Body Weight and Blood Pressure Profile in Nigerian Secondary School Adolescents.

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Abstract

This study was designed to evaluate the blood pressure (BP) profile of secondary school students and to find the influence of gender and school types (i.e. public or private) on BP. A school based cross-sectional survey of secondary school students in Sagamu local government area of Ogun state, Nigeria was carried out. Total of 1638 (790 male and 848 female) apparently healthy students with age ranged between 12 and 18 years were selected from 11 schools (8 public and 3 private). The weight, height, systolic and diastolic blood pressure of the subjects were measured. The results showed an increase in systolic and diastolic blood pressure with age in both gender and in both public and private schools. When systolic BP was adjusted for age, a significant gender difference was observed in ages 12, 14, 15 and 18 years. Boys had significantly lowered systolic BP than girls at ages 12, 14 and 15 years and girls had significantly lowered systolic BP at age 18 years. There was no gender difference in systolic and diastolic blood pressure in the whole population. However, there was significant difference in systolic and diastolic blood pressure of public and private schools students. In conclusion, these findings revealed no gender effect on blood pressure but there was influence of school type on BP of the whole population. Body mass index also showed an independent association with blood pressure.

Key word: blood pressure, body mass index, Nigerian adolescents, school, Non-communicable diseases

Introduction

Non-communicable diseases (NCDs), such as hypertension and other cardiovascular diseases are becoming increasingly important as causes of mortality and morbidity in all developing countries[1]. In sub-Saharan Africa, communicable diseases continue to have the greatest disease burden but it is estimated that in the next few decades NCDs will outstrip communicable diseases as major cause of death[2]. High blood pressure has been identified as one of the leading causes of cardiovascular disease and premature mortality in the world[3]. In traditional African societies, high blood pressure, once rare, is rapidly becoming a major public health burden[4-7]. The recent data show prevalence rates as high as 33% in some communities[4, 7].

In children, blood pressure (BP) tracking patterns confirm that persistent blood pressure elevation may be related to hypertension in adulthood[8, 9]. The emerging data also suggest that primary hypertension is detectable and occurs commonly in the young[10]. In addition, the presence of elevated blood pressure in childhood has been linked with left ventricular hypertrophy[11]. As a result, in most western countries assessment and management of blood pressure in childhood is strongly recommended to promote improved cardiovascular health in adulthood[10]. Given the fast health transition towards non-communicable diseases and changes in lifestyle associated with urbanization, there is an urgent need for research on blood pressure in adolescents so that appropriate cost-effective interventions can be introduced early in life to prevent the double burden of diseases in adulthood[12].

Factors known to affect BP among children include age, sex, body size, race/ethnicity, obesity, physical activities, mental activities and socioeconomic status[13-17]. Several studies have demonstrated a rise in the mean systolic blood pressure (SBP) accompanying age increases in children[12, 13, 15]. One study reported that children with a SBP > 90th percentile have a tendency to remain in the same percentile over time[18]. Gender differences in BP exist irrespective of age, race or other relevant factors[19]. Rosner et al[20] showed that the mean level of SBP was higher in boys 1214 years of age.

One of the challenges in the prevention and treatment of hypertension is to increase its

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detection, which starts with the adequate measuring of the blood pressure. Screening for elevated blood pressure levels is a procedure that has to be carried out by a health practitioner as a preventive measure, as part of the routine medical examination. This simple procedure can detect asymptomatic individuals with elevated blood pressure, thus allowing early treatment with medication and/or based on lifestyle changes[21]. The knowledge that blood pressure during childhood is an established predictor of adult blood pressure, which in turn increases mortality from cardiovascular disease, clearly underscores the importance of studying childhood blood pressure and the need for establishing preventive measures in early life[22, 23]. Therefore, the aims of this study were to asses the pattern of adolescents' blood pressure (BP), and find influence of gender and school type on BP of Nigerian adolescents.

Methods

A school based cross-sectional survey among secondary school students in Sagamu local government area of Ogun state, Nigeria was carried out in 2006. Thirty one secondary schools are in the area, 16 public and 15 private schools. The schools were stratified into public and private schools where sample of 11 (8 public and 3 private) schools was drawn. Participants were drawn from the selected schools by probability proportional to size from various arms of the classes. Total of 1638 (790 males and 848 females) apparently healthy students were selected. Their age ranged between 12 and 18 years. The protocol for this study was approved by the Joint Institutional Review Committee of University of Ibadan and University College Hospital, Ibadan.

Informed consent of the participants and their parents was sought; permission from the local education authority and the principals of the selected schools were sought. The detail of nature, purpose and procedure of the study were explained to the participants. Each participant biodata was taken: this included age (as at last birth day) and sex. The participants were subjected to 3 minutes step test after measurement of anthropometric and BP, their recovery pulse rates were measured 1 to 1 ½, 2 to 2 ½ and 3 to 3 ½ minutes after stepping ceases. The sum of 3 counts was used in the computation.

Anthropometric Measurements

Portable weighing scale (Camry model BR9012 made in China) and height meter (Wunder, made in China) were used to measure weight and height respectively as described in previous study[24]. The body mass index was calculated using the formula: weight/height^2

Blood Pressure Measurement

An aneroid sphygmomanometer (Frank Industries Inc., 9643 Great Smoky Drive, Vacon Rouge LA 70814, USA) and a cuff suitable to the subject's arm circumference were used to measure blood pressure (SBP and DBP) according to American Heart Association guidelines[25]. Trained personnel and researcher measured blood pressure after 5 minutes of rest in the sitting position.

Data Analysis

Statistical analysis was carried out using statistical software package SPSS version 15.0. Descriptive statistics of mean and standard deviation were used to examine the age- and gender-specific weight, height and blood pressure. Independent t-test was applied to see the differences between the BP of the gender and school types. Linear and multiple regressions were applied to the variables. P-value < 0.05 was considered to be statistically significant.

Results

Table 1 presents descriptive statistics of age, weight, height and BMI by gender. Table 2 shows mean (SD) systolic and diastolic blood pressure by age and gender. Both systolic and diastolic blood pressure increased with increasing age in both gender. In a simple regression analysis, systolic and diastolic blood pressure increased by 4 and 2mmHg per year respectively for male and 2 and 1.5mmHg per year respectively for female. The boys had lowered systolic and diastolic blood pressure than girls between ages 12 and 16 years, though only significant for systolic blood pressure at ages 12, 14 and 15years. In the whole population, there are no gender differences in systolic and diastolic blood pressure.

Table 3 presents the mean (SD) systolic and diastolic blood pressure by age and school. There was an increase in SBP and DBP with increasing age in public and private schools except in ages 13 and 18 year from private schools. In a simple regression analysis, SBP and DBP increased by 3 and 1.8mmHg per year respectively for public schools and 3 and 2mmHg per year respectively for private schools. There were significant differences in SBP and DBP of public and private schools students.

Table 4 shows mean (SD) systolic and diastolic blood pressure by BMI group and school. The SBP and DBP were increasing across the BMI group in both public and private school students. The public school students consistently

Table 1: Descriptive Statistics by Gender

Variables	male Mean(SD)	female Mean(SD)
Age(year)	15.1(1.9)	14.8(1.8)
Weight(kg)	46.3(11.7)	46.1(8.2)
Height(m)	1.55(0.12)	1.55(0.73)
BMI(kg/m^2)	18.92(2.83)	19.19(2.54)

BMI: body mass index

Table 2: Mean (SD) Systolic and Diastolic Blood Pressure (Mm Hg) By Age and Gender

Age (Years)	No M	No F	SBP M	SBP F	SBP P	DBP M	DBP F	DBP P
12	**83**	**99**	**71.3(8.8)**	**75.5(11.6)**	**.009**	**42.0(6.9)**	**44.3(8.7)**	**.054**
13	**101**	**126**	**72.5(9.0)**	**75.2(12.1)**	**.065**	**43.4(7.1)**	**44.8(9.4)**	**.194**
14	**126**	**162**	**75.7(12.4)**	**79.3(13.0)**	**.020**	**45.6(7.5)**	**47.0(8.3)**	**.157**
15	**129**	**140**	**79.7(12.1)**	**83.9(13.0)**	**.007**	**47.8(9.4)**	**49.7(8.8)**	**.091**
16	**149**	**157**	**83.5(13.1)**	**85.0(14.1)**	**.345**	**50.3(9.3)**	**50.8(8.8)**	**.636**
17	**88**	**94**	**87.7(14.8)**	**86.6(14.0)**	**.598**	**51.5(9.0)**	**52.3(9.4)**	**.530**
18	**114**	**70**	**96.4(14.8)**	**87.7(12.9)**	**.000**	**56.6(9.1)**	**51.7(8.3)**	**.000**
12-18	**790**	**848**	**81.3(14.8)**	**81.5(13.8)**	**.718**	**48.4(9.6)**	**48.5(9.3)**	**.899**

KEY: SBP: systolic blood pressure DBP: diastolic blood pressure
M: male F: female P: p-value

Table 3: Mean (SD) Systolic and Diastolic Blood Pressure (Mm Hg) By Age and School

Age (years)	Systolic blood pressure Public	Systolic blood pressure Private	P	Diastolic blood pressure Public	Diastolic blood pressure Private	P
12	**73.9(11.6)**	**73.1(9.1)**	**.627**	**44.3(8.5)**	**41.9(7.2)**	**.050**
13	**74.6(11.2)**	**71.0(8.5)**	**.640**	**44.7(8.7)**	**41.8(7.2)**	**.053**
14	**77.9(13.2)**	**76.7(10.3)**	**.586**	**46.5(8.0)**	**45.9(8.2)**	**.680**
15	**81.9(12.8)**	**81.3(12.5)**	**.811**	**49.0(9.3)**	**47.3(7.8)**	**.349**
16	**84.3(13.8)**	**83.3(12.0)**	**.733**	**50.6(9.1)**	**50.0(9.3)**	**.741**
17	**86.8(14.6)**	**95.0(5.3)**	**.115**	**51.5(9.1)**	**61.3(8.3)**	**.003**
18	**93.3(14.9)**	**90.8(10.8)**	**.581**	**54.9(9.0)**	**52.5(10.6)**	**.382**
12-18	**82.1(14.5)**	**77.3(11.8)**	**.000**	**49.0(9.4)**	**45.4(9.0)**	**.000**

Table 4: Mean (SD) Systolic and Diastolic Blood Pressure (Mm Hg) By BMI group and SchoolWt: weight

BMI group	Systolic blood pressure Public	Systolic blood pressure Private	t-value	P	Diastolic blood pressure Public	Diastolic blood pressure Private	t-value	P
Under Wt	74.6(11.9)	72.8(9.4)	1.091	.276	44.5(8.7)	42.7(8.0)	1.532	.126
Normal Wt	82.3(14.1)	77.6(12.2)	3.479	.001	49.3(9.0)	45.3(9.1)	4.585	.000
Over Wt	89.1(13.7)	81.4(11.8)	3.271	.001	52.8(8.9)	47.8(8.9)	3.17	.002
Obese	90.3(16.5)	85.6(8.8)	.844	.402	52.7(10.4)	55.6(7.3)	-.805	.424

Wt: weight

demonstrated higher blood pressure than the private school students across the BMI groups with exception of obese group. Though these were significant for normal and over weight students. Table 5 presents multiple regression analysis of factors associated with systolic and diastolic blood pressure. The multiple regression models explained only 11% to 31% of the variance in systolic and diastolic blood pressures.

Discussion

This study evaluated the blood pressure profile in secondary school students from Sagamu, western Nigeria. The results showed an increase in systolic and diastolic blood pressure with age in both gender and in both public and private schools. There was no gender difference in systolic and diastolic blood pressure in the whole population. However, there was a significant difference in systolic and diastolic blood pressure of public and private schools students.

The mean systolic and diastolic blood pressure for male and female students (81.3/48.4 and 81.5/48.5mmHg respectively) seems to be lower than that of their age counterpart from Ibadan (western Nigeria) and Zaria (northern Nigeria) [26, 13]. The differences might be due to methodology employed in these studies (the aneroid sphygmomanometer used in the present study tends to underestimate blood pressure). The increase in blood pressure with age is consistent with previous reports in Nigeria[13, 26, 27].

Table 5: Multiple regression analysis of factors associated with systolic and diastolic blood pressure

	Systolic blood pressure				Diastolic blood pressure			
Boys	Beta	SE	t-value	p-value	Beta	SE	t-value	p-value
School	-1.09	1.29	-.845	.398	-1.59	.88	-1.805	.072
Body Mass Index	.90	.18	4.952	.000	.47	.12	3.772	.000
Age	3.38	.28	11.982	.000	1.89	.19	9.815	.000
Recovery pulse rate	.06	.02	2.444	.015	.04	.02	2.560	.011
R^2		0.31					0.24	
F-value		87.263					60.45	
p-value		.000					.000	
Girls								
School	-.89	1.37	-.653	.514	-1.08	.93	-1.165	.244
Body Mass Index	1.02	.19	5.479	.000	.57	.13	4.509	.000
Age	1.91	.28	6.872	.000	1.21	.19	6.395	.000
Recovery pulse rate	.003	.018	.153	.878	.004	.012	.341	.733
R^2		0.13					0.11	
F-value		31.775					26.356	
p-value		.000					.000	

This was not only seen in both gender but also seen when adjusted for school i.e. public or private schools. Less than half a century ago, ancestral African populations living traditional lives showed a lower mean blood pressure with little or no increase with increasing age, and low prevalence of hypertension[12]. However, in this study systolic and diastolic blood pressure increased by 4 and 2mmHg per year respectively for male and 2 and 1.5mmHg per year respectively for female. One possible explanation for these blood pressure trends may be changes in lifestyles amongst this population. These findings do not bode well for the future, especially at a time when urbanization and westernization are proceeding at a faster rate.

In the present study, there was no gender difference in systolic and diastolic blood pressure of the whole population. This was in contrast with findings of Obika et al, [27] and Akinkugbe et al, [26] who found lower blood pressure for boys. However, Obika et al, [27] did not find this gender difference in urban community. This is surprising given that Akinkugbe et al's study was conducted in the same region as ours. Nonetheless, gender differences in blood pressure are generally inconsistent among African indigenous populations. The report on blood pressure levels in ethnic minority children in the UK[28], blood pressure levels were generally lower for girls than for boys of African descent, while for adults, blood pressure patterns were more favourable for men than for women[29]. The inconsistency in gender differences was seen when systolic BP was adjusted for age in this study. In ages 12, 14, 15 and 18 years, a significant gender difference was observed. Boys had lowered BP than girls at ages 12, 14 and 15 years and girls had favoured BP at age 18 years.

This study finds difference in systolic and diastolic blood pressure of public and private schools students. This might have serious implication in the future since the adolescent high blood pressure has been linked with adulthood cardiovascular incidence[8, 9]. This observation might be explained due to the fact that students from public school tend to be more overweight than the students in private school (table 4). Also it might be due to the assumption that student's parents from private school had higher educational level than parents of student in public schools. Akinkugbe et al, [26] found correlation between students's BP and their parents' educational level. The lower the educational level the higher the BP. The observation might also be due to the perceived lower socioeconomic status of parents of students from public school. Socioeconomic status disparities have been linked to increased cardiovascular disease risk. Multi-level

modeling indicated that income predicted systolic blood pressure[30]. However, this difference was not seen in the present study when adjusted for age with exception of diastolic blood pressure of ages 12 and 17 years.

From the multiple regression models, body mass index (BMI) show independent association between BMI and blood pressure. The higher the BMI the higher the tendency to have high blood pressure. This is consistent with previous studies who showed the impact of high BMI on blood pressure[17, 31, 32]. The consistent and strong association of high BMI with elevated blood pressure may presage future increases in child, adolescent, and adult hypertension if the prevalence of overweight is sustained or increased[33]. In this study girls had higher BMI than boys and were more likely to be overweight. In our previous study, evidence of overweight was seen in this population[34]. If the increasing frequency of overweight children is left unchecked while urbanization and westernization continues, it may lead to an increase in hypertension and other cardiovascular risk in future generation of Nigerians.

In conclusion, these findings underscore the urgent need for public health measures to prevent non-communicable disease and its sequelae from becoming another public health burden

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