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Blood pressure pattern and hypertension related risk factors in an urban community in Southwest Nigeria: The Mokola hypertension initiative project, Ibadan, Nigeria

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There is rising incidence of hypertension especially among children and young adults in Nigeria. Hypertension in childhood could be harbinger for adult hypertension. This study looked at the prevalence of hypertension in children and adults in an urban community. A cross sectional survey was conducted among 5,733 respondents aged 3 to 78 years residents in Mokola Ibadan, South Western Nigeria selected using a multistage cluster sampling method. Demographic and anthropometric characteristics were collected and Chi square test and logistic regression were used to determine significant determinants and predictors of hypertension at p<0.05. Prevalence of hypertension was 27.3% in adults and 12.8% in children < 18 years. Isolated systolic hypertension (ISH) was found in 10.3% of adults and 4.4% of children while isolated diastolic hypertension (IDH) was found in 4.7% of adults and 5.3% of children. Odds of ISH were significantly 2 times greater among female compared with male children. Among adults, the odds of hypertension and ISH were 1.32 and 2 times, respectively more among the males compared to females. Obese children were about 2 times (OR = 1.50 95%CI: 1.03 to 2.20) and overweight and obese adults were 3 times (OR = 3.20; 95%CI: 2.15 to 4.75) and 4 times (OR =3.5 (95%CI: 2.40 -5.22), respectively more likely to be hypertensive. Adults, male, ever smoked, ever used alcohol and employed were significantly more likely to be hypertensive. Predictors of hypertension in children were obesity [AOR = 1.44 (95%CI 0.98, 2.10)] and among adults were, middle age 35-55 years [AOR = 3.80 (95%CI 2.73, 5.29)] and elderly age 55+ years [AOR = 7.37 (95%CI 4.90, 11.10)], overweight [AOR= 2.55 (95%CI 1.39, 4.71)] and obese [AOR = .02 (95%CI 1.65, 5.52)]. High prevalence of hypertension among children and adults as well as linear increase with age in this community underscores the need for life course approach to control hypertension.

Key words: Hypertension, blood pressure, adults and children, risk factors, urban community.

INTRODUCTION

High blood pressure (BP) or hypertension is the most common non-communicable disease and a significant risk factor for renal disease and cardiovascular diseases such as heart attacks, stroke, and left ventricular

hypertrophy globally (Lim et al., 2012). Sufferers of hypertension are usually unaware that they have the condition, thus many present with the complications or sudden death, and is therefore referred to as a 'silent killer' (Ekore et al., 2009; Ataklte et al., 2015; Adeloye et al., 2015).

According to the World Health Organization (WHO), the prevalence of hypertension is highest in the African Region at 46% of adults aged 25 years and above while the lowest was found in the American region (WHO, 2011). The incidence of hypertension and cardiovascular mortality has been increasing in sub-Saharan Africa over the past few decades (Ataklte et al., 2015) and is expected to nearly double by the year 2030 (Damasceno et al., 2009). In a systematic review of articles published on hypertension between 2000 and 2013 in sub-Saharan Africa, Ataklte et al. reported a pooled hypertension prevalence of 30% in adults and a range from 14.7 to 69.9% depending on the site and age.

In Nigeria, the prevalence of hypertension has been on the increase affecting a significant number of highly productive populations. A review of prevalence among adults from 1990 to 2009 showed combined prevalence of 22% and range from a minimum of 12.4% to a maximum of 34.8% (Ekwunife and Aguwa, 2011). It was estimated that there were about 20.8 million cases of hypertension in Nigeria among people aged at least 20 years, with a prevalence of 28.0% and projected increase to 39.1 million cases with a prevalence of 30.8% by 2030 (Adeloye et al., 2015). A review with wider coverage (1968 -2015) found overall crude prevalence of hypertension to range from 2.1 to 47.2% in adults and from 0.1 to 17.5% in children depending on the study site, target population, type of measurement and cut-off value used for defining hypertension (Akinlua, 2015). Hypertension and its complications constitute approximately 25% of emergency medical admissions in urban hospitals in Nigeria (Ekere et al., 2005).

Multiple factors have been demonstrated to be associated with the development of hypertension and its complications. These are grouped into modifiable and non-modifiable factors. However, the modifiable factors such as environmental and lifestyle factors rather than non-modifiable factors (genetics and sex) are mainly associated with hypertension. Hypertension has a stronger association and causal link with five particular behaviours: Tobacco use, excessive use of alcohol, physical inactivity, unhealthy diet (high salt intake and, insufficient fruit and vegetable consumption) and obesity which are consequences of urbanisation in developing countries (van de Vijver et al., 2013).

Many prevalence studies have been conducted on adult hypertension in Nigeria but only few has been conducted among children and fewer looked at hypertension across all ages in a setting. Hypertension has hitherto not been seen as a problem in children but in adults. However, there is growing evidence of increasing prevalence in children (Bugaje et al., 2005; Samuels, 2012; Okoh and Alikor, 2013) with many adult hypertension beginning during childhood. In addition, hypertension in young people is largely undiagnosed and untreated especially in low-middle income countries (Samuels, 2012). Thus, the American Society for Hypertension (ASH) called for universal screening of all children aged ≥3 years (American Society of hypertension, 2004).

Hypertension prevalence data are crucial for understanding the magnitude of the problem, identifying groups at high risk for cardiovascular disease and evaluating the effects of interventions in policy and practice. To plan effective life course approach to prevention, the magnitude of the problem across all ages needs to be ascertained.

This study was therefore carried out to determine the blood pressure pattern, prevalence of hypertension and the risk factors among persons ≥3 years in Mokola community in Ibadan, Nigeria.

MATERIALS AND METHODS

General characteristics of the population

A cross-sectional population based prevalence study was carried out in Mokola, in Ibadan North Local Government areas (IBNLGA) of Oyo State. The community is urban and multi-ethnic with preponderance of Yoruba people. It is situated in the center of Ibadan metropolis. The inhabitants are mostly low to middle income class families. The community is well laid out and combines some of the features of an urban-slum as described by the United Nations Human Settlements Programme (United Nations, 2005). The people are mainly self-employed traders with a few working in the public service. There is a large popular food market in the community which serves many people in the city. Mokola is one of the 12 wards (ward IX) in Ibadan North Local Government Area (IBNLGA) and has an estimated population of 25,676 (males - 12,717; females - 12,959). Health care is provided mainly by private health establishments as there is no primary health care facility in the community but about 10 private clinics/hospital. The community is close to the University College Hospital, the premier tertiary hospital in Nigeria.

Sample size

Sample size for the study was calculated using prior estimates of 44.3% prevalence of hypertension found among adults in urban

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Table 1. Classification of blood pressure for adults and children.

Blood pressure	Adults			Children		
	SBP		DBP	SBP		DBP
Classification	mmHg		mmHg	Percentile		Percentile
Normal	<140	and	<90	**<90th**	**and**	**<90th**
Pre hypertension	130-139	or	85-89	>90th - <95th	or	>90th - ≤95th
Hypertension	≥140	or	≥90	≥95th	and/or	≥95th
Stage 1 Hypertension	140–159	or	90–99	≥95th - ≤99th	and/or Plus 5 mmHg	≥95th - ≤99th
Stage 2 Hypertension	≥160	or	≥100	> 99th	and/or Plus 5 mmHg	> 99th
ISH	>160	and	<90			
IDH	<160	and	>90			

SBP, Systolic blood pressure; DBP, Diastolic blood pressure; ISH, Isolated systolic hypertension; IDH, Isolated diastolic hypertension. Source: Whitworth, 2003; Chobanian et al., 2003; CDC, 2005).

Lagos by the Nigerian Heart Foundation in 2003 and 0.6% prevalence among adolescents (10-19 years) in Zaria (2005). The sample size required for the study was calculated using these estimates at 2% tolerable error and 95% confidence. In addition design effect of 1.5 and 2 for the adult sample estimates and that of the children, respectively was used to address clustering. The minimum sample size was 3,548 for adults (≥18years) and 1,145 for children (0-18 years).

The multistage cluster sampling method was used to select the sample for this study. The community was divided into four quadrants delineated by a criss- cross of roads and a random sample of two quadrants was selected using balloting method. All the houses in the selected quadrants constituted the sampling units. Thus, all the houses in the selected quadrants were visited and all consenting adults and caregivers of children 3 to 18 years were interviewed by 12 trained nurses with additional training and standardisation on the protocol. Pregnant women and persons who self-reported history of renal diseases or the symptom and signs identified by research nurse were excluded from the study.

Data collection

A semi-structured questionnaire (in English and Yoruba languages depending on the one preferred by respondents**)** was used to collect information on demographic characteristics, history of alcohol intake, cigarette smoking, regular exercise, history of hypertension, diabetes mellitus, and the family history of hypertension and diabetes mellitus. Urinalysis was carried out to detect protein and/or sugar using dipstick test strips Combur test®, Ideal Health Care, India. Regular exercise was defined as regular physical activity that is planned, structured and repetitive for the purpose of conditioning any part of the body aimed at improving health and maintaining physical fitness such as jogging, brisk walking, cycling, dancing, swimming, gardening, or household chore. However intensity of activity was not explored.

Blood pressure measurement

Blood pressure was measured using mercury Accoson sphygmomanometer. The measurements were taken in the sitting position with exposed outstretched right arm on a table after resting for at least 5 min, using appropriate cuff size for age. Blood pressure was measured thrice for each person in the same visit with at least five minutes interval between measurements. The average of the last two measurements was then estimated as the blood pressure level of the subject (William et al., 2009). When fewer than three measurements were recorded, the mean of the recorded measurements was used. For those with a raised BP, two additional BP measurements were made at least a week apart.

Anthropometric measurement

Height and weight of the respondents were measured. The BMI was calculated as weight in kilograms divided by the square of the height in meters wt (kg)/ht (m)^2. BMI criteria of the International Obesity task Force (IOTF) were used to define obesity. The IOTF classification system provides extended BMI cut-off points by age and sex for overweight, obesity and severe obesity among children aged 2 to 18 years (Cole et al., 2000). Subjects with a BMI >30 kg/m^2 were categorized as obese or severely obese according to the extended BMI cut-points. In this study, they would only be referred to as obese subjects. However, underweight was not classified. Hence, children were categorised as normal weight, overweight and obese.

Definition of hypertension

In this study, hypertension was defined as average of two measurements of systolic and/or diastolic BP that is ≥140/90 mm Hg in any adult or self-reported treatment of hypertension with antihypertensive medication taken in the past 2 weeks (Whitworth, 2003) and in children, ≥95 percentile for gender, age and height in children using the standard BP charts developed by the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, United States of America (Chobanian et al., 2003). The total hypertensive population was divided into 3 subsets namely: Combined systolic and diastolic hypertension (SDH), isolated systolic hypertension (ISH) and isolated diastolic HTN (IDH). In children, the 95th percentile relative to age and sex was used as cut-off to pick isolated systolic and diastolic measurements as appropriate (Table 1b). The values obtained from our study are shown in Table 1.

Data analysis

Data was collated and analyzed using IBM Statistical Package for

Table 1b. Classification of isolated systolic and diastolic blood pressure for children.

Children percentile	95th Percentile		
Classification	**mmHg**		
Age group (years)	**SBP**		**DBP**
3-5			
ISH	≥116	and	<76
IDH	<116	and	≥76
6-9			
ISH	≥122	and	<78
IDH	<122	and	≥78
10-12			
ISH	≥126	and	<82
IDH	<126	and	≥82
13-15			
ISH	≥136	and	<86
IDH	<136	and	≥86
16-17			
ISH	≥142	and	<92
IDH	<142	and	≥92

SBP, systolic blood pressure; DBP, diastolic blood pressure; ISH, Isolated systolic hypertension; IDH, Isolated diastolic hypertension.
Source: Chobanian et al. 2003; CDC (2005).

Social Sciences (SPSS)® version 20. The data was summarised using descriptive statistics such as means, standard deviation, range, proportions and percentages. Chi square test was used to determine the significance of association of hypertension with known risk factors measured. Logistic regression model of variables significant at bivariate analysis was used to determine the independent predictors of hypertension. Level of significance was set at 5 and 95% confidence intervals (CI) were calculated for Odds Ratio (OR).

Ethical consideration

This study was carried out in strict adherence to the Helsinki Declaration principles of 1975, as revised in 2000 (available at http://www.wma.net/e/policy/17-c_e.html). Individual verbal informed consent was obtained from adults and parents of children. Assent was obtained from the children. Those discovered to have abnormal results were followed up with free consultations and free counselling by the consultant physician in the team (MAO); but they bought their medications. Those who required further investigation and specialist attention were duly referred to the University College Hospital, Ibadan. Confidentiality was maintained all through data collection and analysis. The respondents' identification was protected as only codes were used as identifier.

RESULTS

A total of 5540 persons consisting of 3780 adults 18 years and above (68.2%) and 1760 children (3-17years) had complete data which were analysed for this study. Table 2 shows the socio-demographic characteristics of respondents by broad age group into: Children (≤ 10 years) constituting 17%, adolescents (11-17 years) -15% and adults (≥ 18 years) - 68%. Overall, there was a slightly female preponderance (51.4%) and this was more pronounced among children. A high proportion of the respondents was not married (59.3%) and less than 2% were either divorced or separated. Only 6.4% of the respondents had no formal education and this was least among respondents aged 11 to 17 years. A similar pattern was observed among respondents with tertiary education with majority of them 18 years and above. About two thirds (68.4%) of the respondents aged 18 years and above were in employment with just above one quarter (27.9%) of them being unemployed. Less than 2% of children aged 10 years and below reported that they were employed. A sizeable percentage (72.4%) of the respondents was Christians.

Table 3 shows the summary statistics of blood pressure and the proportion of respondents who were hypertensive. Among the adults, the mean systolic and diastolic blood pressure was 130.1 (20.6) mmHg and 79.8 (12.6) mmHg, respectively. The mean systolic and diastolic blood pressure was 110.8 (12.4) mmHg and 68.3 (9.7) mmHg, respectively among the children. The mean diastolic and systolic pressures increased with age (Figures 1 and 2). As shown in Figure 2 there are some extreme values of diastolic and systolic blood pressure among the adults. The overall number of respondents presenting with systolic and diastolic BP greater than 140 and 90 mmHg

Table 2. Socio-demographic characteristics of the respondents.

Variable	Age-group (Years)			
	≤10 (N=950) n (%)	11-17 (N=810) n (%)	18+ (N=3780) n (%)	Total (N=5540) n (%)
Gender				
Male	447(47.1)	383(47.3)	1865(49.3)	2695(48.6)
Female	503(52.9)	427(52.7)	1915(50.7)	2845(51.4)
Education				
None	48(5.1)	11(1.4)	294(7.8)	353(6.4)
Primary	859(90.4)	192(23.7)	471(12.5)	1522(27.5)
Secondary	27(2.8)	589(72.7)	1794(47.5)	2410(43.5)
Post-secondary	0(0.0)	6(0,7)	801(21.2)	807 (14.6)
University	0(0.0)	6(0.7)	348(9.2)	354 (6.4)
Not known	16(1.7.0)	6(0.7)	72(1.9)	94 (1.7)
Marital Status				
Married	8(0.8)	13(1.6)	2088(55.2)	2109 (38.1)
Single	927(97.6)	785(96.9)	1572(41.6)	3284 (59.3)
Separated/Divorce/ widowed	0(0.0)	1(0.1)	96(2.5)	97 (1.8)
Not known	15(1.5)	11(1.4)	24(0.6)	50 (0.9)
Employment				
Employed	16(1.7)	334.1)	2587(68.4)	2636(47.6)
Unemployed	894(94.1)	738(91.1)	1056(27.9)	2688(48.5)
Not known	40(4.2)	39(4.8)	137(3.6)	216(3.9)
Religion				
Christian	678(71.4)	580(71.6)	2753(72.8)	4011(72.4)
Islam	246(25.9)	216(26.7)	965(25.5)	1427(25.8)
Others	26(2.7)	14(1.7)	62(1.6)	102(1.8)

were about 15 and 11% respectively. The affected adults were referred to the private clinic of one of the investigators for further investigation and treated. The mean diastolic and systolic pressures were higher in females than males among those ≤10years (p=0.29) and about same among the adolescents (p=0.58). Among the adults the diastolic pressure was marginally higher among males than females, while it was only in the age group 18 to 35 years that men had higher systolic and diastolic blood pressure than females (p<0.0001) (Table 3).

The prevalence of hypertension was 27.3% in adults and 12.8% in children < 18 years. Isolated systolic hypertension was found in 10.3% of adults and 4.4% of children while isolated diastolic hypertension was found in 4.7% of adults and 5.3% of children, respectively. Among the children, there was no significant difference in the proportion of males and females with hypertension (OR 1.29 (0.98, 1.72) and isolated systolic hypertension (OR 1.20 (0.76, 1.90). However, the odds of isolated diastolic hypertension were significantly two times greater in females than in males (OR 1.75 (1.13, 2.71). Contrarily, among the adults, the odds of hypertension and isolated systolic hypertension were 1.32 and 2 times, respectively more among the males compared to females. No significant difference was demonstrated for isolated diastolic hypertension between sexes among adults (OR 0.76 (0.56, 1.03).

Prevalence of risk factors for hypertension

Table 4 shows that obesity was present in 13.1% children and 23.2% adults. Among adults, 8.4% ever smoked compared to less than 1% among children. But alcohol use was reported by 27% of adults and 1% of children 11 to 17 years. The proportion of adults engaged in regular exercise (42%) was higher than among children being 20% in those less than 10 years and 30% for 11 to 17 years. Less than 1 and 2% children and adults had sugar while 3 and 2% had protein, detected in their urine, respectively. About 4% of adults reported they were currently on anti-HTN drugs prior to study. At bivariate analysis, no significant difference was demonstrated in the use of alcohol and smoking among children ≤ 10 years and adolescents (11-17 years). However, among the adults, the proportion of those who smoke cigarette (p<0.0001) and used alcohol (p<0.0001) increased with

Table 3. Prevalence of hypertension in children and adult respondents by sex.

Parameter	Children				Total (N=1760)	OR (95% CI) (M/F) Reference category = F
	<=10 years		11 -17 years			
	Male (N=447) n (%)	Female (N=503) n (%)	Male (N=383) n (%)	Female (N=427) n (%)		
HTN	66 (14.8)	95 (18.9)	28 (7.3)	37 (8.7)	226(12.8)	1.29(0.98-1.72)
ISHTN	25 (5.6)	29 (5.8)	8 (2.1)	15 (3.5)	77(4.4)	1.20(0.76-1.90)
IDHTN	21 (4.7)	44 (8.7)	11(2.9)	17 (4.0)	93(5.3)	1.75(1.13-2.71)*
			Mean(SD)			
Systolic BP	106.4(12.0)	107.2(12.3)	115.0(11.9)	115.4(10.6)	110.8(12.4)	
Test-statistics	t= -1.056, p=0.291		t = -0.554, p=0.580			
Diastolic BP	66.2(10.1)	67.1(10.2)	69.7(9.2)	70.8(8.5)	68.3(9.8)	
Test-Statistics	t= -1.341, p=0.184		t= -1.791, p=0.074			

	Adults							
	18-35years		36-55 years		56 years+		Total (N=3780) n (%)	OR (95% CI) (M/F)
	Male (N=1149) n (%)	Female (N=1117) n (%)	Male (N=498) n (%)	Female (N=539) n (%)	Male (N=218) n (%)	Female N=259 n (%)		
HTN	236(20.5)	97(8.7)	187(37.6)	208(38.6)	136(62.4)	167(65.5)	1031(27.3)	0.76(0.66-0.88)*
ISHTN	149(13.0)	27(2.4)	39(7.8)	42(7.8)	59(27.1)	73(28.2)	389(10.3)	0.53(0.42-0.65)*
IDHTN	41(3.6)	41(3.7)	49(9.8)	36(6.7)	10(4.6)	2(0.8)	179(4.7)	0.76(0.56-1.03)
				Mean(SD)				
Systolic BP	128.6(12.4)	118.8(13.1)	134.1(19.3)	134.1(24.2)	149.6(26.4)	151.9(28.4)	130.0(20.5)	
Test-Statistics	t =18.137, p=0.000		t= -0.031, p=0.976		t= -0.929, p=0.353			
Diastolic BP	77.1(9.4)	74.5(9.9)	85.5(13.1)	85.1(14.3)	87.3(14.0)	85.8(14.4)	79.8(12.6)	
Test-Statistics	t=6.161, p=0.000		t=0.425, 0.671		t=0.250,p=1.152			

HTN, Hypertension, ISHTN, Isolated systolic hypertension; IDHTN, Isolated diastolic hypertension; *Significant at $p < 0.05$.

significantly with age with those aged 56 years and above having the highest, respectively. More of the adolescents reported to have engaged in regular exercise than children ≤10 years ($p<0.0001$) while no significant difference was demonstrated among the adult age groups. Among the children, more of the children ≤10 years were overweight and obese compared with adolescents ($p<0.0001$) whereas among the adults, the proportion overweight and obese increased significantly with age ($p<0.0001$). The use of stimulants also increased significantly with age among the adults ($p<0.0001$) and children ($p<0.0001$).

Those who had protein and sugar in their urine increased significant with age among adults and it was only the proportion of those with protein that was significantly higher among the adolescents

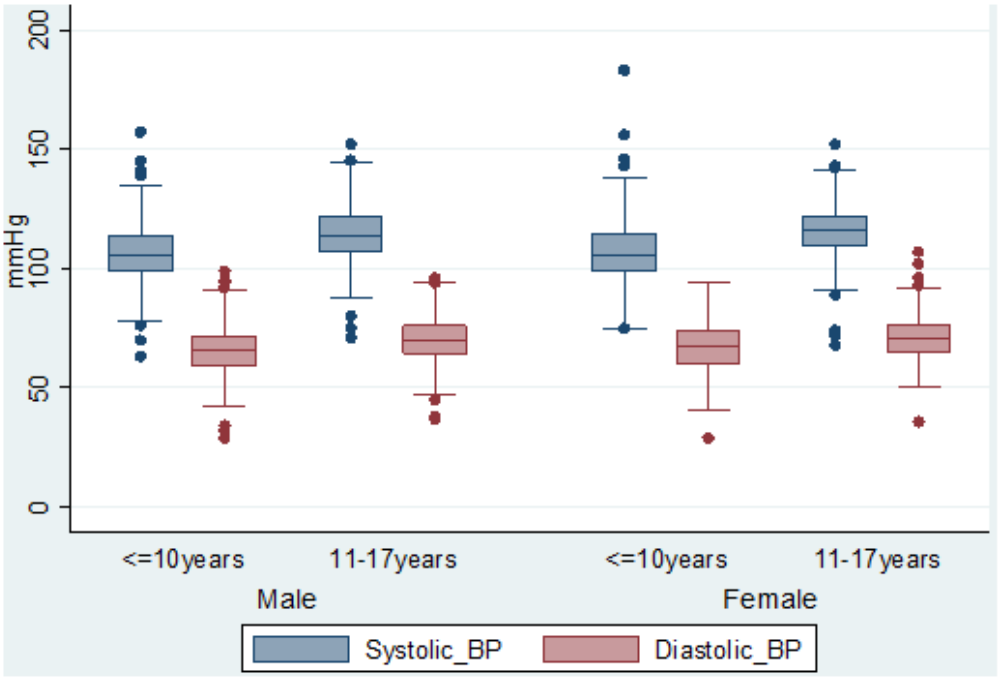

Figure 1. Boxplot showing blood pressure of children (10-17years) by gender.

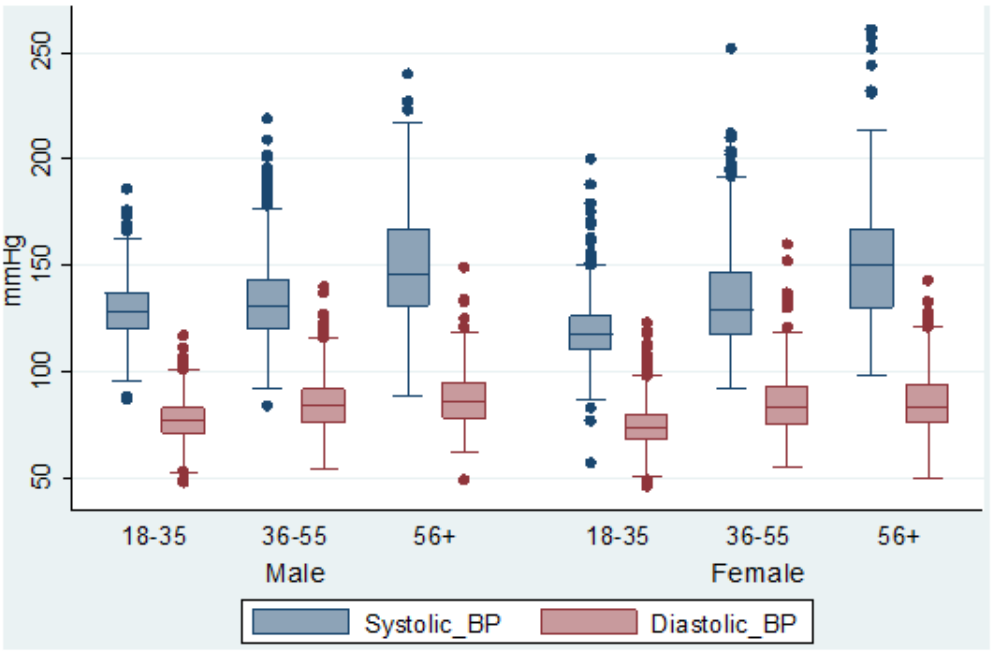

Figure 2. Boxplot showing pattern of blood pressure of adult (18 years and above) by gender.

compared with children ≤10years. The proportion of those who were on anti-hypertensive medication prior to the study increased significantly with age ($p<0.0001$) (Table 4).

Association between selected risk factors and hypertension

The association between selected risk factors and

Table 4. Prevalence of selected risk factors for hypertension by age group of respondents.

Variable	Children Age-group (Years)			Adult age-group (Years)				Overall total
	≤10	11-17	Total	18-35	36-55	56 & above	Total	
Smoking status								
Yes	7(0.77)	4(0.51)	11(0.65)	144(6.50)	110(10.92)	53(11.70)	307(8.35)	318(5.92)
No	907(99.23)	775(99.49)	1682(99.35)	2072(93.50)	897(89.08)	400(88.30)	3369(91.65)	5051(94.08)
Total	914	779	1693	2216	1007	453	3676	5369
Test-statistics		χ2=0.415, p=0.519			χ2=25.283, p=0.000			
Alcohol intake								
Yes	2(0.22)	8(1.02)	10(0.58)	524(23.81)	327(32.54)	137(29.91)	988(26.97)	998(18.57)
No	925(99.78)	776(98.98)	1701(99.42)	1677(76.19)	678(67.46)	321(70.09)	2676(73.03)	4377(81.43)
Total	927	784	1711	2201	1005	458	3664	5375
Test-statistics		Fisher's test=0.051			χ2=29.009, p=0.000			
Regular exercise								
Yes	186(19.96)	244(30.31)	430(24.76)	926(41.47)	457(44.63)	197(42.18)	1580(42.43)	2010(36.81)
No	746(80.04)	561(69.69)	1307(75.24)	1307(58.53)	567(55.37)	270(57.82)	2144(57.57)	3451(63.19)
Total	932	805	1737	2233	1024	467	3724	5461
Test-statistics		χ2=24.856, p=0.000			χ2=2.883, p=0.237			
BMI								
Underweight	N/A	N/A	N/A	175(7.72)	38(3.66)	20(4.19)	233(6.16)	233(4.21)
Normal	763(80.32)	620(76.54)	1383(78.58)	1412(62.31)	414(39.92)	174(36.48)	2000(52.91)	3383(61.06)
Overweight	45(30.61)	102(12.59)	147(8.35)	281(12.40)	272(26.23)	118(27.74)	671(17.75)	818(14.77)
Obese	142(61.74)	88(10.86)	230(13.07)	398(17.56)	313(30.18)	165(34.59)	876(23.17)	1106(19.96)
Total	950	810	1760	2266	1037	477	3780	5540
Test-statistics		χ2=38.675, p=0.000			χ2=288.953, p=0.000			
Stimulant								
Yes	15(1.63)	63(7.99)	78(4.56)	414(18.57)	390(38.27)	220(48.03)	1024(27.62)	1102(20.35)
No	906(98.37)	725(92.01)	1631(95.44)	1816(81.43)	629(61.73)	238(51.97)	2683(72.38)	4314(79.65)
Total	921	788	1709	2230	1019	458	3707	5416
Test-statistics		χ2=39.514, p=0.000			χ2=244.768, p=0.000			
Sugar level								
Yes	1(0.18)	3(0.56)	4(0.36)	7(0.53)	16(2.54)	12(4.21)	35(1.57)	39(1.17)
No	1(0.18)	3(0.56)	1093(99.64)	1305(99.47)	613(97.46)	273(95.79)	2191(98.43)	3284(98.83)
Total	557	540	1097	1312	629	285	2226	3323
Test-statistics		Fisher's test =0.367			χ2=25.801, p=0.000			

Table 4. Contd.

Protein level								
Yes	5(0.89)	27(5.04)	32(2.92)	26(1.99)	10(1.60)	14(4.84)	50(2.25)	82(2.47)
No	554(99.11)	509(94.96)	1063(97.08)	1280(98.01)	614(98.40)	275(95.16)	2169(97.75)	3232(97.53)
Total	559	536	1095	1306	624	289	2219	3314
Test-statistics		$\chi2$=16.554, p=0.000			$\chi2$=10.417, p=0.005			
On HTN drug								
Yes				3(0.18)	44(5.83)	59(16.16)	106(3.79)	106(3.79)
No	N/A	N/A	N/A	1676(99.82)	711(94.17)	306(83.84)	2693(96.21)	2693(96.21)
Total				1679	755	365	2799	2799
Test-statistics					$\chi2$=222.093, p=0.000			

HTN, Hypertension; N/A, Not applicable (IOTF did not categorise underweight for children).

hypertension are shown in Table 5. Obesity was the only risk factor found to be significantly associated with hypertension in both children and adults in this study. Obese children (aged 11-17 years) had 2 times the odds of being hypertensive compared with normal weight children (OR= 1.50 95%CI: 1.03-2.20) while overweight and obese adults had 3 times (OR =3.20 95%CI: 2.15-4.75) and 4 times (OR =3.5 (95%CI: 2.40 -5.22) the odds of being hypertensive compared to normal weight adults. The other risk factor found to be significantly associated with hypertension among children was age whereby those aged 11 to 17 years had 60% decreased risk of being hypertensive compared with those ≤10 years old. Whereas, among adult other risk factors include being male (OR = 1.31 95%CI: 1.13 - 1.51), ever smoked (OR = 1.66 (1.30 - 2.1), ever used alcohol (OR = 1.40 95%CI: 1.20, 1.65) and employed (OR = 1.96 95%CI: 1.65 - 2.34). In the logistic regression analysis age remained significant predictor of hypertension among the children. Those aged 11 to 17 years demonstrated significant decreased risk of 57% [AOR= 0.43 (95%CI 0.32, 0.58)] compared to those in age group ≤10 years. However, those obese still had 44% increased risk of hypertension compared with normal weight children but this association was not significant [AOR = 1.44 (95%CI 0.98, 2.10)]. Among adults, being aged 35 to 55 years [AOR = 3.80 (95%CI 2.73, 5.29)] and 55+ years [AOR = 7.37 (95%CI 4.90, 11.10)], overweight [AOR = 2.55 (95%CI 1.39, 4.71)] and obese [AOR = 3.02 (95%CI 1.65, 5.52) remained significant predictors of hypertension. In addition, the females demonstrated 45% decreased risk of hypertension compared with males [AOR = 0.55 (95%CI 0.42, 0.71) (Table 4).

DISCUSSION

This study highlights the prevalence of hypertension in children and adults as well as associated risk factors in an urban community. Among the children (3 to 17 years), the overall prevalence of hypertension (12.8%) found in this urban community is higher than the 1 to 5% reported for general paediatric population (Lurbe et al., 2010; Obarzanek et al., 2010), the 3.0% reported among US children and adolescents (May et al., 2012), 3.1% found among Chinese children (Meng et al., 2013) and the 11% reported among school-aged children with BMI >95th percentile in the US (Sorof et al., 2004). However, it is less than the 18.2% reported in a study of children 5 to 16 years in India (Itagi and Patil, 2011). The prevalence also supports an increasing trend as it shows three-fold increase or more from figures reported over the last three decades in Nigeria (Akinlua et al., 2015; Obika et al., 1995; Abdurrahman et al., 1978). There is dearth of information on hypertension in young children in Nigeria. Only one paper was found to have recorded the prevalence of hypertension in children (2-5 years) in southeast Nigeria (Oduwole et al., 2012) and the prevalence (1.9%) was far less than what was found among children 3 to 10 years in this study (17.0%) and the males had a slightly higher prevalence than females. The differences between studies could be because in this study, the age for younger children extended

Table 5. Predictors of hypertension among children and adult by demographic characteristics and selected risk factors.

Variable	HTN (Children)		OR (95% CI)	AOR (95% CI)
	No (N=1534) n (%)	Yes (N=226) n (%)		
Age group				
≤10 (Ref)	789(83.1)	161(16.9)	1.00	1.00
11-17	745(92.0)	65(8.0)	0.43 (0.17,0.24)*	0.43 (0.32, 0.58)*
BMI status				
Normal (Ref)	1213(87.7)	170(12.3)	1.00	1.00
Overweight	131(89.1)	16(10.9)	0.87 (0.51,1.50)	1.07 (0.62, 1.87)
Obese	190(82.6)	40(17.4)	1.50 (1.03,2.20)*	1.44 (0.98, 2.10)
Gender				
Male (Ref)	736(88.7)	94(11.3)	1.00	NA
Female	789(85.8)	132(14.2)	1.30 (0.98, 1.72)	
Education				
None (Ref)	51 (86.4)	8 (13.6)	1.00	
Primary	870 (83.3)	175 (16.7)	1.28 (0.60,2.75)	
Secondary	576 (93.8)	38 (6.2)	0.42 (0.19,0.95)	NA
Post-sec	9 (75.0)	3 (25.0)	3.19 (0.50,20.3)	
University	8 (100.0)	0 (0.0)	-	
Sugar level				
Positive	3 (75.0)	1(25.0)	2.51 (0.26,24.34)	NA
Negative (Ref)	965 (88.3)	128 (11.7)	1.00	
Regular exercise				
Yes	378(87.9)	52(12.1)	0.90(0.65, 1.26)	
No	1134(86.8)	173(13.2)	1.00	NA
HTN (Adult ≥ 18 years)				
Age group				
18-35 (ref)	1933 (85.3)	333 (14.7)	1.00	1.00
36-55	642 (61.9)	395 (38.1)	3.57 (3.01, 4.24)*	3.80 (2.73, 5.29)*
55+	174 (36.5)	303 (63.5)	10.11(8.11, 12.60)*	7.37 (4.90, 11.10)*
Gender				
Male (Ref)	1306 (70.0)	559 (30.0)	1.00	1.00
Female	1443 (75.4)	472 (24.6)	0.76 (0.66, 0.88)*	0.55 (0.42, 0.71)*
Education				
None (Ref)	125 (42.5)	169 (57.5)	1.00	1.00
Primary	285 (60.5)	186 (39.5)	0.48 (0.36,0.65)*	0.45 (0.29, 0.69)
Secondary	1395 (77.8)	399 (22.2)	0.21 (0.16,0.27)*	0.38 (0.26, 0.57)
Post-sec	635 (79.3)	166 (20.7)	0.19 (0.15,0.26)*	0.41 (0.26, 0.64)
University	264 (75.9)	84 (24.1)	0.24 (0.17,0.33)*	0.38 (0.22, 0.65)
Sugar level				
Positive	16 (45.7)	19 (54.3)	3.20 (1.63,6.25)*	1.64 (0.75, 3.57)
Negative (Ref)	1597 (72.9)	594 (27.1)	1.00	1.00
BMI Status				
Underweight(Ref)	199 (85.4)	34 (14.6)	1.00	1.00
Normal	1570 (78.5)	430 (21.5)	1.60 (1.10,2.34)*	1.43 (0.80, 2.57)
Overweight	434 (64.7)	237 (35.3)	3.20 (2.15, 4.75)*	2.55 (1.39, 4.71)*
Obese	546 (62.3)	330 (37.7)	3.54 (2.40,5.22)*	3.02 (1.65, 5.52)*
Marital status				
Married	1362 (65.4)	722 (34.6)	0.30 (0.20,0.46)*	0.59 (0.31, 1.13)
Single	1330 (84.6)	242 (15.4)	0.10 (0.07,0.16)*	0.58 (0.28, 1.20)

Table 5. Contd.

Separated/Wid (Ref)	35 (1.3)	61 (6.0)	1.00	1.00
Employment status				
Employed	1791(69.2)	796 (30.8)	1.96 (1.65,2.34)*	0.95 (0.71, 1.29)
Unemployed (Ref)	861(81.5)	195 (18.5)	1.00	1.00
Smoke status				
Yes	193 (62.9)	114 (37.1)	1.66 (1.30,2.11)*	0.83 (0.55, 1.23)
No (Ref)	2486 (73.7)	886 (26.3)	1.00	1.00
Alcohol intake				
Yes	670 (67.8)	318 (32.2)	1.40 (1.20,1.65)*	1.40 (1.07, 1.83)*
No (Ref)	2000 (74.7)	676 (25.3)	1.00	1.00
Regular exercise				
Yes	1163(73.6)	417(26.4)	0.94(0.81, 1.09)	NA
No	1551(72.3)	593(27.7)	1.00	
Take stimulant				
Yes	650 (63.5)	374 (36.5)	1.89 (1.61,2.20)*	0.96 (0.75, 1.22)
No (Ref)	2054 (76.6)	629 (23.4)	1.00	1.00

Wid: Widow; *significant at p<0.05; **Stimulant: e.g kolanut, bitter cola, coffee.

to 10 years and the sample size was more. According to sex of the younger children, a general observation in this study and others studies in Nigeria are that hypertension is more among girls than boys. Due to the earlier onset of puberty, higher BMI among girls may possibly explain this gender disparity of BP (Also et al., 2016). In this study, the main predictor of hypertension in children is obesity and this was more among the girls than boys. The positive relationship between obesity and hypertension in children is similar to findings in previous studies in Nigeria and other parts of the world (Sorof et al., 2004; Oduwole et al., 2012). This gender difference in blood pressure pattern may also be attributed to hormonal changes that occur during puberty which has been noted to occur more rapidly in females than in males. The psychosocial stress associated with menarche has also been documented to cause an increase in blood pressure in early and mid-adolescent stage (Monyeki and Kemper, 2008).

With regards to adolescent age group, the hypertension prevalence of 8.0% among adolescents (11-17yrs) in this study is higher than the 0.6% (using >140/90 mmHg) and 3.7% (using >2SD of mean blood pressure for age and sex) reported among secondary school children (10-19 years) in Zaria, (Bugaje et al., 2005) and 3% reported among 6 to 14 year old primary school children in Kano in northern Nigeria (Also et al. 2016). It is also higher than 4.7% reported among children 6-12 years in Port Harcourt, South-south Nigeria (Cole et al., 2000) and in children 10 to 16 years in South Africa (Moselakgomo et al., 2012). However, it is lower than the 17.5% reported by Ejike et al. among 13 to 18 years adolescent in northcentral Nigeria (Ejike et al., 2010), and 16.6% among 12 to 15 year olds in New Delhi, India (Bahl et al., 2015) but about the same with 7% reported in another study in India (Anand et al., 2014).

Going by sex among the adolescents, the prevalence of hypertension which was 7.3% in males and 8.7% in females in this study is more than that reported in south-south Nigeria (3.9% in males and 5.3% in females) and in South Africa (4.1% in males and 2.8% in females) (Moselakgomo et al., 2012) but less than in North central Nigeria (18.0% in females and 16.9 boys) (Ejike et al., 2010). However, it appears it is higher in females in Nigeria than South Africa. The prevalence of hypertension in Zaria adolescents was not disaggregated by sex but the proportions of those with systolic and diastolic hypertension were reported by gender and the proportion with isolated systolic hypertension was less than that found in our study for females (2.6% versus 3.5%) and more for males (2.3% versus 2.1%). However, for diastolic hypertension, the proportion of males was less in the Zaria study (0.8%) compared to our study (2.9%) and the proportion of females was more in our study (4.0%) compared with the Zaria study (2.0%). Albeit, in this study no significant difference in the proportion of male and female adolescents with hypertension and isolated systolic hypertension was demonstrated. But the females were significantly more likely to have isolated diastolic hypertension. The non-differentials in the prevalence of hypertension by sex is similar to the findings of a review of hypertension studies among children in Nigeria (Akinlua et al., 2015) and among adolescents in Zaria. This was also similar to the findings in India (Bahl et al., 2015; Anand et al., 2014). It is however unlike the findings among adolescents in

South Africa where the prevalence of hypertension was higher among boys than girls and this was related to the fact that females stay at home and carry out household chores which is also a culture in Nigeria. The significantly higher prevalence of diastolic hypertension among female adolescents in this study is similar to the findings in the Zaria study (Bugaje et al., 2005). This similarity is in three different geographical location (north, southwest and south-south) of Nigeria suggesting that this may be due to sex related factors, probably hormonal, rather than environmental.

The prevalence of hypertension (27.3%) among adults in this study is more than found in the children but within the range of 2.1 to 47.2% found among adults in Nigeria (Akinlua et al., 2015; Nwokorie, 2014). The prevalence among young adults and older adults is 14.7 and 38.1%, respectively while it is 63.5% among those 56+ years. The high prevalence in the older age group is similar to findings by Peltzer and Phaswana-Mafuya in South Africa. Older adults are disproportionately affected by hypertension, which is an established risk factor for cardiovascular disease (Peltzer and Phaswana-Mafuya, 2013). Looking at the trend from childhood to adult, findings in this study support the fact that hypertension increases with age (Chadha et al., 1999) and that hypertension in adulthood may be related to persistent blood pressure elevation in children and adolescents (Bao et al., 1995; Anjana et al., 2005). Blood pressure has been found to track from childhood into adulthood and vascular damage from hypertension starts in childhood (Chen and Wang, 2008). The increasing trend of blood pressure with age is also reflected in the mean systolic and mean diastolic pressure across the age categories in this study. The high prevalence of hypertension in young adult is similar to findings in past studies (Ekore et al., 2009). This underscores the need to start screening for hypertension from childhood and institute a life course approach to the control of hypertension in order to reduce the prevalence and complications.

The relationship between sex and hypertension among adults in this study is different from that in the children. Among the children there was no significant difference in prevalence by gender except for the females who had significant higher prevalence of isolated diastolic hypertension. Contrarily, among the adults (overall), the males were significantly more likely to be hypertensive than females. The male preponderance for hypertension (using the cut of >=140/90 mmHg) is similar to findings in many past community based studies in Nigeria (Ekwunife and Aguwa, 2011; Akinlua et al. 2015; Sowemimo et al., 2015) and sub-Saharan countries (Ataklte et al., 2015). In a review of hypertension studies in Nigeria, a slightly higher prevalence in males (4.5 - 50.2%) than in females (8.8 - 48.8%) irrespective of the population settings and BP criteria was reported (Nwokorie, 2014). However, with grouping of adult age into young, middle age and older adults, prevalence of hypertension was marginally higher among females in the young (38.6% vs. 37.6%) and middle aged (65.5% vs. 62.4%) groups. This is similar to findings in a survey of hypertension in an older adult population (50+ years) in South Africa where prevalence among females was (79.6%) compared to males (74.4%) (Peltzer and Phaswana-Mafuya, 2013). Studies have shown that through early middle age, or about age 45, high blood pressure is more common in men and women are more likely to develop high blood pressure at later age (Mozzafarian et al., 2015). The larger proportion of those aged less than 65 years may account for the overall higher prevalence in the males in this study.

Higher prevalence of hypertension is common to prevalence studies on hypertension among adults ≥18 years in urban communities in Nigeria and other African countries compared with rural communities and it is not different in this study as the prevalence is higher than that reported in many rural community studies as illustrated by Akinlua et al. (2015) in a systematic review of hypertension studies in Nigeria. However, hypertension prevalence in this study is still lower than the prevalence found in some other urban communities especially those carried out within the last decade (Akinlua et al., 2015) but higher than the prevalence in studies carried out more than a decade ago (Kadiri et al., 1999) suggesting increasing trend.

There were differentials in the prevalence of known risk for hypertension by age group and in the level of significance of the differences in proportion across the age groups in our study. The known risk factors were more prevalent among adults compared to children and this was more so with the use of stimulants and alcohol, smoking and presence of glycosuria. Overall, just about a third of respondents (comprising 41.8% of the adults and 24.4% of the children) in this study mentioned they engaged in exercise. This differential finding is understandable as human beings pick up various habits along the way growing up. There are limited studies on the prevalence of risk factors for hypertension among children in Africa. However, our findings corroborate risk factors such as overweight and obesity reported in some literature (Moselakgomo et al., 2012, Ejike, 2013). The higher prevalence of overweight and obesity among children aged ≤10 years compared to adolescent could be related to the fact that children store fat while in early childhood, engage less in physical activity including household chores. The children shed this fat as they grow older because of engaging in more physical activity and are less pampered with food especially energy dense food by their parents (Fetuga et al., 2011; Eze et al., 2017). However, our finding is contrary to a study in south-south Nigeria that found prevalence of overweight to be higher among adolescents 10 to 18 years of age

than among children 5 to 9 years of age (Eno-Obong and Ekweagwu, 2012). The increasing prevalence of some of the known risk factors with age among adults is similar to findings in previous studies (Nwokorie et al., 2014; Ntuli et al., 2015).

At bivariate and multivariate analysis, the selected known risk factors of hypertension found to be significantly associated with hypertension in this study are similar to findings in past studies (Ejike et al., 2008; Flores-Huerta et al., 2009; Raj et al., 2010; Oduwole et al., 2012; Nwokorie, 2014; Also et al. 2016). When put in regression model the only lifestyle related factor found to be significant predictor of hypertension was alcohol intake among the adults. Obesity which is a disease and a risk factor for cardiovascular diseases was also found to be a predictor of hypertension in both adult and children. This relates to the trend of increasing obesity and high blood pressure in this environment. The non-modifiable factors were increasing age in both adult and children and male sex in adults. However, Ekore et al. (2009) found no significant association between lifestyle habit like diet, alcohol consumption, smoking, physical exercise and hypertension among young adults attending a secondary mission hospital in Ibadan. Regular exercise was also found not to be significantly associated with hypertension in this study. In a study in Limpopo, rural South Africa none of the lifestyle factors was found to be significantly associated with hypertension (Ntuli et al., 2015). This supports the fact that rural dwellers are less exposed to westernisation. The contributory factor to the high prevalence of hypertension in urban areas is the growing urbanization and related lifestyle changes with a shift towards western habits (van de Vijver et al., 2013). Urban dwellers are more likely to consume high energy dense foods (with resultant obesity) and salt intake as well as engage less in physical activity (van de Vijver et al., 2013).

One limitation of this study is that it is a cross sectional study hence the causal relationship between the identified risk factors and hypertension cannot be affirmed. However, the risk factors found to be significant across the ages provide important information to plan larger cohort study for life-course approach and intervention to control hypertension.

Conclusion

Our study revealed a high prevalence of hypertension in adults and children although with values lower in children than adults. The higher risk of hypertension in younger male and older female adults, female adolescents (diastolic hypertension), the obese and those who engage in unhealthy lifestyle corroborates past findings in this study area and suggests that the effect of the various interventions currently in place to stem the trend is sub-optimal. It is therefore recommended that periodic screening and monitoring of blood pressure across all ages at every opportunity including in the course of routine health care and in well-child clinics should be encouraged. Multi-sectorial intervention that emphasizes lifestyle counseling by healthcare professionals and intensified effort at general public health education on hypertension and its associated risk factors is also suggested.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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