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Blood Pressure Profile of Apparently Healthy Primary School Children in Delta State, Nigeria: Impact of Social Factors and Anthropometric Variables

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Abstract

Background: Systemic hypertension in children is one of the rising public health problems because of its attendant significant morbidity and mortality. Despite the rising prevalence of this problem, it is often under-reported as most of the attention has been focused on hypertension in adults with not much concerted effort made in tackling this problem in children. **Aim:** This study is aimed at determining the prevalence of hypertension and possible risk factors for its development and their relationship to hypertension among healthy primary school children in Asaba, Delta State. **Subjects and Methods:** This was a cross-sectional descriptive study involving 400 primary school students in Asaba. Variables such as weight, height, Body Mass Index (BMI), and blood pressure were measured using standard methods and the children categorized for hypertension and obesity using the Fourth Task Force Report and WHO BMI chart respectively. **Result:** The overall prevalence of hypertension was 3.5% and pre-hypertension 12.5%. The prevalence of hypertension increased from 2.4% in childhood to 12.5% in mid adolescents. Of the 14 subjects with hypertension, 12.5% were obese while 14.3% were overweight. The mean systolic and diastolic blood pressure of subjects in public schools was higher than their counterparts in private schools. Prevalence of hypertension in children was independent of the socioeconomic status and the type of school attended by the children unlike obesity and presence of proteinuria which appeared to be influenced by these variables. **Conclusion:** Hypertension was observed to be common in the study subjects.

It appeared to be more among obese children and those in their mid adolescent period.

1. Introduction

Hypertension is defined as the average systolic blood pressure and or diastolic blood pressure that is ≥95th percentile for age, gender and height measured on three different occasions [1]. It is further defined by the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure (BP) in Children and Adolescents based on percentiles defined as normal if BP is <90th percentile; pre-hypertension if ≥90th to <95th percentile or >120/80 mmHg in adolescents; Stage 1 HPT if between ≥95th to 99th percentile plus 5 mmHg; Stage 2 HPT if >99th percentile plus 5 mmHg [2]. There is documented association of increased morbidity and mortality with each millimeter of mercury increase in blood pressure above the normal [3].

Prevalence of hypertension though difficult to obtain as a single figure due to variability in sex, age and height has been recorded to range between 1% - 5% in developed, high-income countries. This has not been the case for African countries because of the existing significant variability of estimated prevalence rates among various studies conducted in South and certain West African countries (0% - 22.3%) [4].

In a systematic review study published in 2019, a global prevalence of hypertension in children ranged from 4.32% among children aged 6 years to 3.28% among those aged 19 years and peaked at 7.89% among those aged 14 years [5]. The pooled global prevalence was 4.00% for hypertension, 9.67% for pre-hypertension, 4.00% for stage 1 hypertension, and 0.95% for stage 2 hypertension in children 19 years and younger [5]. Certain Nigerian studies have documented the National Prevalence for HTN among adolescents as ranging between 2.5% and 5.4% [6] [7] [8] [9] while for younger children it ranged between 3.0% and 3.7% [10] [11]. These Nigerian studies were carried out in both public (attended mostly by low and medium social-economic groups) and private schools (attended mostly by children from rich homes). It is believed that using only one school type (public or private) could yield erroneous results that are not reflective of what is obtainable in the general population as there are marked socioeconomic disparities between students in both types of schools which could affect the burden of the disease [12] [13].

Uncontrolled hypertension often results in deaths and was said to be the second leading cause of end stage renal disease (ESRD) in the United States of America (USA) [14] [15]. Equivalent data in the less developed and underdeve-

loped countries remain largely unknown.

Worldwide, many studies on hypertension have been carried out on mostly middle aged and elderly patients giving the false impression that hypertension is a disease of only those age groups [9]-[17]. Not so many of these studies have been carried out in children especially those at primary school levels. This study is therefore aimed at determining the prevalence of hypertension among apparently healthy primary school children in Asaba. It also aims to ascertain the relationship between socio-economic statuses, their school type with the prevalence of hypertension. Armed with this knowledge, the cost implication of treating adults with raised BP will be addressed when attention is paid to childhood primary hypertension especially when this knowledge is continuously emphasized. It is also hoped that with this knowledge it would inform the need for routine BP check in children and adolescents in the routine children's clinic. This is because early identification and management appear to have an impact on long-term outcomes of cardiovascular disease as well as hypertension-related morbidity and mortality.

2. Methodology

2.1. Study Area and Population

The study was carried out in Asaba, the Capital city of Delta State. It is the major town in Oshimili South Local Government Area (OSLGA) which is one of the twenty-five LGAs of Delta State. The 2015 projected population of Oshimili South LGA is 198,444 of which 159,177 (80%) reside in Asaba [18].

There are 188 registered primary schools in Asaba as at 2016/2017 academic session, 23 are public schools while 165 are private schools with a total population of 31,917 children (16,094 in public school and 15,823 in private schools) giving the ratio of children in public to private school as 1:1 [19].

2.2. Study Design

The study was a descriptive cross-sectional study among apparently healthy primary school children aged 5 - 16 years. The study was conducted over a period of six months (November 2017 to April 2018) between the hours of 8:30 am and 11:30 am before the children engaged in any form of physical exercise which may affect the blood pressure reading. Four hundred children were selected using a multistage, stratified sampling technique as follows: 2 political wards were randomly selected for the study, 8 schools (2 public and 4 private) were randomly selected from the two political wards with the help of the lists of schools obtained from the State Ministry of Basic and Secondary Education. A proportionate number was allotted to each of the school based on their population. The children were stratified into: 5 - 9 years (childhood), 10 - 13 years (early-adolescents) and 14 - 16 (mid-adolescents). Data were collected using standard pretested questionnaires filled by the parents/guardian. Socio-economic classification was determined using the Olusanya's method of social classifica-

tion [20].

2.3. Inclusion and Exclusion Criteria

Primary school children aged 5 - 16 years who assented and whose parents gave written consent were recruited into the study. Subjects with known or suspected chronic illness such as nephrotic syndrome and other forms of chronic kidney disease (CKD), malignancy, bronchial asthma and those on prolonged steroid therapy were excluded from the study.

2.4. Ethical Considerations

Ethical clearance was sought and obtained from the Ethics Committee of FMC Asaba, State Ministry of Basic and Secondary Education and from the Chief Medical Officer of Health, Oshimili South LGA. Consents were also obtained from the selected school head teachers and from all the parents whose subject was selected for the study. Only subjects whose parents gave their consent were subsequently enrolled into the study.

2.5. Patients and Methods

Blood pressure was measured using ACCOSON Mercury Sphygmomanometer (Essex CM 195 QP, DEKAMET MK.3, England) with appropriate cuff sizes (one with inflatable bladder width of 40% of arm circumference and length to cover 80% - 100% of arm circumference). The children were asked to sit for five minutes with feet on the floor and not crossed, back supported and the right arm supported at the heart level before blood pressure measurement to ensure consistency. The appropriate cuff was wrapped around the arm ensuring that the artery marker points to the brachial artery. While palpating the radial artery, the cuff was then inflated until the radial artery pulsation was no longer palpable then, the cuff was gently deflated at 2 - 3 mmHg per second. The point at which the radial artery becomes palpable was taken as the systolic blood pressure. The cuff was inflated again while palpating the radial artery until the pulses were no longer felt; the bell of the stethoscope was then placed over the brachial artery and the cuff gently deflated at 2 - 3 mmHg/sec. The first rhythmic sounds heard as blood begins to flow through the artery (Korotkoff sound) corresponded with the systolic blood pressure (SBP) while the 5th or disappearance is the diastolic blood pressure (DBP). If 5th occurs at zero, muffling/4th Korotkoff was then used as DBP. Blood pressure was measured to the nearest 2 mm of Hg. Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents was used for classification of hypertension [1] [2]. Children with blood pressure greater than 90th percentile had their blood pressure repeated twice at the same time, and the average SBP and DBP were then taken. Those with elevated blood pressure ≥95th percentile had their blood pressure staged and their blood pressure rechecked on two other different occasions with one-week interval in between. The weight of the children was measured using

the Seca 750 mechanical floor scale. The height was measured using the Seca 213 stadiometer. The Body mass index was calculated as weight (kg) divided by square of height in meters (m^2) (kg/m^2). To enable computation of BMI z score, BMI as derived from weight and height was converted to BMI z score for each subject using the WHO anthroplus software, version 1.0.4.

2.6. Data Analysis

The data were entered into the EXCEL spread sheet and analyzed with Statistical Package for Social Sciences (SPSS) version 23. Chi-square was used to test for significant association of categorical variables while student's t-test was used to compare means of continuous outcome variable. Data presentation was done using frequency tables. Differences were deemed to be statistically significant where P-value <0.05.

3. Results

Four hundred children (200 each from private and public schools) were studied, 206 (51.5%) males and 194 (48.5%) females, giving a male to female ration of 1.1:1. The mean age of the children was 8.9 ± 2.1 years. Students from high SES were 160 (40.0%), while 79 (19.7%) were from low SES. The prevalence of hypertension was 3.5% while that of pre-hypertension was 12.5% as shown in Table 1

Table 1. General characteristics of the study population.

Variables		Frequency (n)	Percentage (%)
Age in years	5 - 9 (childhood)	250	62.5
	10 - 13 (early adolescence)	142	35.5
	14 - 16 (mid adolescence)	8	2.0
Gender	Male	208	52.0
	Female	192	48.0
Socio-economic class	Upper	160	40.0
	Middle	161	40.3
	Lower	79	19.7
Blood pressure	Normal	336	84.0
	Pre-hypertension	50	12.5
	Stage 1 hypertension	14	3.5
Nutritional status (BMI z score)	Obesity	39	9.8
	Overweight	32	8.0
	Normal weight	297	74.2
	Thinness	23	5.8
	Severe thinness	9	2.2

BMI: Body mass index.

Table 2 shows that 12.5% of mid adolescents (though number was small) and 2.4% of the younger age group (5 - 9 years) were hypertensive. Gender specific prevalence of hypertension shows that it was higher in females (5.2%) compared to males (1.9%), p = 0.08 but not related to SES and type of school.

Table 3 shows that pupils from public schools were older than their counterparts in the private section with the mean ages of 9.7 + 1.9 and 8.0 + 1.9 years respectively, p < 0.001. Anthropometric variables such as mean weight and BMI were higher in pupils in private schools compared to their public sector counterparts' p < 0.001 and p < 0.002 respectively. On the contrary, the mean SBP and DBP of students in public school were higher than their private school counterparts, p < 0.001 for both.

4. Discussion

The overall prevalence rate for hypertension and pre-hypertension in this study is 3.5% and 12.5% respectively. The 3.5% prevalence rate for hypertension in this study is similar to 3.0% that was reported by Umar *et al.* [10] in 2016 among

Table 2. Hypertension and subjects' characteristics.

Variables		Hypertension n = 14 (%)	No hypertension n = 386 (%)	χ^2	P-value
Age (years)	5 - 9 (n = 250)	6 (2.4)	244 (97.6)		
	10 - 13 (n = 142)	7 (4.9)	135 (95.1)	3.60	0.15
	14 - 16 (n = 8)	1 (12.5)	7 (87.5)		
Gender	Male (n = 206)	4 (1.9)	202 (98.1)	3.05	0.08
	Female (n = 194)	10 (5.2)	184 (94.8)		
Socio-economic class	Upper (160)	6 (3.8)	154 (96.2)		
	Middle (161)	5 (3.1)	156 (96.9)	0.12	0.94
	Low (79)	3 (3.8)	79 (96.2)		
School type	Public (200)	8 (4.0)	192 (96.0)	0.29	0.58
	Private (200)	6 (3.0)	194 (97.0)		

Table 3. Mean anthropometry and blood pressure according to school type.

Mean Parameters	Public School	Private School	P-value
Age (years)	9.7 ± 1.9	8.0 ± 1.9	<0.001*
Height (cm)	140.9 ± 76.7	134.0 ± 10.7	0.20
Weight (kg)	30.0 ± 7.4	34.6 ± 11.5	<0.001*
BMI (Kg/m²)	16.4 ± 9.9	18.9 ± 5.1	0.002*
Systolic blood pressure (mmHg)	86.4 ± 11.3	81.6 ± 11.2	<0.001*
Diastolic blood pressure (mmHg)	62.4 ± 15.3	53.8 ± 13.3	<0.001*

primary school children in Kano metropolis and 3.7% prevalence reported by Ezeonwu *et al.* [11]. The prevalence rate recorded in this study is also comparable to values found in some African countries. Kidy *et al.* [21] in Uganda and Ellanga-Mbolla *et al.* [22] in Congo reported a prevalence of 3.8% and 3.3% respectively among school children. The similarities in the prevalence in this study compared to other studies [10] [11] [21] [22] is perhaps due to similarity in the study group and guidelines in the diagnosis of hypertension.

The prevalence of 3.5% recorded in this study is lower than 5.4% reported by Ujunwa *et al.* [23] This finding is possible because the latter study [23] involved only adolescents unlike the index study with much younger adolescent children. The prevalence of hypertension was 2.4% within the childhood age, 4.9% among the early adolescents and 12.5% among the mid-adolescents. Thus showing an apparent increase in the prevalence of hypertension with increasing age (although the number sampled among early and mid-adolescents ages was small) which appears to be in tandem with other studies [10] [23].

This study observed no difference in the burden of hypertension between children in public (4%) schools compared to those in private schools (3%). This observation may be due to the fact that factors predisposing these children to hypertension are multi-factorial and may not really be limited to the school type attended by the subjects. The finding is however at variance with the outcome of the works done by Sadoh *et al.* [13] in Benin City and Sabapathy *et al.* [24] in India. While Sadoh *et al.* [13] reported a higher prevalence of hypertension among school children in public schools compared to those that attend private school, Sabapathy *et al.* [24] reported a higher prevalence of hypertension among children in private schools which they attributed to high burden of obesity among such children.

The mean systolic and diastolic blood pressure of subjects drawn from public schools was significantly higher than those drawn from the private schools. This is possible because the children from public schools were slightly older than those from private schools as evidenced by the difference in the mean ages of the subjects in both schools and this finding is similar to what was reported by Sadoh *et al.* [13]. The slight difference in the ages amongst these groups of children stems from the fact that most of these children in the public schools often enroll at a later age compared with their counterparts in the private schools. This is mostly because of financial constraints as a good number of them are burdened with the responsibility of helping fend for their respective families.

There was no significant gender difference in the prevalence of hypertension in the present study.

Similar to the work done by Okpokowuruk *et al.* [25] in 2017, the present study showed that SES does not contribute significantly to the prevalence of childhood hypertension among the children. Though children of high SES had higher BMI, however, weight alone may not be the only factor predisposing these children to hypertension.

5. Conclusion

Childhood hypertension is prevalent among primary school children in Asaba. Prevalence was neither influenced by the school type the children attend nor their socio-economic status. Early identification and prompt management are the key in preventing its long term complications.

Recommendation

Blood pressure measurement should be included as part of health assessment tool of the School Health Program for early detection of children with hypertension.

To further strengthen the study, it is important to relate hypertension with such anthropometric variables as Weight, height and BMI in future studies.

It is also equally important to assess other factors that encourage the development of hypertension when relating with BMI, SES and the school type of the study children.

It is also recommended that future studies should be conducted among children who fall into the same age range or with the same mean ages in both school types.

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Limitation

Long term follow-up of the children could not be done.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Authors Contribution for BP Measurement in Primary School Children in Asaba

AO   Conceptualization and design of the study, Data collection and writing of the manuscript.

EBU   Design of the study, Data collection, and revision of the manuscript.

OCO   Manuscript writing and revision of the manuscript.

MVU   Manuscript writing, revision of the manuscript and correspondance.

OUH   Overall supervision and Manuscript revision.