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THE RELATIONSHIP BETWEEN SOMATOTYPE AND BLOOD PRESSURE AMONG SCHOOLCHILDREN IN PORT-HARCOURT, NIGERIA.

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ABSTRACT
Recently, monitoring blood pressure among paediatric population is being emphasized to allow for early detection and prevention of risk factors associated with hypertention. Few studies have highlighted the relationship between somatotype and blood pressure among children in other populations and relatively none is found in literature for the Nigerian population. The study consisted of 205 children aged 6 to 10 years drawn from three primary schools within Port-Harcourt, Nigeria. Using the Heath-Carter method, somatotype was estimated based on ten anthropometric measurements taken on each subject. Blood pressure was measured using a digital monitoring device. The data were analysed for descriptive statistics. ANOVA and t-test were also carried out to evaluate the age and sex-related differences in measured parameters. Also, Pearson's correlation was done. The results showed that the mean age of the sample was 8.98±1.19 years and mean somatotype was 1.9-3.9-3.5; mean blood pressure were; 89±11.19 and 57±8.88, for systolic and diastolic blood pressure respectively. The student t-test result showed sex difference occurred in endomorphy throughout all ages whereas sex difference was noted for mesomorphy only at ages 6 and 13 years. However, no sex difference was observed in ectomorphy. Endomorphy correlated positively with systolic blood pressure(r=0.132) while ectomorphy correlated negatively with systolic BP(r= - 0.005). The tendency towards development of a risk factor for cardiovascular disease can be attributed to an endomorphic body constitution while ectomorphy (linearity) offers an adaptative advantage to health even in childhood. The knowledge of this relationship is relevant to public health practitioners and clinical epidemiologist.

KEYWORDS: Somatotype, blood pressure, schoolchildren, Port-Harcourt.

INTRODUCTION
High blood pressure is a global epidemic that has been shown to affect both adults and paediatric populations(Munter et al.,2004[1], Connor,2005[2], CDC,2010[3]). Although for a very long time, research practise has been to investigate the incidence of high BP(hypertension) in adulthood, evidences now abound that there is a rising prevalence of this epidemic even among children, probably because of the less attention paid on this age group and there is an increasing prevalence in childhood obesity worldwide (NHBPEP,2004[4]; Munter et al,2004[1], Chiolero,2009[5]),. Childhood hypertension is asymptomatic and can easily be missed, even by health professionals, as unlike in adults, blood pressure monitoring is seldom considered during physical examination for vital signs. Childhood hypertension is shown to be associated with hypertension at adulthood (Munter et al., 2004[1]). Although evidence of prevalence of hypertension among children are in the somewhat low ranges of 3-5%, however higher rates have been observed in certain subgroups (Hansen et al.,2007[6]; Bibbin-Domingo et al.,2007[7]).

Somatotype represents the present morphological configuration of the human body build and it is an appropriate description for the body shape and composition as it presents a detailed outlook of the various components of the body constitution. Introduced by Sheldon and his co-authors in 1949, this approach of describing the human body composition as consisting of three main components-endomorphy, mesomorphy and ectomorphy, representing body fatness, musculoskeletal development and slenderliness or linearity respectively for the human body build, has gained widespread usage after the modifications made by Heath and Carter(1967)[8] to the original method. The somatotype in field of human biology has been studied for several population groups in relation to several factors including biological indicators(age, sex and maturation stages), levels of physical activity, socioeconomic variables, disease risks e.t.c. (Heath and Carter,1971[9]; Walker,1978[10]; Parizkova and Carter,1976[11]; Carter

and Parizkova,1978[12]; William,2000[13]; Herrera et al.,2004[14];).

The relationship between somatotype and blood pressure, as a risk factor for cardiovascular- related diseases, has been examined among adults as well as in children (William et al., 2000[13], Badenhorst et al.,2003[15]; Herrera et al.,2004[14], kalichmann et al.,2004[16]; Malina et al.,1997[17]; Makgae et al.,2007[18]; Toselli et al,1997[19]). These authors were able to infer from the correlation between somatotype components and blood pressure, that Endomorphy and Mesomorphy components of an individual physique are more pronounced in individuals with raised(high) BP levels whereas, Ectomorphy component of physiques is remarkably observed in persons with low B.P levels.

MATERIALS AND METHOD

Subject Sampled

The subjects consisted of children aged 6 to 10 years who were drawn from three primary schools within Port-Harcourt, a southern capital city, in Nigeria. The children were randomly sampled and informed consent was gotten from each individual who was administered with a parental consent form and also obliged to willingly participate in the study after a brief explanation to introduce the purpose for and procedures involved in the study. The ages of the subjects were obtained verbally from each subjects and verified with the school register and in some cases with the filled parental consent forms.

Ethical consideration

The research was approved by the Research and Ethics unit of the University of Port-Harcourt, Nigeria.

Anthropometry

measurement of heights (using an anthropometer) to the nearest 0.1 cm with subject bare-footed, weight with minimal clothing(a portable weighing scale) was taken to the nearest 0.1kg; skinfold thicknesses(triceps, subscapular, suprailiac and medial calf) were obtained with the slimguide calliper and measured to the nearest 0.5mm, biepicondylar bone breadths(taken with a digital bone calliper) measured to the nearest 0.01mm, girths(biceps and calf) were measured with a fibre glass flexible tape, to the nearest 0.1cm.

Somatotype

Based on the ten anthropometric variable measured, the anthropometric somatotype of each subject was calculated using the Heath-Carter(1990)[20] proposed equations as follows;

Endomorphy =- 0.7182 + 0.1451 (X) – 0.00068(X^2) + 0.0000014 (X^3), where X=sum of Triceps, subscapular and suprailiac skinfolds, adjusted by height.

Mesomorphy= {(0.858 x humerus breadth) + (0.601 x femur breadth) + (0.188corrected arm girth) + (0.161 corrected calf girth)} – (stature x 0.131) + 4.50, where corrected arm and calf girths are limb circumferences minus triceps and medial calf skinfolds respectively.

Ectomorphy: this component is estimated from three different equations based on height-weight ratio as follows;

If HWR ≥ 40.75, then ectomorphy = 0.732HWR – 28.58

If 38.25< HWR< 40.75, ectomorphy= 0.463HWR – 17.63

If HWR ≤ 38.25, ectomorphy =0.1.

NB: The height-weight ratio (HWR) is taken a the height divided by the cube root of weight, i.e, $H/(W)^{⅓}$. Any component with a calculated value of zero or negative is assigned a value of 0.1, since rating cannot be zero or negative by definition of Heath-Carter. Also, since somatotype components are derived from regression equations and/or variable ratios with different measure units, no established unit of measurement for somatotype exist in literature.

Blood pressure measurement

The B.P of each subject was measured by means of a device, an Omron machine, M6 comfort (Vietmann), with a cuff of variable sizes(small 17-22mm, medium 22-32 mm and large 32-42 mm) adapted to the arm width. Each subject was measured while seated with the left arm placed on a table, the palm facing upward and at a level with the heart position. Two consecutive readings were recorded for each subject within a 5-mins interval, between which the subject is allowed to rest. The mean value was determined as the B.P of the subject.

Statistical Analysis

The data obtained were analysed for descriptive statistics using SPSS version 21. Further analysis was done involving; Pearson correlation between somatotype and B.P., t-test to determine the sexual differences in somatotype components and ANOVA for the age and sex-related difference between both sex.

RESULTS AND DISCUSSION

Table I shows the descriptive statistics (means±SD) of somatotype and blood pressure for the total sample studied (sexes combined).

Age	Number of subject	Endomorphy	Mesomorphy	Ectomorphy	SBP	DBP
6	8	1.6±0.41	3.8±0.27	3.5±1.06	82±13.02	50±7.40
7	20	1.4±0.46	3.5±0.62	3.7±1.18	83±9.62	51±7.56
8	38	1.6±0.64	3.9±1.10	3.2±1.41	84±10.28	55±7.81
9	42	1.9±1.08	3.8±1.19	3.7±1.61	89±8.92	57±6.79
10	97	2.0±1.10	3.9±1.26	3.6±1.37	94±10.73	60±9.43
Total	205	1.9±0.97	3.9±1.14	3.5±1.40	89±11.19	57±8.89

Table I above, endomorphy showed a more regular trend with increasing age than the other somatotype components. However, mesomorphy and ectomorphy demonstrated irregular but opposite trends in moving upwards from one age group to another. endomorphy ratings of the subjects was relatively low; that is, 1.6 at age 6 to 2.0 at age 10, while the mesomorphy and ectomorphy components were moderate(from 3.5 at 7 years to 3.9 at 10 years; from 3.2 at 8years to 3.7 at 9 years, for mesomorphy and ectomorphy respectively). Both blood pressures increase with age.

Table II shows descriptive statistics (means±S.D) of somatotype components and blood pressure for schoolchildren by sex and age

Age	Sex	N	Endomorphy	Mesomorphy	Ectomorphy	SBP	DBP
6	M	5	1.5±0.46	3.9±0.27	3.5±1.17	80±15.63	49±7.79
	F	3	1.7±0.26*	3.5±0.15*	3.9±0.84	81±11.53	52±9.07
7	M	11	1.2±0.34**	3.6±0.61	3.7±1.37	84±9.33	51±7.95
	F	9	1.7±0.47*	3.4±0.65	3.6±0.99	82±10.36	51±7.51
8	M	18	1.4±0.39	3.9±1.24	3.1±1.48	84±10.71	56±8.12
	F	20	1.9±0.74*	3.8±0.97	3.2±1.38	84±10.16	54±7.57*
9	M	16	1.6±0.67**	3.8±0.86	3.5±0.89	87±7.32	57±5.68
	F	26	2.2±1.22*	3.8±1.37	3.8±1.94	90±9.62*	57±7.48
10	M	58	1.7±0.94**	4.1±1.21	3.6±1.34	93±11.37	60±10.44
	F	39	2.4±1.20*	3.8±1.33*	3.6±1.44	94±9.79	59±7.74
Total	M	108	1.6±0.78	3.9±1.09	3.5±1.29	89±11.50	58±9.64
	F	97	2.2±1.08*	3.8±1.20*	3.6±1.52	90±10.89	54±7.97*

*t –test shows that value is significant at p<0.5(2-tailed). M= male, F=female, DBP=diastolic pressure, SBP=systolic pressure. **ANOVA shows value is significant at p<0.05.

Table II. Generally, blood pressure showed an increase tendency with age in both sexes. systolic pressure is relatively higher in females than males except at ages 7 and 8.

Endomorphy increases with age in females and is relatively higher in females than in males. Females also appeared to have higher mean Ectomorphy than males, in all ages except at ages 7& 10. However, males have higher mesomorphy than females across all ages except at 9years.

Table II above also shows that there was a sex difference in the endomorphy component across all ages (p<0.5) whereas sex difference was noted for mesomorphy only in ages 6 and 13(p<0.5). However, there was no sex difference in ectomorphy across all ages (p>0.5). No sex difference in blood pressure was observed except for systolic BP at age 9 and diastolic BP at age 8.

Significant age and sex –related differences was indicated by ANOVA and it occurred only in endomorphy between ages 7 and 9 years and 7 and 10 years, between the groups-that is, between male and female respectively(p<0.05).

Table III. shows the somatotype categories frequency for the different subjects studied in the entire sample.

Somatotype category	frequency	Percentage frequency
Balanced endomorph	-	0
Mesomorphic endomorph	2	0.9
Mesmorph-endomorph	-	0
Endomorphic mesomorph	-	0
Balanced mesomorph	26	12.7
Ectommorphic- mesomorph	59	28.8
Mesomorph-ectomorph	35	17.1
Mesomorphic-ectomorph	*65	31.7
Balanced ectomorph	10	4.9
Endomorphic ectomorph	-	0
Endomorph-ectomorph	-	0
Ectommorphic endomorph	-	0
Central	8	3.9
Total	205	100

*indicates dominant somatotype category for the entire sample.

Table IV Age-wise correlation coefficients for blood pressure and somatotype components in school children aged 6-10 years in respect to sex

Age group	SBP			DBP		
	ENDO	MESO	ECTO	ENDO	MESO	ECTO
Males(n=108)						
6	0.688	-0.235	0.376	0.351	0.153	0.048
7	0.060	-0.525	0.598	-0.061	-0.007	0.214
8	-0.190	0.123	-0.045	-0.303	-0.043	0.071
9	-0.322	-0.420	0.270	-0.076	-0.145	0.144
10	0.152	0.099	-0.066	-0.101	0.065	-0.020.
All males	0.160	0.068	0.068	-0.019	0.069	0.038
Females(n=97)						
6	0.705	-0.965	0.874	0.666	-0.950	0.898
7	-0.300	0.301	0.244	-0.089	-0.198	0.285
8	0.010	-0.092	0.071	-0.071	0.054	-0.014
9	-0.129	0.183	-0.205	0.063	0.210	-0.292
10	0.096	0.130	-0.215	-0.117	-0.110	0.104
All females	0.115	0.122	-0.079	0.046	0.030	0.016
Combined sex	0.132	0.092	-0.005	-0.004	0.012	0.055

In the Table above, correlation coefficient ranges from -0.322 to 0.688 in males and from -0.965 to 0.898 in females. Across all age groups and between both sexes, no somatotype component correlated significantly with blood pressure, even though the correlation coefficients ranged from low to high values.

The result for the Pearson's correlation between Age and blood pressure, showed that Age was positive and significantly correlated with both blood pressure (SBP and DBP) ($r=0.402$, $r=0.343$ respectively, $p<0.01$, significant) omitted in the Table above, confirmed results of previous studies(Daniel et al., 2013).[21]

For the combined sex, somatotype components (mesomorphy and endomorphy) positively correlated with SBP while ectomorphy negatively correlated with SBP. However, endomorphy negatively correlates with DBP while mesomorphy and ectomorphy correlates positively with DBP. Thus, mesomorphy showed positive correlation with both BP.

In this study, the association between somatotype and blood pressure was examined. several authors had observed that there was an association between somatotype and blood pressure for different population and across varied age groups, in adult and children.(Badenhorst et al.,2003[15]; Herrera et al.,2004[14]; Kalichman et al.,2004[16]; Williams et al., 2000[13]; Neni,2012[22], Makgae et al,2007[18]; Toselli et al.,1997[19]).

The purpose of studying this relationship by various authors is to see how somatotype contributes to the development of cardiovascular disease. whereas some authors suggested that there may exist a common physiological pathway regulated by pleitropic or epigenetic mechanism in explaining the relationship between body physique and blood pressure regulation(Kalichmann et al.,2004[16]), others maintained that the physiologic pathway is obscured as there are indication of several risks clustering in the development of many organic diseases(Sing et al., 2003).[23]

The results from this study revealed that there is a positive relationship between the endomorphic physique and blood pressure. Other studies have reported similar correlation between endomorphy and blood pressure (Toselli et al.,1997[19], Hererra et al.,2004.[14])

The dorminant somatotype for the sample is mesomorphic ectomorph(Table III).

Both blood pressure exhibited an increasing trend with age in both sexes (TableII). This is the usual observation reported in most studies (Neni RT,2012[22]; Cornoni-Huntley et al., 1979[23], Oliver et al.,1977[25]; Pickering, 1968[26], Daniel Goon et al., 2013[21]).

This increase of blood pressure with age has been attributed to an aggregation of several factors including the decrease in arterial compliance (as a result of artherosclerosis) and increased body weight (Berne and Levy, 1992.[27]).

The mean blood pressure was relatively higher in females than in males (except for SBP at age 7 years). This is in agreement with earlier studies (Cornoni-Huntley,1979[24], Daniel et al,2013[20]). However, the difference in blood pressure was not significant between both sexes (except for few cases SBP at age 9years and DBP at 8 years). This is in accordance with some studies (Ramoshaba et al.,2015[28]; Daniel et al,2013,[20]).

From the study results (Table II) females were more endomorphic and ectomorphic than the males while males were more mesomorphic than females. Generally as reported in most studies females are more endomorphic than males while males appears to be more mesomorphic (Zuk,1958[29], Heath and Carter, 1971.[9], Duquet, 1980.[30], Bhasin and Jain.S,2007.[31]; Gakhar and Malik, 2001.[32], Toselli and Gruppioni,2006.[33]). However, there are conflicting opinions on the differences in ectomorphy between sexes. while some studies maintain that males are more ectomorphic than females, others stated that females are more ectomorphic than males or both are equally ectomorphic (Herrera et al.,2004[14]; Kalichman et al.,2004[17]; Buffa et al., 2005.[34]; Kalichman and Kobyliansky, 2006.[35]; Toselli and Gruppioni, 2006.[33]).

On examination of the sex differences in somatotype component in the present study, It was observed that endomorphy exhibited pronounced sexual differences across the ages considered whereas in few ages, there was significant sex difference in mesomorphy. However, no sex difference was observed in ectomorphy. This observation for sex difference only in endomorphy and mesomorphy was also noted by some authors(Munoz-Cachon et al.,2007.[36]).

In our study, we observed that among the somatotype components when correlation for the entire sample was done, only endomorphy appeared to correlate with blood pressure(Table IV) (r=0.132), which suggest that there is tendency that increased blood pressure may result from an increase in endomorphy in both sex. However, on examination of the correlation coefficient values between somatotype and blood pressure for both sex when treated separately(Table IV), both endomorphy and mesomorphy correlated with blood pressure(SBP) in females while only endomorphy correlated with blood pressure in males. The suggestions by other authors (Hererra et al., 2004.[14], Katzmarzyk et al., 1998.[37]) that the both the first and second components of somatotype are related to blood pressure may be sex-related and dependent on age range in the young population.

CONCLUSION

This study clearly shows that endomorphy correlates positively with blood pressure in both sex and this may be a common component of physique that contributes to the development of risk factor for CVD in the paediatric population.

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