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The Correlation between Anthropometric parameters and Blood Pressure of apparently Healthy Secondary School Students in Lokoja, Kogi State, Nigeria

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Abstract

Background: The prevalence of hypertension among adolescents is a global health challenge. This study investigated the correlation between anthropometric parameters and blood pressure in apparently healthy adolescents in Lokoja, Kogi State, Nigeria.

Methods: The cross-sectional study was conducted among 810 mixed-sex secondary school students. Data were obtained using a structured self-administered questionnaire, anthropometric parameters were measured and participants' blood pressure was measured using the mercury sphygmomanometer. Data were analysed using SPSS statistical package (version 25.0) with level of significance set at $p < 0.05$.

Results: The mean age of the study population was 14.41 ± 2.03 years with no significant gender difference ($p = 0.308$). The females had significantly higher, Body Mass Index (BMI) (p=0.001), Waist Circumference (WC) (p=0.020), and Hip Circumference (HC) ($p< 0.001$) compared with the males, while the males had a significantly higher Waist-Hip Ratio (WHR) ($p< 0.001$) compared with females. The prevalence of hypertension among the study population was 16.3%, and the mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) were 101.76 ± 13.18mmHg and 65.05 ± 10.44mmHg respectively. The females had significantly higher mean DBP ($p = 0.003$) and SBP ($p= 0.049$) compared with the males. Significant positive correlations were found between anthropometric parameters for both SBP and DBP ($p< 0.001$).

Conclusion: Given the high prevalence of hypertension reported in this study, it is recommended that regular blood pressure measurement and nutrition education programs should be incorporated into the Secondary school Health Program.

Keywords: Adolescents, Anthropometric parameters, Hypertension, Kogi State.

How to cite this article

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Introduction

The prevalence of childhood hypertension is on the rise globally, with its associated risk for cardiovascular disease, a leading cause of death worldwide.[1] Hypertension, also known as high blood pressure, connotes a condition in which the blood vessels have persistently raised pressure.[1] It is defined as the average systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) that is ≥ 95th percentile for age, sex, and height on ≥ 3 occasions.[1] Other terminologies include elevation in blood pressure suggesting an increase in systemic blood pressure >90th percentile.[2] Studies have shown that high blood pressure in childhood and adolescence increases the risk in adulthood.[2-4] This is further strengthened by hypertension being a key component of metabolic syndrome, a condition that is increasingly noted in childhood and adolescence with resultant long-term adverse consequences in adulthood.[4, 5]

There are several factors implicated in the aetiology of hypertension; however, obesity is a major risk factor for childhood hypertension. Childhood Obesity is on the rise due to an increase in sedentary lifestyle, increased use of video games, and mobile devices, and increased hours of television viewing, coupled with the lack of a standard school environment which is characterized by inadequate land space for sporting activities.[6] Hypertension and obesity have no specific symptoms until complications set in.[2, 7] Due to the strong association between obesity and hypertension, routine assessment of the body mass index and blood pressure is, therefore, an important aspect of cardiovascular risk assessment.[8] About one in 25 adolescents have hypertension,[9] of which is more prevalent in persons with obesity.[9] Research has shown the pattern of blood pressure among children and adolescents, with some relating these patterns to overweight and obesity.[10] While The prevalence of hypertension and obesity however varies from location to location.[11] The impact of this burden is more in developing countries like Nigeria, challenged with numerous communicable diseases.[12] and existing limited resources which can be a major cause of economic loss.[12]

In Nigeria, the incidence of hypertension ranges from 0.1% - 17.5%.[13-17] A study[10] reported 5% in South-western Nigeria compared to the 6.7% prevalence observed in another study[14] in South-south Nigeria. As cited in a study in Kano[18] Abdulrahaman and Babaoye, observed a mortality rate of 28% within the first year following the diagnosis of hypertension in Nigerian children. Obesity on the other hand ranges between 0.3% - 18%.[11,19] The prevalence of 0.3% and 0.84% of obesity recorded in Sokoto[11] and Kano[20] respectively in Northern Nigeria were lower when compared to 18% reported in Southern Nigeria in 1997.[19] This may be due to the socioeconomic, cultural, and dietary differences in these regions. Individuals who become hypertensive would usually pass through a phase of elevated blood pressure, usually associated with overweight/obesity during the disease development.[10]

The association between obesity and hypertension as prevalent risk factors for cardiovascular disease development cannot be ignored;[11,10] Hence there's a need to review the correlation between body mass index and other anthropometric parameters with blood pressure. We envisage that this study will provide additional information on childhood hypertension. In addition to evidence-based health resource allocation and policymaking specifically in Kogi State and in Nigeria as a whole.

Methods

Study area

The cross-sectional study was carried out in eight randomly selected public and private secondary schools in Lokoja, Kogi State in the North Central Nigeria.

Sampling population

Using the multistage sampling technique, the study population included 810 (503 from public schools and 307 from private schools) secondary school students between ages 10 to 18 years. The Sample size (810) was calculated using the Leslie Kish sample size formula for single proportion.[21] Students who assented and whose parents/guardians gave written informed consent were recruited into the study, however, those who presented with gross physical deformities, acutely ill or with chronic diseases, or chronic medical condition, as well as those who refused to give consent to participate, were excluded from the study.

Data collection

Data for the study were collected using a well-structured questionnaire to obtain general information on Socio-demographic characteristics of subjects/respondents.

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Anthropometric parameters of the participants such as; Weight were measured using a battery-powered digital scale (Seca, Inc., Columbia, MD, USA), Height was measured using a stadiometer (Seca Model: 213, USA) [22, 23] BMI was calculated from the weight and height using the formula (BMI= weight(kg)/height(m)^2). The values obtained were compared with BMI percentile charts for age and sex from the Centres for Disease Control and Prevention.[22, 24]. The Waist circumference (cm), Hip circumference (cm), and waist-hip ratio (WHR) were determined as described by WHO[23]. Blood pressure (BP), Systolic BP, and Diastolic BP were also analysed using the mercury sphygmomanometer.[3, 25]

Data analysis

Data were analysed using the IBM Statistical Package for Social Sciences (IBM SPSS) statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA) was used to enter and analyse the data. Both descriptive and inferential statistical methods of analysis were employed in the study. The descriptive statistics included the use of tabular representation of data, percentage, and frequency analysis. Simple arithmetic means and standard deviation to summarize data on blood pressure, weight, height, body mass index, waist circumference, hip circumference, and waist-hip ratio. Frequency and percentages were used to summarize the socio-demographic characteristics of respondents. The Student's t-test was used to compare the means of any two normally distributed continuous variables. Analysis of variance (ANOVA) was used to compare the means of the anthropometric parameters. Correlation analysis was done between the anthropometric parameters and blood pressure. A *p*-value of less than 0.05 indicated statistical significance.

Results

Table1: shows the socio-demographic data of participants. A total number of 810 students participated in this study with 370 (45.7%) males and 440 (54.3%) females. The number of students from public schools was 507 (62.1%) while 307 (37.9%) were from private schools. The Igala tribe was the predominant ethnic group (36.9%) in the study. About 81.3% of the participants were from a monogamous family, while 17.2% were from a polygamous family, with 81% of the participants having both parents as caregivers.

Table 1: Socio-demographic characteristics of the study participants

Variables	Frequency (n =810)	Percentages
Gender		
Male	370	45.7
Female	440	54.3
Type of school		
Public	503	62.1
Private	307	37.9
Ethnicity		
Igala	299	36.9
Ebira	202	24.9
Yoruba	120	14.8
Hausa	35	4.3
Nupe	29	3.6
Igbo	25	3.1
Bassa-nge	59	7.3
Others*	41	5.1
Family setting		
Monogamous	659	81.3
Polygamous	139	17.2
Divorced	12	1.5
Religion		
Christianity	442	54.6
Islam	368	45.4
Caregiver		
Both parents	659	81.3
Father only	43	5.3
Mother only	41	5.1
Others**	67	8.3

Others*= Bassa-komo, Ebira-koto, Fulani, TIV, Kupa, Gbagi, Kakanda
Others**= Uncle, Aunty, Grand-mother, Sister

Anthropometric parameters and the systolic and diastolic blood pressure of the study population according to sex are presented in Table 2: the mean BMI (kg/m^2), WC (cm), and HC (cm) were significantly higher in females than in males, p <0.05. However, the male students had a significantly higher WHR compared with the female students $p < 0.001$. The Systolic Blood Pressure of the study population ranged from 70mmHg to 153mmHg while the Diastolic Blood Pressure ranged between 40mmHg to 95mmHg. The means ± SD of SBP and DBP of the study population were 101.76 ± 13.18mmHg and 65.05 ± 10.44mmHg respectively. The mean SBP and DBP were significantly higher in females than males, $p < 0.05$.

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Table 2: Anthropometric parameters and Mean blood pressure of the study population by gender

Variables	Male Mean ± SD	Female Mean ± SD	Total Mean ± SD	t	*p*-value
BMI (kg/m²)	18.36 ± 2.56	18.98 ± 2.85	18.67 ± 2.71	3.220	**0.001**
Waist circumference (cm)	65.82 ± 9.25	67.22 ± 7.71	66.52 ± 8.48	2.337	**0.020**
Hip circumference (cm)	74.19 ± 10.42	80.82 ± 9.11	77.51 ± 9.77	9.658	**<0.001**
Waist/Hip ratio	0.89 ± 0.06	0.83 ± 0.06	0.86 ± 0.06	13.560	**<0.001**
SBP (mmHg)	100.84 ± 13.74	102.67 ± 12.62	101.76 ± 13.18 (**Min 70 Max 153**)	1.975	**0.049**
DBP (mmHg)	63.94 ± 11.17	66.15 ± 9.70	65.05 ± 10.44 (**Min 40 Max 95**)	3.015	**0.003**

Table 3: Presents the distribution of mean SBP ± SD and DBP of the study population according to age and sex. Females generally had higher BP values than males, with a statistically significant value at 12 years, $p = 0.002$. The males had a significantly higher SBP value at 17 years, $p = 0.002$.
The mean DBP of the study population according to sex and age is presented in Table 7 below. The results show a significantly higher values in females at 13 and 15 years while in males at 17 years, $p<0.05$.

Table 3: The mean SBP and DBP of the study population according to sex and age

	SBP (mmHg)			
Age (years)	**Male Mean ± SD**	**Female Mean ± SD**	**t**	***p*-value**
10	90.42 ± 8.53	88.00 ± 5.81	0.801	0.430
11	87.81 ± 9.51	92.88 ± 11.65	1.478	0.148
12	93.64 ± 10.59	101.60 ± 12.67	3.156	**0.002**
13	97.43 ± 10.34	100.11 ± 10.40	1.290	0.200
14	101.47 ± 12.40	100.32 ± 12.20	0.559	0.577
15	100.22 ± 14.26	104.26 ± 11.57	1.950	0.053
16	105.38 ± 13.44	106.54 ± 13.60	0.429	0.669
17	114.72 ± 10.16	107.60 ± 10.85	3.195	**0.002**
18	108.18 ± 11.83	105.68 ± 15.10	0.635	0.528
Age (years)	**DBP (mmHg)**			
10	57.68 ± 10.09	53.20 ± 4.73	1.321	0.198
11	55.05 ± 6.68	56.65 ± 8.12	0.667	0.509
12	62.10 ± 9.49	65.06 ± 9.83	1.431	0.156
13	62.57 ± 10.26	67.23 ± 9.96	2.302	**0.023**
14	63.97 ± 11.22	66.09 ± 9.47	1.241	0.217
15	62.59 ± 10.93	66.47 ± 9.33	2.391	**0.018**
16	66.15 ± 9.29	68.77 ± 8.77	1.464	0.146
17	72.97 ± 11.99	68.00 ± 9.60	2.207	**0.030**
18	67.75 ± 10.73	65.45 ± 8.71	0.776	0.442

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Pearson (r) correlation for the studied variables

As shown in **Table 4** there is a strong correlation coefficient (r) and *p* value between the anthropometric parameters and the systolic and diastolic blood pressure. BMI (r = 0.424, $p < 0.001$), WC (r = 0.395, $p < 0.001$), and HP circumference (r = 0.394, $p<0.001$) had significant positive correlation with SDP. Similarly, these parameters equally had a significant positive correlation with DBP. The WHR had no significant correlation (r = -0.079, $p = 0.025$) with diastolic and systolic blood pressure. (r = -0.020, $p = 0.571$)

Table 4: Pearson correlation for the studied variables

Variables		BMI	WC	HC	WHR	SBP	DBP
BMI	r	1	0.547	0.515	0.019	0.424	0.286
	p value		**<0.001**	**<0.001**	0.596	**<0.001**	**<0.001**
WC	R	0.547	1	0.833	0.199	0.395	0.279
	p value	**<0.001**		**<0.001**	**<0.001**	**<0.001**	**<0.001**
HC	R	0.515	0.833	1	-0.372	0.394	0.315
	p value	**<0.001**	**<0.001**		**<0.001**	**<0.001**	**<0.001**
WHR	R	0.019	0.199	-0.372	1	-0.020	-0.079
	p value	0.596	**<0.001**	**<0.001**		0.571	**0.025**

The bar chart below shows the comparison between the blood pressure profile of male and female participants.

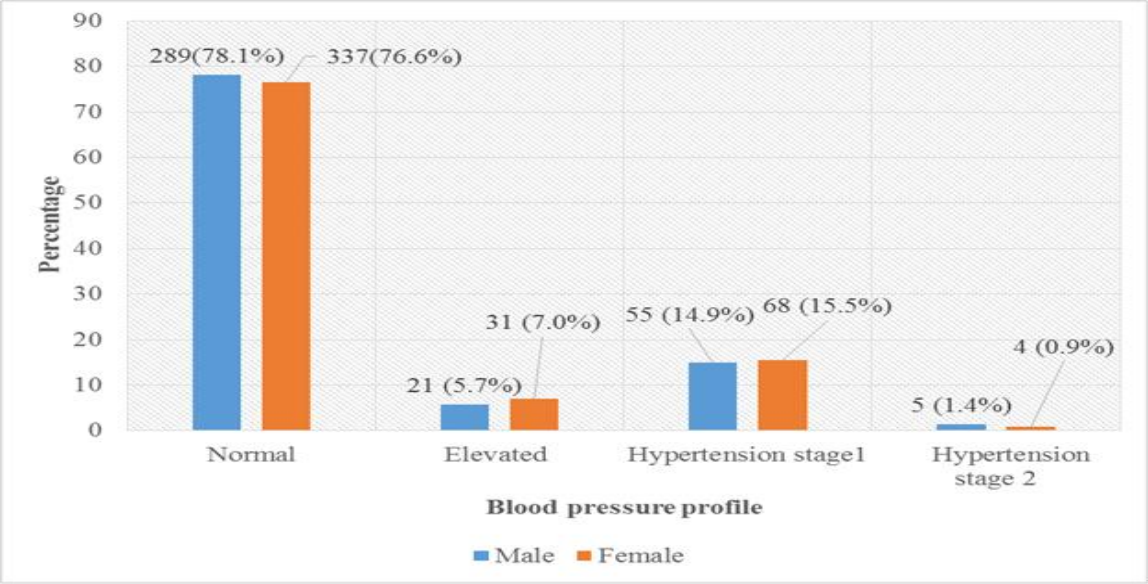

Figure 1: Blood pressure profile of males and females in percentage

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Discussion

Anthropometric measurements are a series of quantitative measurements of the muscle, bone, and adipose tissue used to assess the composition of the body.[26] Weight, height, BMI, body circumference (waist, hips, head, limbs), and skin fold thickness are examples of anthropometric measurements.[26] These measurements represent important diagnostic criteria for under-nutrition and over-nutrition.[26]

In this study, females had a higher mean anthropometric index (BMI, WC, and HC) when compared to their male counterparts, as reported in previous studies.[27, 28, 29] In addition, the anthropometric variables were found to increase significantly with age, this agrees with findings from other studies. [15,18, 19, 20, 30, 31, 32, 33]which suggested that this observed increase is expected to occur as part of anatomical and physiologic development and growth. The rapid increments in the anthropometric parameters noted at ages 12 to 14 years, corresponds with the period of pubertal growth spurt which is probably due to a rapid surge of hormones especially gonadal hormones such as progesterone and testosterone.

The mean SBP and DBP of the population were 101.76 ± 13.18mmHg and 65.05 ± 10.44mmHg, respectively. These values were lower than the findings (108.31 ± 11.83mmHg (SBP) and 71.21 ± 7.89mmHg (DBP)) reported in Enugu in 2013;[30] Anambra ((110.5 ± 10.2mmHg (SBP) and 71.5 ± 8.5mmHg (DBP)) in 2014;[34] and (111.7 ± 13.2mmHg (SBP) and 67.7 ± 9.6mmHg (DBP)) in Sokoto 2018. [11] Different modifiable environmental and social factor's effects on blood pressure in the different populations could account for the findings. Blood pressure patterns have been documented to vary between males and females. In this study, the mean SBP and DBP for females were significantly (0.049 and 0.003) higher than the values obtained in males. These are still lower when compared with reported values in Sokoto, [11] Enugu,[30], and Anambra.[34] In contrast, a higher SBP and DBP in males was reported in Cross-river Nigeria[35] and Brazil,[36] These authors attributed the finding to the high prevalence of obesity in the male participants of their study population.

Generally, higher mean blood pressure was recorded in girls than in boys in this study. This was similar to findings in Ekiti,[13] Kano[37], and Port Harcourt[38] where consistently higher mean blood pressure values in females were documented compared to their corresponding male counterparts. In contrast to the findings of the current study, other studies in Port Harcourt,[31] Ibadan[28] and Brazil[39] reported higher mean blood pressure values in males, while in Zaria,[40] no significant variation between both sexes was found. The variations in the measured anthropometric parameters and early pubertal onset in girls could probably account for the difference in the mean blood pressure between boys and girls reported in the study. Psychosocial stress associated with menarche in girls has also been documented to cause an increase in blood pressure. [10] Moreover, socio-cultural factors that do not afford females opportunities for outdoor activity and exercise as their male counterparts may also be responsible.[41]

There was an observed increase in blood pressure with age in this study. This increase was found in both systolic and diastolic blood pressure. This is similar to most findings by researchers in Nigeria[42] and Worldwide.[41] The peak age of rise in BP in this study occurred at ages 13 and 14 years for girls and 16 and 17 years for boys, however, the early rise occurred in girls at 11 and 12 years while the second rise at 16 and 17 years was similar. This was similar to an earlier study's findings among secondary school adolescents in the same city in 2010.[43] Girls, 12 years old showed statistically significant higher mean SBP while this was observed in boys at 17 years. Similarly, males also had a statistically significant higher mean DBP at 17 years but this occurred in females at ages 13 and 15 years. The initial age groups are usually the period of onset of puberty in both sexes while the later increase may reflect the phase of growth spurt at the end of puberty. The chronologic age is not the main factor responsible for blood pressure increase with age but rather, the progressive increase in size of the individual. An increase in body size with the growth and maturity of organs associated with the physical and hormonal changes during puberty may potentially lead to increasing blood pressure.[4] The significance of this increase in blood pressure with age is that those with hypertension in childhood are at higher risk in adulthood.

The overall prevalence of hypertension in the study was 16.3% (132 of 810) with the male and female prevalence of 16.3% (60 of 370 boys) and 16.4% (72 of 440 girls) respectively. This prevalence of 16.3% is higher than values of 13.9% obtained in Lagos southwestern Nigeria,[15] 10.7% in Enugu south-eastern Nigeria,[4] and

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7.2% in Kano North-west Nigeria.[15] However, these were within the range of 0.1% - 17.5% reported in a systematic review in 2015 involving studies carried out in Nigeria over four decades.[17] Higher prevalence was reported in South Africa,[41] Brazil,[36] and Peru. [44] The differences in the incidence of hypertension reported in the different studies may reflect different criteria used to define and diagnose hypertension, varying methodology, timing of measurement and different geographical regions.

Implication of the study

This study has revealed the significant prevalence of hypertension among secondary school pupils in Lokoja. The prevalence of 16.3% is significantly high among this age group. Hence there is need for further study to determine the risk factor associated with the incidence of hypertension among the studied group. Routine medical check-ups should be carried out in secondary schools, in addition- interventions such as health talk that address problems associated academic stress, emotional stress and social vices issues among teenagers should be incorporated into the school curriculum.

Further study should be carried out to determine the underlying cause of hypertension in the students found to be hypertensive. Investigations such as urinalysis, electrolytes, urea and creatinine, lipid profile, and echocardiography should be included as part of blood pressure evaluation in children and adolescents.

Limitation of the study

The limitation of the study is based on the fact that the study could not identify the causes or a link to factors responsible for the prevalence of hypertension among the study group. The inability to do home-based blood pressure measurement especially early morning measurement for those with high blood pressure to possibly eliminate the effect of stress, traffic and/or trekking, and other school-related stresses which may affect blood pressure during the day. Due to the absence of established blood pressure reference values in Nigeria, this study relied on the standards laid out in the BP tables of the fourth report to define the cut-off for definition of hypertension. There may be important differences in BP levels between the Nigerian adolescent population and the population used to generate the data in the fourth report.

Conclusion

In conclusion, this study revealed that the anthropometric parameters were higher in females than males, and they increased with age. The mean blood pressure of the participants also increases with age. The prevalence of hypertension in this study was 16.3% using the> 95th percentile definition for hypertension. The BMI, WC, and HC had a positive correlation with the SBP and DBP, while the WHR had a negative correlation. Based on high prevalence of hypertension in this study, periodic screening and monitoring of blood pressure as well as general public health education on hypertension should be incorporated into the school's health education curriculum, as a preventive strategy.

Declarations

***Ethical approval and consent to participate*:** Ethical clearance for this study was obtained from the Ethical Research Committee of the Federal Medical Centre, Lokoja. (FTHL) (FMCL/HREC/Vol.1/2021/129). Ethical approval was obtained from Lokoja Local Government Area (LGA) Education Authority. Written consent and assent were obtained from the parent/guardian and students respectively, having been offered all necessary.

Authors' Contribution: D.A, AA, MD, participated in the design of the study, coordinated data collection. DA performed statistical analysis and interpreted the data. DA, and TO drafted the initial manuscript, OO, EA and TO drafted the final manuscript. TO critically reviewed the manuscript for correctness. All authors approved the final manuscript.

***Conflict of interest*:** The authors declare that they have no competing interests.

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References

1. Mills KT, Bundy JD, Kelly TN, Reed JE, Kearney PM, Reynolds K, et al. Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries. CIRC J.2016; 134:441-450.
2. Lande MB. Systemic hypertension. In: Kleigman RM SB, St Geme JW, Schor NF, Behrman RE, editor. Nelson textbook of Paediatrics.20th ed. Philadelphia: Elsevier; 2016. p.2294-2303.
3. National High Blood Pressure Education Program. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents: US Department of

Print ISSN: 0189-9287 Online ISSN: 2992-345X

Health and Human Services, National Institutes of Health; 2005.
4. Uwaezuoke S, Okoli C, Ubesie A, Ikefuna A. Primary hypertension among a population of Nigerian secondary school adolescents: Prevalence and correlation with anthropometric indices: a cross-sectional study. Niger. J. Clin. Pract.2016;19:649-654.
5. Gebrie A, Alebel A, Zegeye A, Tesfaye B, Ferede A. Prevalence and associated factors of overweight/obesity among children and adolescents in Ethiopia: a systematic review and meta-analysis. BMC obesity.2018;5:19.
6. Senbanjo I, Oshikoya K. Physical activity and body mass index of school children and adolescents in Abeokuta, Southwest Nigeria. World J. Pediatr.2010;6:217-222.
7. Gahagan S. Overweight and Obesity. In: Kleigman RM SB, St Geme JW, Schor NF, Behrman RE, editor. Nelson Textbook of Paediatrics.20th ed. Philadephia: Elsevier; 2016. p. 307 - 316.
8. Sorof J, Daniels S. Obesity hypertension in children: a problem of epidemic proportions. J. Hypertens. Res.2002; 40:441-447.
9. Centre For Disease Control and Prevention. High blood pressure in kids and teens 2020. Available from: www.cdc.gov/bloodpressure/youth. Accessed 20/11/2020.
10 Senbanjo I, Oshikoya K. Obesity and blood pressure levels of adolescents in Abeokuta, Nigeria. Cardiovasc. J. Afr.2012; 23:260.
11. Isezuo K, Jiya N, Audu L, Ibitoye P, Sani U, Yusuf T, et al. Blood pressure pattern and the relationship with body mass index among apparently healthy secondaryschool students in Sokoto metropolis, Nigeria. S. Afr. j. child health.2018;12:105-110.
12. Akpa M, Mato C. Obesity in Nigeria: current trends and management. Niger. Med. Pract.2008;54:11-15.
13. Emmanuel EE, Dada SA, Amu EO, Aduayi VA, Atoyebi OA, Marcus O, et al. Hypertension and its correlates among in-school adolescents in Ekiti State, South-west, Nigeria. Asian J. Med. Sci.2017; 8:1-5.
14. Odey F, Anah M, Ansa V, Ogbeche J, Meremikwu M, Ekanem E. Pre-Hypertension and Hypertension in Apparently Healthy Adolescents in Calabar, Nigeria. Glob. J. community. med.2009; 2:13-20.
15. Owoeye O, Olawale O, Tella B, Ajuluchukwu J, Akinbo S. Prevalence of hypertension and pre-hypertension in male adolescent football: A cross-sectional cohort study of Nigerian Players. Am J Hypertens Res.2013; 1:26-28.
16. Oyeyemi AY, Usman MA, Oyeyemi AL, Jaiyeola OA. Casual blood pressure of adolescents attending public secondary schools in Maiduguri, Nigeria. J. Clinical hypertension.2015;21:1-6.
17. Akinlua JT, Meakin R, Umar AM, Freemantle N. Current prevalence pattern of hypertension in Nigeria: A systematic review. PloS one.2015;10:e0140021.
18. Mijinyawa M, Iliyasu Z, Borodo M. Prevalence of hypertension among teenage students in Kano, Nigeria. Niger J Med.2008; 17:173-178.
19. Owa J, Adejuyigbe O. Fat mass, fat mass percentage, body mass index, and mid-upper arm circumference in a healthy population of Nigerian children. J. Trop. Pediatr.1997;43:13-19.
20. Yusuf S, Mijinyawa M, Musa B, Gezawa I, Uloko A. Overweight and obesity among adolescents in Kano, Nigeria. J. Metab. Syndr.2013;2:126.
21. Kish L. Survey sampling 1965.
22. Han TS, Sattar N, Lean M. Assessment of obesity and its clinical implications. J. BMJ.2006;333:695-698.
23. World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8-11 December 2008. 2011.
24. Centre for Disease Control and Prevention. Body mass index: BMI for children and teens. Available at: www.cdc.gov.healthyweight/assessing/bmi/children. Accessed 15/12/2019.
25. Ogedegbe G, Pickering T. Principles and techniques of blood pressure measurement. J. Cardiol. Clin.2010;28:571-586.
26. Casadei K, Kiel J. Anthropometric Measurement. StatPearls: StatPearls Publishing; 2020.
27. Wariri O, Jalo I, Bode-Thomas F. Discriminative ability of adiposity measures for elevated blood pressure among adolescents in a resource-constrained setting in northeast Nigeria: a cross-sectional analysis. BMC obesity.2018;5:1-10.
28. Ezeh E, Kadiri S. Blood pressure, hypertension and obesity in young adults in a tertiary health institution in Southwest Nigeria. Afr. J. Biomed. Res.2020; 23:81-84.
29. Benkeser R, Biritwum R, Hill AJ. Prevalence of overweight and obesity and perception of healthy and desirable body size in urban, Ghanaian women. Ghana Med. J.2012; 46:66-75.
30. Ujunwa FA, Ikefuna AN, Nwokocha AR, Chinawa JM. Hypertension and prehypertension among

Print ISSN: 0189-9287 Online ISSN: 2992-345X

adolescents in secondary schools in Enugu, South East Nigeria. Ital. J. Pediatr.2013;39:70.
31. Okagua J, Anochie IC. Blood pressure profile and hypertension in adolescents in Port Harcourt, Southern Nigeria. Afr J Pediatr. Nephrol.2014;1:77-82.
32. Sadoh W, Omuemu V, Sadoh A, Iduoriyekemwen N, Nwaneri U, Adigweme I, et al. Blood pressure percentiles in a group of Nigerian school age children. Niger. J. Paediatr.2014;41:223-228.
33. Okagua J, Anochie I, Akani NJ. Adolescent blood pressure pattern in Rivers State, Nigeria: A rural-urban comparison. Niger. J. Pediatr.2015;42:21-27
34. Ezeudu CE, Chukwuka JO, Ebenebe JC, Igwe WC, Egbuonu I. Hypertension and prehypertension among adolescents attending secondary schools in urban area of South-East, Nigeria. Pan Afr. med. j.2018;31.
35.Eberechukwu LE, Eyam ES, Nsan EJI. Types of obesity and its effect on blood pressure of secondary school students in rural and urban areas of Cross River state, Nigeria. J. Pharm. Res.2013; 3:60-66.
36. Moser DC, Giuliano IdCB, Titski ACK, Gaya AR, Coelho-e-Silva MJ, Leite NJ. Anthropometric measures and blood pressure in school children. Jornal de Pediatria.2013;89:243-249.
37. Also U, Asani M, Ibrahim M. Prevalence of elevated blood pressure among primary school children in Kano Metropolis, Nigeria. Nigerian Journal of Cardiology. 2016 Jan 1;13(1):57-61.
38. Okoh BA, Alikor EA, Akani N. Prevalence of hypertension in primary schoolchildren in Port Harcourt, Nigeria. Paediatr. Int. Child Health.2012;32:208-212.
39. Magliano ES, Guedes LG, Coutinho ESF, Bloch KV. Prevalence of arterial hypertension among Brazilian adolescents: systematic review and meta-analysis. BMC Public Health.2013;13:1-12.
40. Bugaje M, Yakubu A, Ogala W. Prevalence of adolescent hypertension in Zaria. World J Pediatr.2005;32:77-82.
41.Nkeh-Chungag BN, Sekokotla AM, Sewani-Rusike C, Namugowa A, Iputo JE. Prevalence of hypertension and pre-hypertension in 13–17-year-old adolescents living in Mthatha-South Africa: a cross-sectional study. Cent. Eur. J. Public Health.2015;23:59-64.
42. Ugochukwu EF, Onubogu CU, Ofora VC, Okeke KN, Uju CM. Blood pressure profiles and determinants of hypertension among public secondary school students in Nnewi, Southeast Nigeria. Eur. J. Med. Health. Sci.2020;2.
43. Ejike CE, Ugwu C. Hyperbolic relationship between blood pressure and body mass index in a Nigerian adolescent population. 2010.
44. Nam EW, Sharma B, Kim HY, Paja DJV, Yoon YM, Lee SH, et al. Obesity and hypertension among school-going adolescents in Peru. J. Lifestyle Med.2015; 5:60.

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