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## CHILDHOOD HYPERTENSION AND OBESITY IN A DEVELOPING COUNTRY SETTING: A SURVEY AMONG SCHOOL-AGE CHILDREN IN CALABAR, NIGERIA.

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### ABSTRACT

#### BACKGROUND

Childhood hypertension is silently rising and gradually becoming a serious public health burden and concern due to its attendant significant morbidity and mortality. It is often neglected and rarely reported. Also, childhood obesity is increasingly assuming epidemic proportion with a consequent predisposition to cardio-metabolic diseases.

#### AIM

To determine the prevalence of childhood hypertension in association with obesity among apparently healthy school age children in Calabar

#### STUDY DESIGN/SETTING

A cross-sectional descriptive study conducted among randomly selected school-age children, in Calabar, Nigeria.

#### METHODS/SUBJECTS:

This cross-sectional study was conducted among children, aged 6 – 12 years old who were selected from public and private primary schools through multi-stage sampling. Blood pressure and body mass index (BMI) were categorized based on the updated 2004 fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents and International Obesity Trust Fund (IOTF) respectively.

#### RESULTS

A total of 374 children were enrolled with a male to female ratio of 1.0: 1.3 and mean (SD) age of 9.48 (1.42) years. Mean (SD) systolic blood pressure was  $95.9 \pm 8.8$  mmHg and the mean (SD) BMI was  $16.6 \pm (2.6)$  kg /m<sup>2</sup>. Hypertension was observed in 9 (2.4%) out of 374 children. Hypertension occurred more in the adolescents 6(3.2%) than in the pre-adolescents 3(1.6%). Similarly, hypertension was higher in females 8(3.7%) than in males 1(0.6%) With regards to obesity, 15 (4%) were obese with a female: male ratio of 1.5: 1. Obesity was higher in adolescents [11 (5.8%)] than in pre-adolescents [4(4%)]

#### CONCLUSION:

The prevalence of hypertension was 2.4% and it was commoner in females than in males who were more obese. Obesity was strongly associated with increasing BP. Awareness should be created among health care professionals to regularly check for hypertension and overweight among school children for early diagnosis and treatment. .

#### KEY WORDS

Childhood, hypertension, overweight, obesity prevalence.

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### INTRODUCTION

There is a high and increasing burden of undetected childhood hypertension, which unfortunately progresses through adulthood as a silent killer and leading cause of huge morbidity and mortality globally<sup>1,2</sup>. Globally, the prevalence of childhood hypertension is highly variable and ranges from 2% - 13% depending on the

methodology employed, race and other factors such as obesity<sup>3</sup>. In Africa, a meta-analysis of paediatrics hypertension, by Simone et al<sup>4</sup> found an overall prevalence of 11.4% and 7.5% respectively for elevated blood pressure and hypertension respectively. There is high prevalence of hypertension and its attendant complications in Nigeria<sup>5</sup>. Recent estimates of hypertension among Nigerian children and adolescents is as high 2.4-10% depending on the methodology, age, gender and associated factors such as obesity (6-9). In Nigeria currently, children and adolescents comprise over half of the population, and represent future adults that may suffer accumulated risk of cardio-metabolic diseases, which may have been detected and mitigated in their earlier life.<sup>10,11</sup> High burden hypertension in children may be due to rising prevalence of modifiable risk factors for its development and progression of hypertension including obesity, dyslipidemia and psychosocial stress.<sup>1,2</sup> High burden of these risk factors may in turn be due to poor practice of preventive behaviour, including regular medical screening.<sup>2</sup>

The onset and progression of this chronic disease and its risk factors may be occurring undetected early in life during childhood and adolescence.

The true picture of childhood hypertension in low-middle-income countries (LMICs), is poorly understood partly as a result of lots of missed opportunities for screening at schools, home visits and even at health facilities because clinicians do not take blood pressure of children routinely.

Early childhood and adolescence are suitable periods for commencement of medical screening, especially among high-risk individuals with family history of cardio-metabolic-diseases (CMDs)<sup>12</sup>. This will enable prompt intervention towards preventing further progression and prevention of complications. This study therefore sets out to ascertain the severity of childhood hypertension in our locality and add to the volume of knowledge already available.

## **MATERIALS AND METHOD**

### **STUDY AREA**

The study area was Calabar. Calabar, as earlier described by Ineji et al<sup>13</sup> is the Cross River State Capital. The city is known for its tourism attraction due to the yearly Christmas carnival festival. Calabar has two tertiary health facility, three secondary, health facilities and several primary health care facilities. At the time of this study, there were 23 public and 80 private primary schools in Calabar municipality with a total enrolment of 14,499 and 25,581 respectively.

### **STUDY DESIGN**

A cross-sectional descriptive study conducted among randomly selected school-age children, in Calabar, Nigeria, among primary schools (public and private) children aged 6 to 12 years in Calabar, South South Nigeria.

## **SUBJECT AND METHOD**

Based on the number of public schools of 23 and private schools of 80, 2 public schools and 4 private schools were randomly selected. Also, based on the total school enrolment of 14,499 and 25,581 for private and public schools respectively, the study participants were selected by multi-stage sampling methods, 135 pupils from public schools and 239 pupils from private schools based on a numerical ratio of 0.36 : 0.64. Examination was done between 9.0am to 11.0am, before their break to avoid physical exercise that may affect blood pressure. Subjects were made to sit relaxed for about 5 minutes. Blood pressure (BP) was taken using a standard mercury sphygmomanometer, ACCOSON England, with age-appropriate cuff sizes. Readings were taken at the first and fifth Korotkoff sounds as recommended by the updated 2004, 4th report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents<sup>3</sup>. Each subject had three readings taken at intervals of five minutes and the averages of the readings taken as the blood pressure of the individual. Systolic or diastolic blood pressure of 90th to 94th percentile was classified as elevated blood pressure while values equal to or greater than the 95th percentile for age, sex and height was classified as hypertension respectively, based on the recommendation of the 4th report<sup>3</sup>.

Anthropometric indices including weight and height were measured using standard guidelines and the body mass index (BMI) (weight in Kg/ Height in m<sup>2</sup>. ) was calculated as recommended by National Centre for social research, 2010<sup>14</sup>. A BMI of 85th to 94th percentile was taken as overweight, BMI of equal to or greater than the 95th percentile was considered as obesity, based on the International Obesity Task Force (IOTF)<sup>15</sup>. Pretested questionnaires containing the bio-data of each participant including parental educational levels and occupation were used and subjects were stratified into 3 social classes, upper, middle and lower socio-economic classes based on Onyedjeji's classification<sup>16</sup>.

### **ETHICAL APPROVAL**

Ethical approval for this study was obtained from the ethics committee of the University of Calabar Teaching Hospital and Cross River State ethical committee.

Permission and approval were also obtained from the local education authority as well as the authorities of the enrolled schools. Written consent was obtained from parents/guardian and assent was obtained from the participants.

## INCLUSION/EXCLUSION CRITERIA

Subjects aged 6 - 12 years in the selected schools were recruited for the study.

Subjects with known chronic medical conditions and those on prolonged medications that may induce weight gain or hypertension, such as bronchial asthma, nephrotic syndrome and patients on prolonged steroids were excluded from the study.

## DATA ANALYSIS

Data was entered and analysed using SPSS version 21.0. Socio-demographic characteristics of subjects were presented using frequency tables. Subjects were categorized based on their blood pressure and anthropometric values. Comparison of BMI and other relevant variables were done between the blood pressure percentile groups using chi-square, independent t-test, and Analysis of Variance (ANOVA) as inferential statistics. alpha level of significance at 95% confidence level set at  $< 0.05$ .

## RESULTS

A total of 374 primary school children aged as at last birthday from 6 to 12 years participated in the study, out of which 160(42.8%) were males while 214(57.2%) were females with a male to female ratio of 1.0 : 1.3. The participants who were at most 9 years accounted for 184(49.2%) compared with those aged 10 years and above who accounted for 190(50.8%). The overall mean age  $\pm$  standard deviation of study participants was  $9.48 \pm 1.42$  years. That for males and females were  $9.98 \pm 1.45$  years and  $7.50 \pm 0.71$  years respectively. The difference in mean age between male and female study participants was not statistically significant ( $p=0.269$ ). Regarding BP, 29(7.8%) and 9(2.4%) had measurements within the elevated BP and hypertensive percentile ranges respectively (mean systolic BP  $\pm$  standard deviation was  $95.9 \pm 8.8$  mmHg). Regarding participants with elevated BP 13(7.1%), were aged 9 years and below while a slightly higher, 16(8.4%) were aged 10 years and above. Concerning systolic hypertension, 3(1.6%) were in the age group of 9 years and below compared with 6(3.2%) in the age group of at least 10 years. The difference by age group was not statistically significant ( $p=0.540$ ). Also, the relationship between sex and hypertension ( $p=0.071$ ), and social class ( $p=0.419$ ) were not statistically significant. Regarding BP, 29(7.8%) and 9(2.4%) had measurements within the elevated BP and hypertensive percentile ranges respectively (mean systolic BP  $\pm$  standard deviation was  $95.9 \pm 8.8$  mmHg). Regarding participants with elevated BP 13(7.1%), were aged 9 years and below while a slightly higher, 16(8.4%) were aged 10 years and above. Concerning systolic hypertension, 3(1.6%) were in the age group of 9 years and below compared with 6(3.2%) in the age group of at least 10 years. The difference by age group was not statistically significant ( $p=0.540$ ). Also, the relationship between sex and hypertension ( $p=0.071$ ), and social class ( $p=0.419$ ) were not statistically significant.

A total of 328(87.7%) had body mass index (BMI)  $< 85$ th percentile, 31(8.3%) were overweight (BMI 85th to 94th percentile) while 15(4.0%) were obese (BMI  $\geq 95$ th percentile). The mean BMI  $\pm$  standard deviation of study participants was  $16.55 \pm 2.57$  kg/m<sup>2</sup>.

Among participants who were overweight, 18(9.8%) were aged 9 years and below compared with 13(6.8%) among those aged 10 years and above. Conversely, among those with obesity, a higher proportion 11(5.8%) were in the 10 years and above age group compared with 4(4.0%) among those aged 9 years and below. However, the relationship between age group and BMI was not statistically significant ( $p=0.134$ ). A greater proportion of study participants with overweight occurred among female 19(8.9%) compared with male 12(7.5%), also a greater proportion of obesity occurred among female 9(4.2%) compared with male 6(3.8%). However, the difference was not statistically significant ( $p=0.864$ ). The relationship between social class and body mass index was statistically significant ( $p=0.029$ ).

TABLE i: PREVALENCE OF ELEVATED BP AND HYPERTENSION AMONG PRIMARY SCHOOL CHILDREN

Demography	Normal BP (n= 336) N (89.8%)	Elevated BP (n= 29) N (7.8%)	Hypertension (n= 9) N (2.4%)	X <sup>2</sup> (P-Value)
Age				
<9	168 (91.3%)	13 (7.1)	3 (1.6)	1.234 (0.540)
>10	168 (85.4)	16 (8.4)	6 (3.2)	
Sex				
Male	145 (91.0)	14 (8.7)	1 (0.6)	5.289 (0.071)
Female	192 (89.2)	15 (7.0)	8 (3.7)	
SES				
LSSES	99 (89.2)	8 (0.8)	4 (0.4)	8.148 (0.419)
MSES	154 (88.5)	16 (9.1)	5 (0.3)	
USES	83 (94.3)	5 (5.7)	0 (0.0)	

TABLE ii: RELATIONSHIP BETWEEN SOCIODEMOGRAPHIC CHARACTERISTICS AND BODY MASS INDEX (BMI)

Demography	Normal weight (n= 328) N (87.7 %)	Overweight (n= 31) N (8.3%)	Obesity (n= 15) N (4.0%)	X <sup>2</sup> (P-Value)
Age				
<9	162 (88.0)	18 (9.8)	4 (2.3)	4.027 (0.134)
>10	166 (89.4)	13 (6.8)	11 (5.8)	
Sex				
Male	142 (88.8)	12 (7.5)	6 (3.8)	2.920 (0.864)
Female	186 (86.9)	19 (8.9)	9 (4.2)	
SES				
LSSES	90 (81.1)	16 (14.4)	5 (4.5)	12.153 (0.029)
MSES	158 (90.3)	10 (5.7)	7 (4.0)	
US	80 (91.0)	5 (5.7)	3 (3.4)	

TABLE iii: THE PREVALENCE OF ELEVATED BLOOD PRESSURE, HYPERTENSION, OVERWEIGHT AND OBESITY AMONG SCHOOL CHILDREN AGED, 6 – 12 YEARS.

Age (year)	Normal BMI	Normal BP	Elevated BP (%)	Hypertension (%)	Overweight (%)
6	4 (0.0)	4 (100)	0 (0.0)	0 (0.0)	0 (0.0)
7	29 (82.9)	29 (87.9)	3 (9.1)	1 (3.0)	2 (6.1)
8	46 (86.8)	49 (92.5)	2 (3.8)	2 (3.8)	6 (11.3)
9	83 (88.3)	86 (91.5)	8 (8.5)	0 (0.0)	10 (10.6)
10	83 (83.8)	88 (88.9)	6 (6.1)	5 (5.0)	8 (8.1)
11	56 (91.8)	57 (93.4)	4 (6.6)	0 (0.0)	3 (6.7)
12	27 (90.0)	23 (76.7)	6 (2.0)	1 (3.3)	2 (6.7)
Sex: Male	142 (88.8)	144 (90.0)	15 (9.4)	1 (0.6)	12 (7.5)
Female	186 (86.9)	192 (89.7)	14 (6.5)	8 (3.7)	19 (8.9)



## DISCUSSION

This study recorded a prevalence of 7.8% and 2.4% for elevated blood pressure and systemic hypertension respectively. This however, was low but falls within the reported global prevalence of 2% to 13% of childhood hypertension.<sup>3</sup>

Several studies<sup>17-20</sup>, both local and international studies have reported varying outcomes. This prevalence was similar to some Nigerian studies, Umar et al<sup>6</sup> reported a prevalence of childhood hypertension of 3.0% in Kano metropolis among 2000 school children, aged 6 to 12 years, Bugaje et al<sup>21</sup> reported a prevalence of 3.7% among adolescents in Zaria, while Ajaegbu et al<sup>22</sup> reported a prevalence of 12.5% and 3.5% for elevated blood pressure and hypertension respectively in Delta state and Ibrahim et al<sup>7</sup> reported a prevalence of hypertension of 3.0% in Ilorin.

However, slightly higher prevalences were reported in some Nigerian studies. Odey et al<sup>8</sup> reported a prevalence of 7.5% and 6.7% for pre-hypertension and hypertension respectively in Calabar among adolescents, Ujunwa et al<sup>23</sup> had a prevalence of 5.8% among adolescents in Enugu.

The higher prevalences reported in these later studies may be due to the fact that their subjects were older and blood pressure is said to increase with age<sup>17,21,24</sup>. In Ghana, Afaa et al<sup>25</sup> reported a prevalence of 6.0% and 2.5% for pre-hypertension and hypertension respectively among Ghanaian school children 5 years to 14 years, Monyeki et al<sup>19</sup> reported a prevalence of 4.8% for boys and 5.4% for girls among rural South African school children aged 6 to 13 years and Ellangambolla et al<sup>26</sup> reported a prevalence of 3.8% and 3.3% for pre-hypertension and hypertension respectively among school children in Congo. Kamath et al<sup>20</sup> reported an overall prevalence of 2.2% among school children in Coastal South India while Sheikh et al<sup>127</sup> reported a prevalence of 6.25% and 3.57% for pre-hypertension and hypertension respectively among rural school children in India.

Blood pressure variations as demonstrated may be due to geographical, ethnic, genetic factors as well as lifestyle and gender variations as well as associated factors like obesity.

This present study also reported a higher prevalence of hypertension among females, eight (3.7%) had hypertension compare to males, one (0.6%). This finding agrees with several studies<sup>19,18</sup>, (27-8). On the other hand, Bugaje et al<sup>21</sup> and Mostafa et al<sup>29</sup> found no significant gender differences in blood pressure of their subjects.

This gender differences in BP may be related to the postulation that pre-pubertal females have greater arterial wall thickness compare with males with a resultant tendency to cause raised blood pressure<sup>30</sup>. Kirchengast<sup>31</sup> attributed this difference to the early pubertal onset and weight gain in females more than males, while Montero<sup>32</sup> demonstrated that the involvement of males in physical activities is associated with vasodilation of arterioles, reduction in sympathetic tone with consequent fall in peripheral vascular resistance and blood pressure.

This present study also reported a significant correlation between overweight and obesity. 8.3% and 4.0% of the study population were overweight and obese respectively. Elevated blood pressure was found mostly among those who were overweight or obese. This finding is in consonant with both local and international studies<sup>21,22,27,29</sup>.

There is an intricate relationship between body mass index and blood pressure which favours the development of cardio-metabolic diseases<sup>33</sup>. Evidence shows that overweight children have a fourfold risk of developing hypertension when compared with children with normal BMI<sup>34</sup>.

The rising trend in childhood and adolescent hypertension in consonance with overweight and obesity is of significant public health concern. This is particularly so in view of the fact that childhood and adolescent hypertension tracks into adulthood. In the African sub-region there is a profound lack of regional protocol for diagnosis and management of childhood and adolescents hypertension. There is therefore a compelling need for the formulation of appropriate acceptable guidelines for the diagnosis and treatment of hypertension in children and adolescents. Also the need for deliberate development and implementation of effective preventive strategies to address the obesity epidemic can not be overemphasized if grave morbidity and mortality are to be avoided.

## CONCLUSION

This study shows that childhood hypertension is an emerging cardio-metabolic risk factor in developing countries especially in the presence of childhood obesity. This trend is worrisome since childhood hypertension can progress into adulthood later in life. There is an urgent need for public health campaign and implementation of strategies to mitigate this menace early in life. Routine blood pressure measurement should be encouraged and promoted among physicians caring for children. Also effective nutritional health education and school health program incorporating age appropriate physical exercises to reduce childhood obesity be implemented.

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## CONFLICT OF INTERESTS

There is no conflicts of interest with regards to this study.

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