4)	25 (5.3)	4 (1.1)	
	Others	67 (7.9)	49 (10.3)	18 (4.8)	
Employment status	Government employed	86 (10.3)	86 (18.7)	0 (0.0)	<0.001
	Non-Government employed	31 (3.7)	29 (6.3)	2 (0.5)	
	Self-employed	556 (66.7)	243 (52.9)	313 (83.7)	
	Retired	4 (0.5)	4 (0.9)	0 (0.0)	
	Unemployed	65 (7.8)	59 (12.9)	6 (1.6)	
	Student	91 (10.9)	38 (8.3)	53 (14.2)	
	N/A	19	16	3	
BMI (kg/m^2)	Underweight	67 (7.9)	36 (7.6)	31 (8.2)	<0.001
	Normal	517 (60.7)	254 (53.5)	263 (69.8)	
	Overweight	175 (20.5)	112 (23.6)	63 (16.7	
	Obese	93 (10.9)	73 (15.4)	20 (5.3)	
	Mean (±SE)	24.09 (0.21)	24.92 (0.25)	23.04 (0.36)	<0.001
Blood Pressure (mmHg)	Mean SBP (±SE)	125.01 (0.55)	126.19 (0.69)	123.53 (0.88)	0.016
	Mean DBP (±SE)	75.66 (0.43)	78.37 (0.53)	72.25 (0.68)	<0.001

* widowed, divorced, separated; ** African Traditional Religion; N/A: Not available, BMI: Body Mass Index, DBP: Diastolic Blood Pressure, SBP: Systolic Blood Pressure, SE: Standard Error of Mean

Of the respondents who self-reported a history of hypertension, 89 (87.3%) were currently on anti-hypertensive medications, and 42 (41.2%) had blood pressure readings less than 140/90 mmHg. Whereas treatment for hypertension did not differ by place of residence, a significantly higher proportion of males, 50 (94.3%), were on treatment (p=0.001).

Using the JNC-7 classification of blood pressure readings, the frequency distribution of blood pressure readings as normal, prehypertension and hypertension was 257 (30.2%), 387 (45.4%) and 208 (24.4%), respectively. Among the respondents with blood pressure readings in the hypertensive range, 157 (75.5%) were Stage 1, and 51 (24.5%) were Stage 2.

The overall prevalence of prehypertension and hypertension in this study, however, was 42.5% (362/852) and 29.3% (250/852), respectively. More than half of the respondents with prehypertension (55.5%) and hypertension (55.6%) were females.

The observed gender differences in blood pressure category were not statistically significant ($\chi^2 = 0.087$, df=2, p=0.958). The mean (±SD) ages of respondents with prehypertension and hypertension was 40.1 (±15.7) years and 48.5 (±14.4) years, respectively. The observed difference in mean age was statistically significant (t=-6.696; 95% CI: -10.814 to -5.909; p<0.001).

More than half (56.7%) of the respondents with prehypertension were aged between 25-44 years, while the majority (88.8%) of the respondents with hypertension were aged 35 years and above. (Figure 1) The association between age group and blood pressure category was statistically significant ($\chi^2 = 106.999$, df=10, p<0.001).

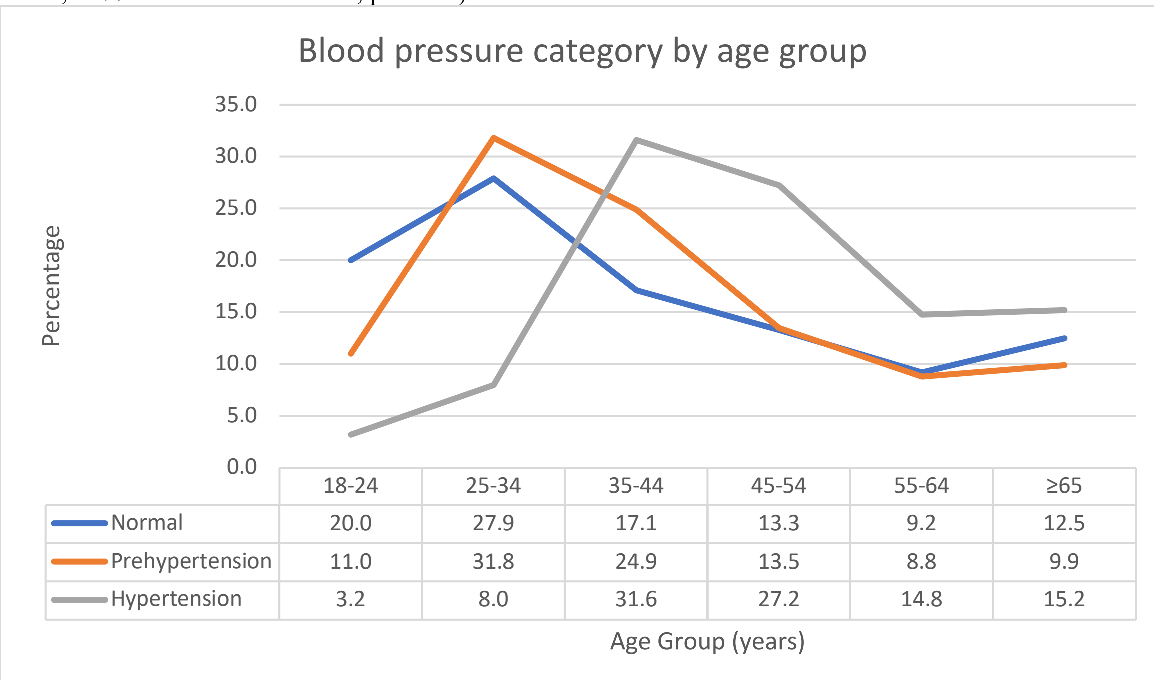

Figure 1 Age group and blood pressure category among respondents

The prevalence of prehypertension and hypertension were significantly higher among urban dwellers (χ^2 = 30.480, df=2, p<0.001). (Figure 2). The mean (±SD) BMI of respondents with prehypertension and hypertension was 22.97 (±4.64) kg/m^2 and 25.82 (±5.15) kg/m^2, respectively. The observed difference in mean BMI was statistically significant (t=-7.134; 95% CI: -3.633 to -2.064; p<0.001). About half of the respondents with hypertension were either overweight or obese.

Among the respondents who were overweight and obese, a higher proportion had hypertension. (Figure 3) The association between body mass index and blood pressure category was statistically significant (χ^2 = 70.210, df = 6, p <0.001).

The blood pressure category significantly correlated with age, place of residence, level of education, employment status, body mass index and fruit intake less than five portions daily. (Table 2).

Table 2 Correlates of blood pressure categories among the study population

Variable	Correlation Coefficient	p-value
Sex	0.008	0.815
Age Group	0.243	<0.001**
Place of residence	-0.188	<0.001**
Marital Status	0.059	0.090
Level of Education	0.096	0.006*
Employment Status	-0.146	<0.001**
Ever Smoked Cigarette	-0.039	0.259
Alcohol Use	0.014	0.680
Fruit Intake (<5 portions per day)	-0.105	0.005*
Body Mass Index	0.162	<0.001**
Waist-to-Height Ratio	0.034	0.322

*Significant Correlation at <0.01, ** Significant Correlation at <0.001

DISCUSSION

The high prevalence of hypertension and prehypertension in this study reaffirms the substantial and waxing contribution of high blood pressure as a public health challenge in Nigeria. The prevalence of hypertension in this study is comparable to previous reports from Nigeria that used the blood pressure readings of ≥140/90mmHg as the cut-off.[7,16-19]

The prevalence of prehypertension reported in South-East Nigeria,[16, 20] was also similar to that from this study. The awareness of high blood pressure was low in this study, as only two-fifths of the respondents with hypertension had prior knowledge. Low awareness is a bane to stemming the scourge from hypertension, especially as the condition while uncomplicated is relatively asymptomatic. The low awareness of hypertension in the index and other previous studies across Nigeria,[7, 8, 16, 21-23] give credence to the poor practice of screening for hypertension among Nigerians.[24, 25] Even among healthcare workers in Nigeria, the level of awareness of hypertension could be better.[26]

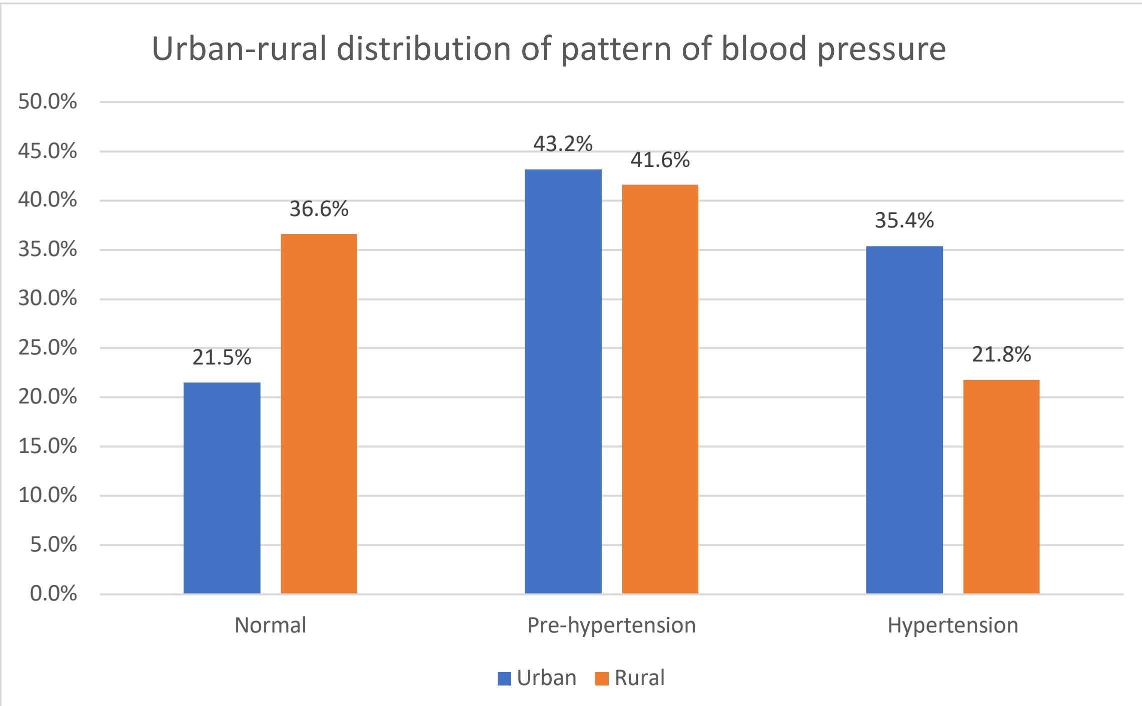

Figure 2 Prevalence of prehypertension and hypertension by area of residence

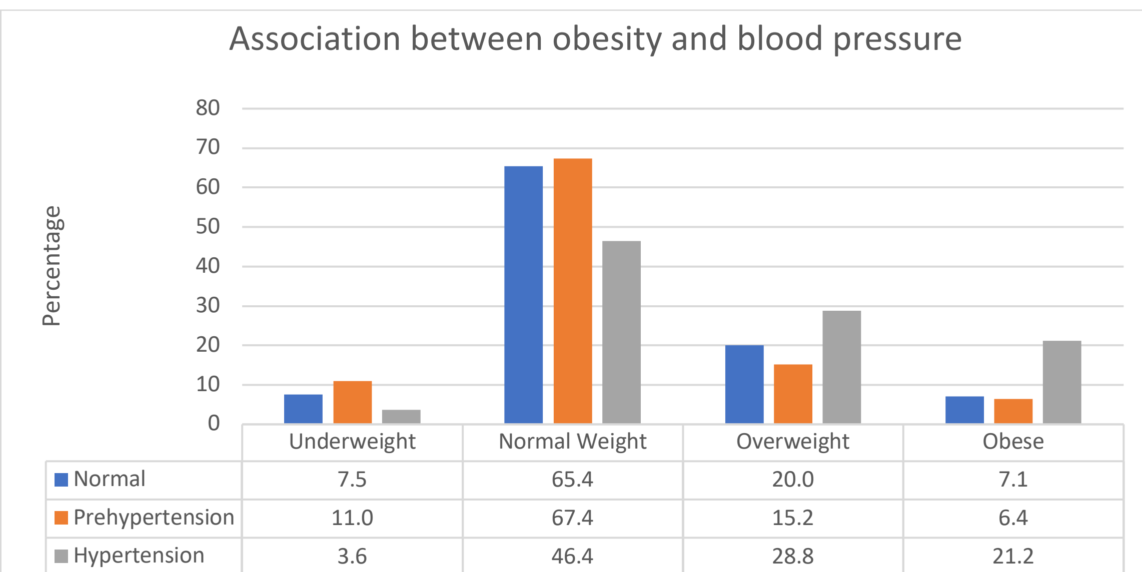

Figure 3 Association between blood pressure category and body mass index

Although the majority of the respondents who were aware of their hypertensive status reported the use of antihypertensives, blood pressure control was unsatisfactory as about less than half of them had blood pressure readings <140/90mmHg. Uncontrolled hypertension predisposes humans to various end-organ damage, chief among which are stroke and heart disease. Indeed, hypertension, the "silent killer", continues to contribute significantly to mortality and morbidity around the globe,[27] Nigeria inclusive.

The prevalence of prehypertension and hypertension were found to be higher in urban than rural respondents in this study. Previous studies have also reported similar findings.[7, 28-30] Urbanisation alters lifestyle patterns; is associated with reduced physical activity, intake of high-calorie diet, smoking, alcohol consumption, increased workload/stress, and poor sleep.[31- 33] As in this study, obesity, a modifiable risk factor for the development of hypertension, was more prevalent among urban dwellers. On the other hand, rural dwellers are less exposed to health education and promotion activities. Indeed, many targets for crucial intervention strategies to prevent non-communicable diseases are in facilities located in urban areas. The inequity in domiciling strategic interventions may fuel rural dwellers' poor awareness and utilisation of healthcare facilities. In this study, over 80% of respondents who were aware of a prior diagnosis of hypertension were urban dwellers.

The high prevalence of prehypertension in this study is worrisome. Prehypertension is an important predictor of the development of hypertension in later life.[34-37] Particularly, Blacks have an accelerated progression to hypertension from prehypertension.[37] Evidence from existing literature show that prehypertension can amplify the possibility of a cardiovascular event especially in the presence of unhealthy habits such as alcohol intake, excess fat consumption and a sedentary lifestyle.[34, 12] Indeed, the high prevalence of prehypertension in this study is an indication for urgent public health action across all ecological levels to stem the scourge.

Hypertension and prehypertension are both associated with age. The respondents with hypertension were significantly older than those with prehypertension in this study. Ageing has been positively associated with the development of prehypertension, and subsequently hypertension with increasing age.[38] In humans, systolic blood pressure gradually increases in an upward fashion with age. In contrast, diastolic blood pressure rises, peaking at approximately 50years before declining gradually until old age.[39] This may, in part, explain the findings in this study of a younger peak of prehypertension between 25-34years and an older peak of hypertension 45-54years which showed a statistically significant difference ($p < 0.001$). Isezuo et al. also reported a similar pattern of younger peak age for prehypertension compared with hypertension.[19]

This finding suggests that the progression of prehypertension to hypertension is a slow but steady one indicating that prehypertension is a precursor of hypertension.[34-37] The higher prevalence of prehypertension compared to hypertension in this study gives an inkling to rising prevalence of hypertension in the near future as this population ages if no action is taken especially with regards to education and lifestyle modification. Besides, increasing age and urbanisation contribute to both stressful and sedentary lifestyle that is injurious to health and promote the development of hypertension.

Although prehypertension and hypertension were more prevalent in females than males in this study, the observed differences were not statistically significant. Many studies have shown a male preponderance in the prevalence of hypertension and even prehypertension.[40-44] However, observed gender differences have not translated to sex-specific management.[45] Although women are likely to have a better knowledge of hypertension than men due to better healthcare utilisation than men, this does not necessarily translate into better blood pressure control.[46]

CONCLUSION

This study has shown a high prevalence of prehypertension and hypertension among Nigerian adults. Significant correlates of prehypertension and hypertension in this study were age, place of residence, level of education, employment status, body mass index and fruit intake less than five portions daily.

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