Original Research Article

Adolescent high blood pressure pattern, in Lagos, South West Nigeria.

ABSTRACT:

Adolescent high blood pressure (HBP), now a growing significanthealth problem with lasting consequences on cardiovascular health,wasconsidered rare at a time. Several end-organ complications could occur if thisoftentimesasymptomatic condition is uncontrolled, and tracks into adulthood. The 2004 Fourth Reportwas developed to address the cumbersome challenges in the detection of adolescent hypertension.

Aims: The objective of this study was to determine the prevalence of high blood pressure among adolescents in Mushin Local Government Area (LGA) using the 2004 Fourth report.

Study design: Descriptive cross-sectional study.
Place and Duration of Study:14 secondary schools in Mushin Local Government Area (LGA) between August 2020 and December 2020.

Methodology:A two-stage sampling techniquewas used to select 14 secondary schools.Within selected schools, participants were recruited from each class determined by proportional allocation using the school's register. Students were stratified as males and females using the class register. Subjects were selected from each stratum by simple random sampling (balloting). We included 1490, (744 male,746 female, age range 10-19 years old students.A structured questionnaire was used to obtain socio-demographic information and relevant clinical data. The blood pressure measurements was taken according to standard protocol (elevated blood pressure is systolic and/or diastolic blood pressure ≥ 90th percentile but ≤ 95th percentile for age, gender and height). Descriptive statistics was used to describe socio-demographic and anthropometric characteristics. Frequency, percentages, mean and standard deviation were used to summarize categorical and numerical variables.P-values of 0.5 was termed significant

Results: The subjects were 1490,with aresponse rate 99.3%;49.9% (744) were male and 50.1% (746) females (male: female ratio was 1: 1). Prevalence of high blood pressure, elevated blood pressure and hypertension were 14.5% (n =216), 6.1% (n =92), and 8.4% (n =124)respectively. The prevalence of high blood pressure increased progressively with the age group in the early and mid adolescent age group, while the prevalence was lowest in the oldest age group.

Conclusion: High blood pressure, elevated blood pressure and hypertension prevalence, among adolescents was high. Development of complications could be obviated by early detection, life style modification and treatment.

Comment [WU1]: Not needed here

Keywords: adolescent hypertension, high blood pressure, prevalence, pattern, 2004 Fourth Report

- Management strategies emphasized lifestyle modifications, including weight reduction, increased physical activity, dietary changes, and, in some cases, pharmacological treatment

1. INTRODUCTION

High blood pressure(HBP) in adolescents prevalence, estimated at 11.2% globally[1] out of the about 1.13 billion people worldwide living with hypertension is huge; two-third of this number resides in low to middle-income countries.[2] In Sub-Saharan Africa, adolescent HBP prevalence ranges from 0.2 to 24.8%,[3] and in Nigeria, the prevalence ranges from 0.1% to 17.5%[4] A large number of adolescents are at risk for HBP and the risks include: birth weight, maturity during birth, heredity, renal abnormalities, coarctation of the aorta, medications, neoplasm, etc.[5] Age, gender, obesity, physical inactivity, family history of hypertension in first degree relatives, socioeconomic status, cigarette smoking and alcohol intake are other risk factors.[6]Its growing prevalence amongst adolescents calls for a enhanced perceptive of this condition to improve early detection and management. Regular assessment of adolescents with risk of HBP needs be prioritized.

The assessment and detection of HBP is complex and fraught with many challenges and discrepancies.[7] knowing that BP in adolescents is subject to several variables such as age, height, and gender which have to be accounted for when effort is made at describing "normal" and "abnormal" BP. However, the introduction of evidence based practice (which serves to help physicians in identifying symptoms and signs while making the best clinical decisions based on the most recent available evidence); led to the development of the 2004 Fourth report which aided HBP detection and treatment. The 2004 Fourth Report included normative data and the adaptation of this data to the childhood growth charts from Centers for Disease Control and Prevention for the year 2000. This 2004 Fourth report would therefore make evaluation, detection and treatment of HBP easier. Evaluation of persons with elevated blood pressure, at risk for hypertension would aid early identification, prompt intervention (lifestyle modifications, weight reduction, exercise, dietary changes,drugs) and prevention of complications associated with hypertension. The need for targeted screening and interventions, particularly among adolescents is heightened when variable prevalence rates and risk factors are taken into consideration.

This study therefore, sought to determine the prevalence and pattern of high blood pressure among adolescents in Mushin Local Government Area using the 2004 Fourth report. It was hoped that the findings of this study will provide accurate information on the current burden of high blood pressure among adolescents in Mushin Lagos; while providing useful material for health advocates and policy makers on screening for high blood pressure in adolescents

Provide a factual background, clearly defined problem, proposed solution, a brief literature survey and the scope and justification of the work done.]

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

Methods

Study design and setting: A descriptive cross-sectional study, conducted in Mushin Local Government Area of Lagos State South-western part of Nigeria from August 2020 through

December 2020. This study was conducted in 14 (12 private and 2 public) secondary schools in Mushin, which has one educational district called Educational District VI located in the Oshodi area of Lagos State. Study population was adolescents aged 10 to 19 years.

Inclusion and exclusion criteria: Subjects were consecutively enrolled following consent from their parents/ guardians and or from among eligible adolescents(aged 18 years and above) who gave assent for the study. Adolescents with renal conditions such as acute glomerulonephritis, reno-vascular and renal parenchymal diseases; and or those who were on antihypertensive medications were excluded.

Ethical approval: ethical approval was obtained from the health research ethics committee of the Lagos University Teaching Hospital with number NHREC/DCST/HERC/2659. Lagos State Ministry of Education also gave approval with number LG/C530/VI/122.

Sampling procedure: The sample size was determined using prevalence studies formula.[8]

n = *Z2P/Qd2*

Where: n = minimum sample size when study population is > 10,000;

z = Standard normal deviation corresponding to 95% confidence interval = 1.96;

p = prevalence rate of high blood pressure in adolescents from a previous study done in Lagos, Nigeria

i.e. 16.5% (0.17).[9]

q = (1 - p) i.e. 0.83; d = precision level.

For this study, this was set at 2% (0.02) Substituting these figures into the formula:

n = 1.962 × 0.17 × 0.830.022 = 1355

The minimum sample size was 1355. An additional 10% (135 pupils) was added for non-response. This brought the total calculated sample size for the study to 1490. Thus 1,490 adolescents were recruited into the study.

Data collection: within randomly selected schools, participants were recruited from each class determined by proportional allocation using the school´s register; and stratified along gender lines. Subjects were selected from each stratum by simple random sampling. Socio-demographic information and relevant clinical data were obtained using a structured questionnaire. Questions were asked to exclude presence of symptoms of renal disease and history of hypertension in the participants. The anthropometry and blood pressure measurements were taken according to standard protocol. WHO chart for children 5-19 years.[10] The weight was measured to the nearest 0.1kg with minimal clothing using a standardized weighing scale (SECA model 756). Height was measured with the participant standing straight on bare feet, with both heels placed together, buttocks, shoulder blades and head without headgear in Frankfurt plan[11] in contact with the measuring rule, and readings recorded to the nearest 0.5cm using a stadiometer (SECA model 213). The blood pressure was measured after the subject must have rested in a seated position for 5 minutes legs uncrossed and flat on the floor; using Accoson sphygmomanometer. The measurement was done as recommended in the Seventh Report of the Joint National Committee on

Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7) [12] with the subjects sitting quietly and the right arm on a table at the level of the heart.

An appropriately sized cuff was snuggly wrapped on the right upper arm after restricting clothing had been removed. The cuff was then inflated to a pressure of 30 mmHg above the level at which the radial pulse was no longer palpable. The stethoscope was placed over the brachial artery in the cubital fossa and the pressure in the cuff was deflated at 2 mmHg per second. The first audible sound (first Korotkoff sound) was recorded as the systolic blood pressure (SBP). The pressure in the cuff was further lowered until the sounds disappear completely. This was the fifth Korotkoff sound, and the corresponding pressure recorded as the diastolic blood pressure (DBP). The blood pressure was measured three times at an interval of 2 minutes and the mean recorded. The MSD manualcalculator was the tool used in calculating the blood pressure percentiles based on the 2004 Fourth Report.[13] Social class was determined using the socioeconomic indices of the parents as described by Oyedeji.[14] All children who were identified to have high blood pressure, were counselled on lifestyle modification, behavioural changes and referred to specialized clinics for further investigations and follow up.

Normal blood pressure (NBP) was defined as systolic and diastolic blood pressure that is < 90th percentile for gender, age and height.[14]Normal blood pressureis systolic and/or diastolic blood pressure less than the 90th percentile for age, gender and height of an individual.[15]

Pre-hypertensionis defined as systolic blood pressure or diastolic blood pressure that is greater than or equal to the 90th percentile, but less than the 95th percentile for age, gender and height of an individual. OR systolic and/or diastolic blood pressure ≥ 120/80 mmHg but less than the 90th percentile.[15]

Stage 1 hypertensionis systolic and/or diastolic blood pressure equal to or greater than the 95th percentile but less than the 99th percentile plus 5 mmHg for age, gender and height of an individual.[15]

Stage 2 hypertensionis systolic and/or diastolic blood pressure equal to or greater than the 99th percentile plus 5 mmHg for age, gender and height of an individual.[15] Normal weight was BMI- for age between the 5th and 85th percentile. Overweight was BMI-for-age between 85th and 95th percentile. Obesity was BMI-for-age above 95th percentile.[16]

Data analysis: The dataset was analyzed using the Statistical Package for Social Science (SPSS) version 23, Armonk, NY: IBM Corp. Descriptive analysis was utilized to summarize the socio-demographic and other background variables using mean and standard deviation for quantitative variables. The prevalence rate of HBP, elevated BP, and HTN were summarized using frequency and percentages. Alpha was set at 5%, with p-value of less than 0.05 regarded as statistically significant.

3. **Results and discussion**

Characteristics of the study participants

Of the initial 1500 adolescents invited into the study, 1490 completed responses, giving a response rate of 99.3%. There was about equal representation of boys and girls; mean age of the participants was 14.39 ± 2.79 years. The highest proportion of participants (649: 43.6%) belonged to the upper socio-economic class. Majority of participants (83.5%), had normal nutritional status as assessed by Body Mass Index, while 88 (5.9%) were thin. There were 132 (8.9%) overweight and 25 (1.7%) obese participants (Table I).

Table I: Socio-demographic and BMI Status of participants

Variable	Frequency (n = 1490)	Percentage
Age (years)		
10 – 13 (early adolescence)	590	39.6
14 – 16 (middle adolescence)	504	33.8
17 – 19 (late adolescence)	396	26.6
Mean age ± SD	14.39 ± 2.79	
Gender		
Male	744	49.9
Female	746	50.1
Socio-economic status		
Upper Class (I and II)	649	43.6
Middle Class (III)	545	36.6
Lower Class (IV and V)	296	19.8
Body Mass Index (BMI Z scores**)**		
Thin (< – 2 SD)	88	5.9
Normal (≥ – 2 SD – ≤ + 1 SD)	1245	83.5
Overweight (> + 1 SD – ≤ + 2 SD)	132	8.9
Obese (> + 2 SD)	25	1.7

BMI- Body Mass Index, SD: Standard Deviation

Prevalence of high blood pressure among participants based on the 2004 Fourth Report

The overall prevalence of high blood pressure was 14.5% (n = 216), while 1274 (85.5%) had normal blood pressure.

Pattern of high blood pressure among participants based on the 2004 Fourth Report

Table II shows the pattern of high blood pressure using the 2004 Fourth Report. The prevalence rate of prehypertension was 6.1% while the prevalence rate of stage 1 hypertension was 4.8% and the prevalence rate of stage 2 hypertension was 3.6%. With respect to the 216 participants that had high blood pressure, 42.6% had prehypertension, 32.9% stage 1 hypertension and 24.5% stage 2 hypertension. The mean systolic blood pressure and diastolic blood pressures increased steadily across the various blood pressure categories.

Table II: Pattern of high blood pressure among participants based on the 2004 Fourth Report

Variable	Frequency	Percentage of the study population	Percentage of high blood pressure	SBP (Mean±SD)	DBP (Mean±SD)
Prehypertension	92	6.1	42.6	127.95±4.34	75.82±7.47
Stage 1 HTN	71	4.8	32.9	133.21±3.22	81.03±7.48
Stage 2 HTN	53	3.6	24.5	140.58±8.89	94.00 ± 4.65
High BP	216	14.5	100	132.78±7.45	81.99±7.08

SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, HTN: Hypertension, SD: Standard Deviation,CI: Confidence Interval

Blood pressure pattern according to the age group of participants using the 2004 Fourth Report

The prevalence of high blood pressure increased progressively from early adolescent to mid adolescent but drop in the late adolescents' age group (17 to 19 years) as shown in Table III.

The higher prevalence affected prehypertension and stage 1 hypertension but not stage 2 hypertension, in the mid and late adolescents age group, while in the early adolescents the higher prevalence was noted in the stage 1 and stage 2 hypertension.

Table III: Blood pressure pattern according to the age group of participants using the 2004 Fourth Report.

	2004 4th Report

Age Group	Blood Pressure	N (%)
10 – 13	Normal BP	504 (85.4)
(n=590)	High BP	86 (14.6)
	High BP	
	Pre HTN	27 (4.6)
	Stage 1 HTN	30 (5.1)
	Stage 2 HTN	29 (4.9)
14 – 16		
(n=504)	Normal BP	425 (84.3)
	High BP	79 (15.7)
	High BP	
	Pre HTN	38 (7.5)
	Stage 1 HTN	27 (5.4)
	Stage 2 HTN	14 (2.8)
17 – 19		
(n=396)	Normal BP	345 (87.1)
	High BP	51 (12.9)
	High BP	
	Pre HTN	27 (6.8)
	Stage 1 HTN	14 (3.5)
	Stage 2 HTN	10 (2.5)

All p values calculated using Mcnemar Bowker's test of symmetry. ***** *Significant*

BP: Blood Pressure HTN: Hypertension

Mean systolic and diastolic blood pressures by socio-demographic and BMI status of participants.

The mean systolic and diastolic blood pressures differed according to the BMI status with obese participants having the highest systolic and diastolic blood pressure readings, the

differences being statistically significant (p = 0.001 and p = 0.030, for SBP and DBP respectively). Participants from the upper socio-economic class had the highest mean systolic and diastolic blood pressures. The differences were not, however, statistically significant (p = 0.050 and 0.615) (Table IV)**.**

Table IV: Mean systolic and diastolic blood pressure by socio-demographic and BMI status of participants

Variables	Frequency n	SBP Mean ± SD	DBP Mean ± SD
Body Mass Index			
Thin (<– 2 SD)	88	106.95±14.93	63.61±10.28
Normal (≥ – 2 SD – ≤ +1 SD)	1245	110.55±13.81	65.35±10.85
Overweight (> +1 SD – ≤ + 2 SD)	132	115.58±14.53	67.67±14.97
Obese (> + 2 SD)	25	115.60±14.43	68.08±10.82
F *(p-value)*		8.48 (0.001)	2.98 (0.030)
Socioeconomic Status			
Upper (I and II)	649	111.56±13.96	65.80±10.80
Middle (III)	545	110.98±13.75	65.38±11.76
Lower (IV and V)	296	109.16±14.74	65.06±11.35
F *(p-value)*		2.99 *(0.050)*	0.48 *(0.615)*

F: one-way analysis of variance (ANOVA) test, t: student's t-test, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, SD: Standard deviation

3.1 DISCUSSION

The current study demonstrates that there is a high burden of high blood pressure in Lagos Nigeria, a low-income country. It confirms that pre-hypertension and elevated blood pressure is the common pattern using the 2004 Fourth Report. Within each age group, the prevalence of high blood pressure was significantly higher among the mid and late adolescents, in contrast to the early adolescent group. This accentuates the need for regular checks of BP and detection of high blood pressure amongst adolescents.

The first significant finding of this study is the establishment of the fact that the prevalence of high blood pressure (HBP) amongst adolescents in the current study is 14.5% using the 2004 Fourth Report.This is comparable to 14.2% observed by Odey et al,[17] in Calabar, Cross River State in a population of adolescents aged 10 to 18 years with a similar obesity rate of 1.9% using the Fourth Report. Some previous studies had demonstrated higher prevalence of HBP of 27.5%[18] and 22.5%[19]among adolescents using the 2004 Fourth Report. This disparity may be attributable to the remarkably lower prevalence of overweight subjects in the current study (1.7%) than 9.6% and 12.6% in the earlier Lagos and Enugu studies.[18, 19]

However, the HBP prevalence rate of 4.1% reported by Omisore et al,[20] in Osun state was lower than the rate obtained in our study; despite subjects being in similar age group and a seemingly low obesity prevalence of 3%. This difference may be attributable to sedentary lifestyle and unhealthy dietary changes common in cosmopolitan urban areas like Lagos (our

study area); which predisposes to cardiovascular risk factors, including high blood pressure.[21]
Another striking finding with respect to age in the present study was that the prevalence of high blood pressure increased progressively with the age group when the 2004 Fourth report was applied in early and mid adolescent age group, while the prevalence was lowest in the oldest age group. This finding with the 2004 Fourth Report was unusual because blood pressure is known to progressively increase with age.
Higher blood pressure was found to be associated with higher BMI in the present study. This corroborates the finding by Oduwole et al, [18] Abiodun et al, [22]Sharma *et al*, [23] Khoury et al, [24] and Dong *et al*.[25] Obesity is implicated in the development of metabolic syndrome. The high number of children living with metabolic syndrome globally highlights the urgent need for multi-sectorial intervention to reduce the global burden of metabolic syndrome and conditions that lead to it, including childhood overweight and obesity.[26] This is more so, because of its increasing incidence in low- and middle-income countries, particularly in urban settings.[27]

Limitation of study: The descriptive cross-sectional nature of this study limits its ability to determine causative factors as it can only describe associated factors. A multi setting study may need to be done since children not in school were excluded because of limited resources; as social factors that influence HBP may differ amongst them.

4. CONCLUSION

Hypertension in adolescents remains an important public health concern. That, more than one eighth of subjects were hypertensive underscores the need for regular screening for HBP amongst adolescents. Preventing and controlling hypertension can be achievedwhen risk factors arerecognized and appropriate lifestyle modifications implemented. This is becausehigh blood pressure if left undetected and untreated tracks into adulthood with its attendant end organ complications. All children who were identified to have high blood pressure were counseled on lifestyle modification, behavioral changes and referred to specialized clinics for further investigations and follow up.

CONSENT (WHEREEVER APPLICABLE)

All authors declare that ‘written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal

ETHICAL APPROVAL

Ethical approval: ethical approval was obtained from the health research ethics committee of the Lagos University Teaching Hospital with number NHREC/DCST/HERC/2659. Lagos State Ministry of Education also gave approval with number LG/C530/VI/122.

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