



High Blood Pressure and Related Factors among Nursery School Children in Port Harcourt, Nigeria

P. N. Tabansi^{1*}, K. C. Onyemkpa² and I. C. Anochie¹

¹*Department of Pediatrics and Child Health, University of Port Harcourt, Choba, Port Harcourt, Rivers State, Nigeria.*

²*Department of Pediatrics, Garki Specialist Hospital, Area 8, Garki District, Abuja, FCT, Nigeria.*

Authors' contributions

This work was carried out in collaboration between all authors. Authors KCO and PNT designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author ICA managed the analyses of the study. Authors PNT and KCO managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2018/38338

Editor(s):

(1) Thomas I. Nathaniel, University of South Carolina, School of Medicine-Greenville, Greenville, USA.

Reviewers:

(1) Irina Iuliana Costache, Grigore T. Popa University of Medicine and Pharmacy, Romania.

(2) O. Sharaye Kolade, Ahmadu Bello University Teaching Hospital, Nigeria.

(3) L. V. Athiththan, University of Sri Jayewardenepura, Sri Lanka.

(4) Samuel Grossman, City University of NY, USA.

Complete Peer review History: <http://www.sciencedomain.org/review-history/22742>

Original Research Article

Received 22nd October 2017
Accepted 27th December 2017
Published 15th January 2018

ABSTRACT

Introduction: High blood pressure is often considered a disease of old age; but the precursors are sometimes present in young children long before clinical manifestation of hypertension in adulthood. Essential hypertension is a major risk factor for atherosclerosis, heart disease, stroke and chronic kidney disease. There is no cure for hypertension, as such, identifying the risk factors in childhood and providing appropriate intervention early will impact positively on the morbidity and mortality indices of the disease; and, should form the basis of primary preventive strategy.

Aim: To determine the prevalence and factors related to high blood pressure in nursery school children in Port Harcourt.

Materials and Methods: A self-administered questionnaire was used to obtain relevant aspects of history from parents/caregivers of nursery school children (aged 2 to 5 years). Anthropometry (Weight and height) was done, and BMI calculated. Basal blood pressure (BP) was subsequently measured and cross-comparisons made.

*Corresponding author: E-mail: petronillatabansi@yahoo.com;

Results: There were 710 pupils, 365(51.4%) males and 345(48.6%) females. Mean systolic and diastolic BP was 93.4±10.8 mmHg and 58.8±8.0 mmHg respectively. Systolic and diastolic BP increased with increasing BMI. Prevalence of high BP was 10.9%. High BP was more among 3 year olds (15.9%) and obese pupils (25%). Pupils in social class II (13.7%), history of prematurity (12.5%), low birth weight (13%), birth asphyxia (14.3%) and positive family history of hypertension, had a higher representation among those with high BP.

Conclusion: High BP is prevalent among nursery school children in Port Harcourt and factors related include obesity, family history of hypertension, low social class, prematurity, and low birth weight.

Keywords: High blood pressure; nursery school children; Port Harcourt.

1. INTRODUCTION

Studies have shown that high blood pressure (essential hypertension) occur in children and adolescents [1,2], and carries the same risk for heart disease, atherosclerosis and stroke as seen in adult populations [3,4]. The prevalence of hypertension among children has been reported to range from 5.4% to 19.4% [3].

In the general population, normal physiologic growth in height and weight occurring during childhood and adolescence exert the greatest influence on the blood pressure [5]. However, other epidemiologic determinants of BP levels in children have been shown to be related to gender, obesity, race/ethnicity, socioeconomic status, and genetic inheritance [2,6,7,8,9,10,11]. Essential hypertension has no known cause or cure [3,12] though there is demonstrated efficacy of long term drug treatment [3]. However, the associated problems of availability, cost, unpleasant side effects and the need for complete adherence to life-long medication have made it increasingly clear that primary prevention rather than treatment is key to mitigating or eliminating the disease [13,2].

1.1 Pathophysiology of High Blood Pressure

The role of altered salt excretion by the kidney as a central mechanism in the development of hypertension was proposed by Guyton [14]. According to Guyton's hypothesis, there is impaired excretion of sodium ions by tubular epithelial cells of the kidney. To maintain salt and water hemostasis, the body adapts a pressure-natriuresis approach that ultimately leads to elevation in BP; thus the renal-pressure natriuresis mechanism is reset in patients with essential hypertension so that normal sodium excretion is maintained only at elevated blood pressures [15].

Omvik et al. [16] demonstrated that when arterial pressure was acutely reduced by nitroprusside infusion in patients with essential hypertension, sodium excretion decreased below normal indicating that pressure natriuresis was reset in these patients. Similar abnormalities of renal-pressure natriuresis have been found in all animal models of genetic hypertension studied [17,18].

The observation of abnormal pressure natriuresis in essential hypertension is not direct evidence that such an abnormality plays a causal role in elevating blood pressure [15]. However, in genetic models of spontaneous hypertension that have many similarities to human essential hypertension, there is evidence that abnormalities of pressure natriuresis occur before the development of hypertension and are not merely secondary to increased blood pressure.

Parfrey [19] also reported that, in children born to parents who were both hypertensive, the pressure natriuresis curve was shifted when compared with that of children with normotensive parents, even before the onset of hypertension. These observations provide further support for the view that abnormal pressure natriuresis in essential hypertensive patients may be a cause and not merely a consequence of increased blood pressure. However, once the hypertensive process begins pathological changes can occur in the kidneys that can add to the shift of the pressure natriuresis curve and further elevate blood pressure.

About 12% of the Nigerian adult population suffers from essential hypertension; [20] yet few studies exist that have shown the prevalence and determinants of high blood pressure in Nigerian children especially in early childhood or pre-school years. This study thus attempts to address this gap by determining the prevalence of high blood pressure in children aged two to

five years and relate same to some sociodemographic factors, so as to profile children with an increased risk.

1.2 Aim

To determine the prevalence and factors related to high blood pressure in nursery school children in Port Harcourt, Nigeria.

2. METHODOLOGY

This was a cross sectional descriptive study of children attending nursery schools in Port Harcourt – a city located in the petroleum oil-rich Niger-Delta basin of Southern Nigeria; from September to December 2013. Port Harcourt has 140 nursery schools (71 public schools and 69 private) located within its three school districts of Township, Diobu, and Trans Amadi. A multistage sampling technique was employed to select 710 nursery school pupils for the study from both public and private schools spreading across each district. Ethical clearance for the study was obtained from the University of Port Harcourt Teaching Hospital; and permission for the study was obtained from the Rivers State Primary School Board and all Head Teachers of selected schools.

The sample size of 710 was obtained using the formula [21]

$$N = \frac{z^2(pq)}{e^2}$$

where N = minimum sample size; z = 1.96 at 95% confidence limits, so that $z^2 = 3.8416$

p = Prevalence of hypertension in preschool children [22]; and q = 1 – p

An attrition rate of 20% was also added to the minimal sample size.

(for “p” - a hypertension prevalence of 12.5% obtained in a cohort study of pre-school children in Johannesburg-Soweto [22] was used).

A self-administered questionnaire was used to obtain relevant aspects of history from parents/caregivers of nursery school children (aged 2 to 5 years) including biodata, birth weight, history of prematurity, birth asphyxia, exclusive breast feeding, and family history of hypertension, stroke and sudden death. Each pupil had his/her anthropometric measurement (weight and height) done and body mass index (BMI) calculated using the formula $\text{Weight (kg)} / \text{Height (m}^2\text{)}$. This was subsequently compared to world health organization (WHO) standard charts and used to categorize the pupils. A BMI less than the 5th percentile was regarded as underweight, BMI between the 5th percentile to less than the 85th percentile was regarded as normal weight; between the 85th percentile to less than the 95th percentile as overweight and BMI equal to or greater than the 95th percentile [21] as obese. The basal blood pressure was also measured using a mercury sphygmomanometer with appropriate cuff sizes. In children, normal blood pressure is defined as systolic and diastolic pressures < 90th percentile for age, sex and height [14]. The measured BP in the children was thus compared to standard WHO BP charts; and BP greater than the 95th percentile for age, sex and height was regarded as high blood pressure.

The pupils social class was determined using the classification by Oyedeji [23] as shown below.

Score	Profession	Educational attainment
1	Professional, senior public servant, owners of large business concerns, senior military officers, large scale contractors.	University graduates or equivalents
2	Non-academic professionals e.g. nurses, secondary school teachers, secretaries, owners of medium sized business, intermediate grade public servants	School certificate holders and equivalent
3	Non manual skilled workers including clerks, typists, telephone operators, junior school teachers, drivers.	Grade II teachers certificate or equivalent
4	Petty traders, laborers, messengers	Primary school certificate
5	Unemployed, full time house wives, students, subsistence farmers	No formal education

Data analysis and sub-group comparison of blood pressure across age, sex, BMI, social class and other variables as stated above was also analyzed and presented as tables, pie charts and bar charts.

3. RESULTS

3.1 Age and Gender Distribution of Study Population

There were 710 pupils studied, 365 (51.4%) boys and 345 (48.6%) girls giving a boy to girl ratio of 1.1:1. The subjects ranged from 2 to 5 years with a mean age of 3.79 ± 1.06 years and mode of 5 years (32.54%). The least represented age was 2 years (15.63%). Table 1 shows the age and sex distribution of the study subjects. There was no statistical difference between the mean age of 3.81 ± 1.06 years for males and 3.77 ± 1.07 years for females. ($\chi^2 = 1.013$, $df=3$, $p = 0.568$).

3.2 Socio Economic Class of Subject

Of the 710 respondents, 707 had data from which the socio-economic class of their families could be calculated [23] and 3 did not, as such their socio-economic class was unknown. Fig. 1 shows the social class distribution of the subjects. The greatest proportion of children 356 (50.4%) was from socioeconomic class III and the least proportion 9 (1.3%) was from social class V.

3.2.1 Mean weight according to age and sex

The overall mean weight of the pupils was 16.5 ± 3.3 kg with a range of 8 – 32 kg. The mean weight increased with age as shown in Table 2. The overall mean weight for males was higher than that of the females and the difference was statistically significant ($t=2.889$, $p=0.004$). In addition, the mean weight for boys was higher than that of the girls in each of the ages. However, the difference was only statistically significant at age 2 years ($t=3.491$, $p=0.007$).

3.2.2 Mean height according to age and gender

The mean height of the pupils was 104.6 ± 9.2 cm with range of 74 – 142.1 cm. The mean height increased with age as shown in Table 3. The overall mean height of the boys was 105.2 ± 8.7 cm compared to 103.9 ± 9.7 cm for the girls. Boys were taller than girls at ages 2 and 3 years with the observed difference being statistically significant at age 2 years. ($t=3.120$, $p = 0.002$).

3.2.3 Mean Body Mass Index (BMI) according to age and gender

The mean BMI of the pupils was 15.0 ± 1.8 kg/m² with a range of 9.1 - 25.5 kg/m². The mean BMI showed a gradual decrease with age as shown in Table 4. The overall mean BMI of the boys was 15.2 ± 1.8 kg/m² compared to 14.9 ± 1.9 kg/m² for girls and the observed difference was statistically significant ($t=2.306$, $p=0.021$).

Table 1. Age and gender distribution of study subjects

Age (months)	Male (%)	Female (%)	Total (%)
24-35	54 (48.7)	57 (51.3)	111 (100)
36-47	83 (52.9)	74 (47.1)	157 (100)
48-59	105 (49.8)	106 (50.2)	211 (100)
60-71	123 (53.3)	108 (46.7)	231 (100)
Total	365 (51.5)	345 (48.6)	710 (100)

Table 2. Mean weight according to age and sex

Age (Months)	Over all		Boys		Girls		t	p
	No.	Mean \pm SD Weight (Kg)	No.	Mean \pm SD Weight (Kg)	No.	Mean \pm SD Weight (Kg)		
24-35	111	13.6 ± 3.2	54	14.7 ± 3.9	57	12.6 ± 1.9	3.491	0.007*
36-47	157	15.0 ± 2.3	83	15.3 ± 2.3	74	14.7 ± 2.2	1.472	0.143
48-59	211	17.1 ± 3.3	105	17.3 ± 2.9	106	16.9 ± 3.6	0.899	0.370
60-71	231	18.4 ± 2.6	123	18.5 ± 2.4	108	18.2 ± 2.4	0.934	0.351
Total	710	16.5 ± 3.3	365	16.9 ± 3.2	345	16.1 ± 3.5	2.889	0.004*

* Statistically significant

Table 3. Mean height according to age and gender

Age (Months)	Over all pupils		Boys		Girls		t	p
	No.	Mean ± SD height (cm)	No.	Mean ± SD height (cm)	No.	Mean ± SD height (cm)		
24-35	111	92.2 ± 7.7	54	94.5 ± 9.2	57	90.1 ± 5.3	3.120	0.002*
36-47	157	99.5 ± 5.5	83	100.1 ± 5.6	74	98.8 ± 5.3	1.475	0.142
48-59	211	106.9 ± 6.3	105	106.9 ± 5.5	106	106.9 ± 7.0	0.036	0.971
60-71	231	111.8 ± 5.4	123	111.9 ± 5.3	108	111.8 ± 5.6	0.149	0.882
Total	710	104.6 ± 9.2	365	105.2 ± 8.7	345	103.9 ± 9.7	0.219	0.067

* Statistically significant

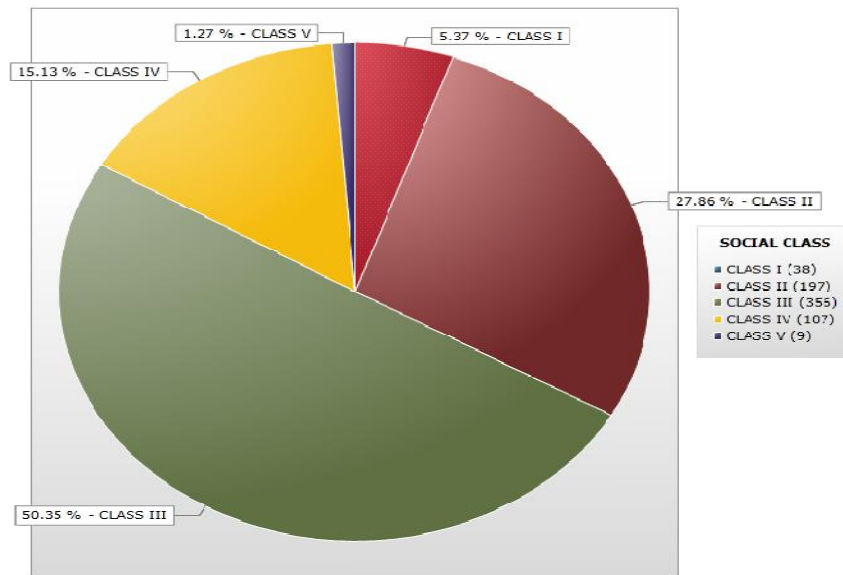


Fig. 1. Socio-economic class of study subjects

3.2.4 BMI classification of the study subjects

Fig. 2 shows the BMI classification of the subjects. The largest proportion of the subjects (75.2%) had normal BMI while 5.6% were obese.

3.2.5 Mean BP pattern of the subjects

The overall mean systolic BP of the pupils was 93.2 ± 10.6 mmHg with a range of 70 – 130 mmHg. The overall mean diastolic BP of the pupils was 58.8 ± 8.0mmHg with a range of 40 – 88.7 mmHg.

3.2.6 Mean systolic BP according to age and gender

Table 5 shows the mean systolic BP of the pupils according to age and gender. The mean systolic BP increased with age. The average rate of increase was 2.3 mmHg/year of life. The overall

mean systolic BP of the males was 94.0 ± 9.7 mmHg compared to 92.4 ± 11.5 mmHg of the females. The difference was statistically significant (t=2.008, p=0.045).

3.2.7 Mean diastolic BP according to age and gender

Table 6 illustrates that the mean diastolic BP increased with age. The average rate of increase was 1.6 mm/year of life. The mean diastolic BP of the boys was higher than that of the girls in each of the ages except age 5 years. The difference was statistically significant only at age 2 years (t=2.429, p=0.017).

3.2.8 Prevalence of high blood pressure

Six hundred and thirty-three (89.1%) pupils had normal BP while 77 pupils had high blood pressure giving a prevalence of 10.9%. Of those with high BP, 26 (3.7%) had isolated high systolic

BP, 32 (4.5%) had isolated diastolic high BP and 19 (2.7%) had combined high systolic and diastolic BP (Table 7).

pupils (9.9%), however this was not statistically significant. ($X^2=0.680$, $df=1$, $p = 0.409$).

3.2.9 Age and gender prevalence of high BP

The highest frequency of high blood pressure of 15.9% was found among the 3-year-old children while the lowest frequency of 8.2% was found among the 5-year-old children as shown in Table 8. Male pupils had a higher prevalence of hypertension (11.8%) compared to the female

3.2.10 Relationship between BMI Percentile and high blood pressure of subjects

Table 9 shows that the prevalence of high blood pressure increased as the BMI percentile increased with the highest prevalence of high blood pressure of 25% observed in the obese pupils. The difference was statistically significant ($X^2= 15.35$, $df=3$, $p = 0.002$).

Table 4. Mean BMI according to age and gender

Age (Months)	All pupils		Boys		Girls		t	p
	No.	BMI (Kg/m ²)	No.	BMI (Kg/m ²)	No.	BMI (Kg/m ²)		
24-35	111	15.9 ± 1.9	54	16.2 ± 2.2	57	15.5 ± 1.6	1.917	0.058
36-47	157	15.1 ± 1.4	83	15.2 ± 1.3	74	15.1 ± 1.5	0.554	0.581
48-59	211	14.9 ± 2.1	105	15.1 ± 1.8	106	14.8 ± 2.3	1.288	0.199
60-71	231	14.7 ± 1.7	123	14.8 ± 1.6	108	14.5 ± 1.8	1.283	0.201
Total	710	15.0 ± 1.8	365	15.2 ± 1.8	345	14.9 ± 1.9	2.306	0.021*

*Statistically significant

Table 5. Mean systolic BP according to age and gender

Age (Months)	All pupils		Boys		Girls		t	p
	No.	SPB (mmHg)	No.	SPB (mmHg)	No.	SBP (mmHg)		
24-35	111	88.2 ± 9.9	54	90.5 ± 9.4	57	86.0 ± 9.9	2.439	0.016*
36-47	157	92.3 ± 10.8	83	93.9 ± 10.2	74	90.6 ± 11.2	1.912	0.058
48-59	211	94.6 ± 10.6	105	94.9 ± 9.7	106	94.3 ± 11.5	0.420	0.675
60-71	231	95.0 ± 10.1	123	94.9 ± 9.1	108	95.2 ± 11.1	0.212	0.832
All ages	710	93.2 ± 10.6	365	94.0 ± 9.7	345	92.4 ± 11.5	2.008	0.045*

*statistically significant

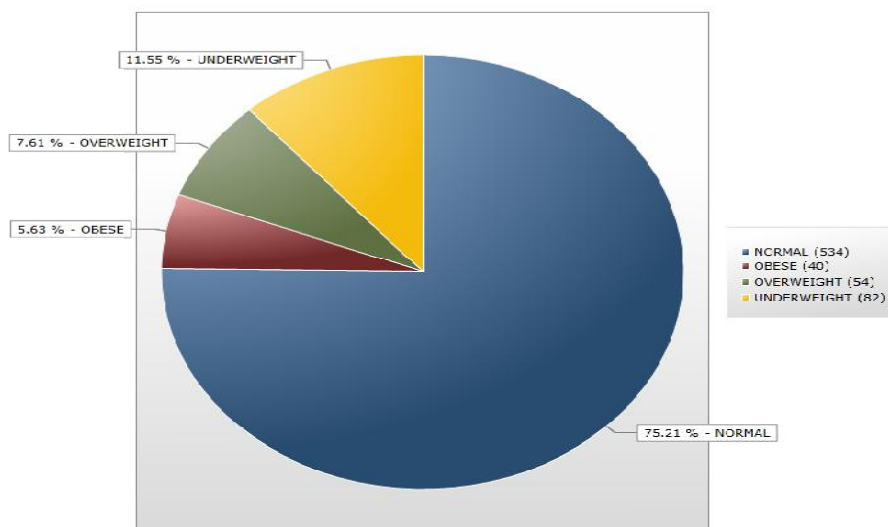


Fig. 2. BMI classification of the study subjects

Table 6. Mean diastolic BP according to age and gender

Age (Months)	All pupils		Boys		Girls		t	p
	No.	DPB (mmHg)	No.	DBP (mmHg)	No.	DBP (mmHg)		
24-35	111	55.4 ± 7.7	54	57.2 ± 8.3	57	53.7 ± 6.6	2.429	0.017*
36-47	157	58.2 ± 8.1	83	58.9 ± 8.4	74	57.4 ± 7.6	1.177	0.241
48-59	211	59.7 ± 8.6	105	60.2 ± 8.5	106	59.2 ± 8.7	0.856	0.393
60-71	231	60.2 ± 7.1	123	59.8 ± 6.8	108	60.6 ± 7.4	0.828	0.409
All ages	710	58.8 ± 8.0	365	59.3 ± 8.0	345	58.3 ± 8.1	1.645	0.100

*Statistically significant

Table 7. Prevalence of hypertension

Blood pressure	No.	%	Prevalence
Isolated Systolic high BP	26	33.7	3.7
Isolated diastolic high BP	32	41.6	4.5
Combine high systolic & diastolic high BP	19	24.7	2.7
Total	77	100	10.9

Table 8. Age and gender prevalence of high blood pressure

Age (Months)	Over all		Boys		Girls	
	Normal BP No. (%)	High BP No. (%)	Normal BP No. (%)	High BP No. (%)	Normal BP No. (%)	High BP No. (%)
24-35	100 (90.1)	11 (9.9)	46 (85.2)	8 (14.8)	54 (94.7)	3 (5.3)
36-47	132 (84.1)	25 (15.9)	69 (83.1)	14 (16.9)	63 (85.1)	11 (14.9)
48-59	189 (89.6)	22 (10.4)	92 (87.6)	13 (12.4)	97 (91.5)	9 (8.5)
60-71	212 (91.8)	19 (8.2)	115 (93.5)	8 (6.5)	97 (89.8)	11 (10.2)
Total	633 (89.1)	77 (10.9)	322 (88.2)	43 (11.8)	311 (90.1)	34 (9.9)

Table 9. Relationship between BMI percentile and high blood pressure in the subjects

BMI Percentiles	High blood pressure		Total (%)
	No (%)	Yes (%)	
Underweight	75 (91.5)	7 (8.5)	82 (100)
Normal weight	485 (90.8)	49 (9.2)	534 (100)
Overweight	43 (79.6)	11 (20.4)	54 (100)
Obese	30 (75.0)	10 (25.0)	40 (100)
Total	633 (89.2)	77 (10.8)	710 (100)

 $\chi^2 = 15.35, df=3, p = 0.002$ **3.2.11 Blood pressure level according to social class**

Table 10 illustrates the distribution of the blood pressure according to the social class category of the pupils. High blood pressure was highest in pupils belonging to social class II (13.7%). None of the pupils in social class V had high blood pressure 0 (0%). This difference was however not statistically significant ($\chi^2=4.478, df=4, p = 0.345$).

3.2.12 Blood pressure levels according to prematurity

Of the 710 parent/caregiver respondents, 551 (77.6%) gave information on gestational age at

birth and 159 (23.4%) did not. Table 5 shows that high blood pressure was more in those who were born premature (12.5%) compared to 11.4% in those without a history of prematurity. The difference was not statistically significant ($\chi^2=0.911, df=2, p = 0.634$).

3.2.13 Blood pressure level according to birth weight

Out of the 710 respondents, 662 (93.2%) provided information regarding birth weight and 48 (6.8%) did not and therefore their birth weights were unknown. High blood pressure was noted more in pupils with a history of low birth weight (13.0%) than those without a history

(10.9%) as shown in Table 12. This difference was not statistically significant ($X^2=0.205$, $df=1$, $p = 0.6508$).

3.2.14 Blood pressure level according to history of birth asphyxia

A total of 42(5.9%) pupils of the study subjects had a history of birth asphyxia. High blood pressure was more prevalent in the children with a history of birth asphyxia 14.3% compared to 10.6% in those without such a history as shown in Table 13. The difference was not statistically significant ($X^2 = 0.547$, $df=1$, $p = 0.460$)

3.2.15 Blood pressure according to family history of hypertension

The relationship between the blood pressure of the subjects and a family history of hypertension is shown in Table 14. High blood pressure was observed more in subjects with a family history of hypertension (14.6%) compared to 9.7% subjects without a family history of hypertension. The

difference is not statistically significant ($X^2 = 3.15$, $df=2$, $p= 0.207$)

3.1.16 Relationship between pupils' blood pressure level and family history of stroke

More pupils with a positive family history of stroke (13%) had high blood pressure compared with those without (10.7%). As shown in Table 15, this difference was not statistically significant ($X^2 = 0.266$, $df=2$, $p = 0.876$).

3.1.17 Relationship between pupils' blood pressure level and family history of sudden death

Table 16 shows the relationship between the pupils' blood pressure and a family history of sudden death. Pupils with a positive history of sudden death (16.3%) had more cases with high blood pressure compared to those without (10.5%). The difference is not statistically significant ($X^2=1.408$, $df=2$, $p = 0.494$).

Table 10. Relationship between social class and high blood pressure

Social class	High blood pressure		Total No. (%)
	No (%)	Yes (%)	
I	36 (94.7)	2 (5.3)	38 (100)
II	170 (86.3)	27 (13.7)	197 (100)
III	320 (89.9)	36 (10.1)	356 (100)
IV	97 (90.7)	10 (9.3)	107 (100)
V	9 (100)	0 (0)	9 (100)
Total	632 (89.4)	75 (10.6)	707 (100)

$X^2 = 4.478$, $df=4$, $p = 0.345$

Table 11. Relationship between prematurity and hypertension

Prematurity	High blood pressure		Total No.(%)
	No (%)	Yes (%)	
No	467 (88.6)	60 (11.4)	527 (100)
Yes	21 (87.5)	3 (12.5)	24 (100)
Don't know	145 (91.2)	14 (8.8)	159 (100)
Total	633 (89.2)	77 (10.8)	710 (100)

$X^2 = 0.911$, $df=2$, $p = 0.634$

Table 12. Relationship between low birth weight and hypertension

Low birth weight	High blood pressure		Total No. (%)
	No (%)	Yes (%)	
No	549 (89.1)	67 (10.9)	616 (100)
Yes	40 (87.0)	6 (13.0)	46 (100)
Total	589 (89.0)	73 (11.0)	662 (100)

$X^2 = 0.205$, $df=1$, $p = 0.6508$

Table 13. Relationship between birth asphyxia and hypertension

History of Birth asphyxia	High blood pressure		Total No. (%)
	No (%)	Yes (%)	
No	597 (89.4)	71 (10.6)	668 (100)
Yes	36 (85.7)	6 (14.3)	42 (100)
Total	633 (89.2)	77 (10.8)	710 (100)

$\chi^2 = 0.547, df=1, p = 0.460$

Table 14. Relationship between high blood pressure and family history of hypertension

Family history	High blood pressure		Total No. (%)
	No (%)	Yes (%)	
No	477 (90.3)	51 (9.7)	528 (100)
Yes	134 (85.4)	23 (14.6)	157 (100)
Don't know	22 (88.0)	3 (12.0)	25 (100)
Total	633 (89.2)	77 (10.8)	710 (100)

$\chi^2 = 3.15, df=2, p= 0.207$

Table 15. Relationship between blood pressure level and family history of stroke

Family history of stroke	High blood pressure		Total No. (%)
	No (%)	Yes (%)	
No	570 (89.3)	68 (10.7)	638 (100)
Yes	40 (87.0)	6 (13.0)	46 (100)
Don't know	23 (88.5)	3 (11.5)	26 (100)
Total	633 (89.2)	77 (10.8)	710 (100)

$\chi^2 = 0.266, df=2, p = 0.876$

Table 16. Relationship between hypertension and family history of sudden death

Family history of sudden death	High blood pressure		Total No. (%)
	No (%)	Yes (%)	
No	573 (89.5)	67 (10.5)	640 (100)
Yes	36 (83.7)	7 (16.3)	43 (100)
Don't know	24 (88.9)	3 (11.1)	27 (100)
Total	633 (89.2)	77 (10.8)	710 (100)

$\chi^2=1.408, df=2, p = 0.494$

4. DISCUSSION

This study showed that the mean systolic BP of the children was 88.2 ± 9.9 mmHg at 2 years and increased with age to a mean value of 95.0 ± 10.1 mmHg at 5 years of age. The mean diastolic BP was 55.4 ± 7.7 mmHg at 2 years and increased with age to a mean value of 60.2 ± 7.1 mmHg at 5 years of age. This is similar to the findings of Ogunkunle et al. [24] and de Swiet et al. [25] but contrasts with the findings of Hashimoto et al. [26] whose BP values were higher, with a mean systolic BP of 97.7 mmHg at the age of 2 years. A strong reason for this difference could be the method of blood pressure measurement. While this study as well as the study by Ogunkunle et al. [24] and de Swiet et al. [25] used the conventional sphygmomanometer,

Hashimoto et al. [26] used an oscillometric device which has been shown to give higher blood pressure values [27].

This observed progressive increase in BP among preschool children with age, is similar to other studies carried out both in preschool and older children [28,29].

In the present study, both systolic and diastolic BP increased with age. This is similar to the findings of Ogunkunle et al. [24] but contrasts with those of Hashimoto et al. [26] where age had an effect only on diastolic BP. The average rate of rise per year for mean systolic BP in this study, which was 2.3 mmHg/year, is however higher than the 1.4 mmHg/year reported by Ogunkunle et al. [24] On the other hand

Ogunkunle et al. [24] found a rate of rise of 1.7mmHg/year for mean diastolic BP similar to the 1.6mmHg/year in this study. The reason for the difference in systolic blood pressure may be due to environmental factors and differences in ethnicity.

Opinions have differed concerning the relationship between gender and BP. Studies consistently reported that mean systolic BP was slightly higher in girls than in boys up to the age of 12 years, after which boys showed a higher mean systolic BP [1,30-32]. This pattern has not been demonstrated with diastolic BP [29]. The present study, however, showed higher mean systolic and diastolic BP in males compared to females. This was similar to the findings of de Swiet et al. [25] who studied blood pressure in the first 10 years of life and found that the blood pressure of males was higher than that of females by 1 mmHg at all age groups ($p < 0.0001$) even after allowing for the effect of weight. In contrast to these findings, Brady [33] showed there was no difference in blood pressure between male and female children younger than six years but found that at puberty and beyond males had a slightly higher blood pressure than females. Ogunkunle et al. [24] observed no gender-related difference in BP in children aged 1 – 5 years except in the 12 – 23-month age group where the females had a significantly higher BP than the males. The reason for these variations in BP with respect to gender is unclear. The differences in race, ethnicity, environment and genetic factors could be possible explanations for the inconsistency in the effect of gender on blood pressure in different populations.

The global prevalence of paediatric overweight and obesity has increased largely over the last 2 decades [34]. In this study, the prevalence of overweight and obesity was 7.6% and 5.6% respectively. Senbanjo et al. [35] also studied the prevalence of overweight and obesity in Nigerian preschool children in a rural community in Osun state found a higher prevalence of overweight of 13.7% but a similar prevalence of obesity of 5.7%. This shows a gradual shift in the BMI distribution in Nigerian children towards childhood obesity which is becoming an increasing public health problem in sub Saharan Africa. The reason for this is probably as a result of rapid changes in type of food intake and life style such as fast foods, excess fat and salt consumption and sedentary lifestyle.

The prevalence of hypertension in this study of 10.9% is similar to 10.7% reported by Arnaud et al. [35] in a Houston survey of school children. It however contrasts with a lower prevalence of 3.2% by Ogunkunle et al. [24]. The reason for the high prevalence in this study is probably due to the high prevalence of overweight and obesity of 7.6% and 5.6% respectively found in this study. The prevalence of hypertension was significantly higher (25%) in obese children in this study. This is collaborated by Haslam et al. [36] who stated that the risk of hypertension is 5 times higher in the obese than those of normal weight and that up to two-thirds of cases of essential hypertension can be attributed to excess weight. In addition, the continuing population increase and changes in lifestyle, which includes a diet rich in sugar and high-fat processed foods and sedentary behaviour mediated by television viewing, computers and cars now prevalent in our environment may also play a role.

The higher prevalence of hypertension in males (11.8%) compared to 9.9% in females found in this study is similar to the findings of Sorof et al. [9] but differs from the findings in other studies in which females tended to have a higher prevalence of hypertension [37-39]. The reason for this higher prevalence of hypertension in males found in this study may be due to the higher BMI levels in males. Studies have shown that BMI significantly correlates with blood pressure [38-40] and overweight children have been shown to be 2 to 4 times more likely than normal-weight children to have high BP [38,39]. Londe et al. [10] and Sorof et al. [9] also found a higher prevalence of hypertension in obese compared to none-obese children. Arnaud et al. [35] reported a prevalence of hypertension of 10.7% in obese children compared with 2.6% in children with normal BMI. This study supports these findings as there was a significantly higher percentage (25%) of hypertension in those that had a high BMI. This finding is important because it shows that the relationship between blood pressure and BMI is evident even in preschool age, irrespective of the observation by Lauer et al. [6] that the relation between BMI and BP is stronger in adolescence than childhood. Although the prevalence of paediatric hypertension in the United States has been calculated to be between 1 and 5 percent, [40,41] this value is expected to increase due to the close association between hypertension and obesity [42,43] as was seen in this study. Studies show that slight elevations in BP (1 to 2 mmHg) in childhood will elevate the risk of developing

hypertension as an adult by 10 percent [41,44-46]. Life style and diet modification will therefore go a long way in the prevention of childhood and adulthood hypertension by preventing the increase in prevalence of obesity.

Low socioeconomic status has been associated with higher blood pressure [33,47]. This study revealed a higher prevalence of hypertension, though not statistically significant among children from a higher socio economic class compared to those of low socioeconomic class. This compares to the finding by Oviasu et al. [48] even though the age group studied differs. Oviasu et al. [48] observed that Nigerian children aged 6-12 years living in rural areas had significantly lower systolic and diastolic blood pressures than those living in the urban areas. On the other hand, Blankson et al. [47] in Ghana and Balogun et al. [49] in Nigeria did not reveal any significant relationship between parental socio-economic status and BP level. Epstein et al. [50] also found no relationship between BP and socio economic status in Israel high school students. The findings in this study may be explained by the significantly higher prevalence of overweight and obesity in children from the upper class compared to the prevalence found in the middle and lower socio-economic class children. In addition, the adoption of different parameters to define socioeconomic class and social class stratification by different researchers may have also accounted for these disparities observed. For example, in the study by Akinkugbe et al. [51], the socioeconomic status of the students was equated to the educational levels of their parents, while the Epstein et al. [50] study used the status symbol which included indices such as ownership of cars, houses, utensils and appliances. In this study, the social classification scheme by Oyedjeji [23] was used, which uses a combination of parental occupation and parental educational level.

Low birth weight is a known risk factor for subsequent elevated BP in children and in adults [52,53]. Children born preterm have shown significantly higher systolic BP values than children born full term [52-54]. Giacomo et al. [55] found that the prevalence of hypertension in preschool children was higher in those born preterm or who were low birth weight. This study agrees with this finding as there was a higher prevalence of 12.5% in children born preterm compared to the children born full term, and a higher prevalence of 13% in those who had low birth weight compared to 10.9% who had normal

birth weight. Other studies carried out elsewhere have also revealed similar finding [54-56]. The possible pathophysiologic mechanism for this is the impaired renal development in premature new-borns which has been proven to be related to hypertension later in life [57].

The 14.3% prevalence rate of hypertension amongst pupils with a history of birth asphyxia was higher though not significant than the 10.6% prevalence in those without such history. Birth asphyxia, being a known complication of prematurity and low birth weight, with its consequent role in the aetiology of renal artery thrombosis and cortical necrosis may account for the higher prevalence of hypertension in these children.

The finding of higher mean systolic and diastolic blood pressure in children with family history of hypertension, stroke and sudden death in this study compares favourably with other studies [58-60]. Mijinyawa et al. [60] in Kano found that hypertensives were significantly more likely to have a family history of hypertension compared to their normotensive counterparts. This is similar to findings from the index study and is important because it can potentially be used for risk profiling of children for early intervention.

5. CONCLUSION

From this study, the following conclusions are drawn on children aged 2-5 years attending nursery schools in Port Harcourt metropolis:

1. The overall mean systolic and diastolic blood pressures are 93.2 ± 10.6 mmHg and 58.8 ± 8.0 mmHg respectively.
2. The mean systolic and diastolic pressure increased with age at an average rate of 2.3 mmHg/year and 1.6 mmHg/year respectively.
3. Blood pressure increased as BMI increased.
4. The prevalence of hypertension is 10.9%

6. RECOMMENDATIONS

Based on the conclusions in this study, the following recommendations are made:

1. BP measurement should be performed routinely as part of the physical examination in all children visiting health care facilities during each visit or at least 3 times a year at the beginning of each school term from age two years.

2. BP measurement should be part of the school health programme at preschool entrance and periodic medical examination for children in order to detect and appropriately refer those with hypertension.
3. Children and their parents/guardians should have regular health education on prevention of overweight as means of prevention of hypertension.

7. LIMITATIONS

There was limited contact between the researcher and the parents/guardians of the subjects, so information obtained could not be confirmed by direct interview.

Blood pressure levels in this study were based on average of three readings at a single visit. A more precise estimate of blood pressure level would have been obtained by multiple measurements obtained on three visits.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ximena UR, Christie UE, Sejong B, John M, Manuel B, Patrick AR, et al. High Blood Pressure in School Children: Prevalence and Risk Factors. *BMC Paediatrics*. 2007; 6:32-38.
2. Gillman MW, Ellison RC. Childhood prevention of essential hypertension. *Ped Clin North Am*. 1993;40:179-193.
3. Whelton PK. Epidemiology of hypertension. *Lancet*. 1994;344:101-106.
4. Berenson GS, Srinivasan SR, Bao W, Newman WP, Tracy RE, Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. The Bogalusa Heart Study. *N Engl J Med*. 1998;338:1650-1656.
5. Voors AW, Webber LS, Frerichs RI, Berenson GS. Body height and body mass as determinants of basal blood pressure in children – The Bogalusa heart study. *Am J Epidemiol*. 1977;106:101-108.
6. Lauer RM, Clarke WR. Childhood risk factors for high adult blood pressure: The Muscatine study. *Paed Clin North Am*. 1993;40:23-40.
7. Szklo M. Epidemiological patterns of blood pressure in children. *Epidemiol Rev*. 1979; 1:143-169.
8. Charles A, Eline O, Wilco Z, Johannes W, Karien S. Blood pressure and body mass index in an ethnically diverse sample of adolescents in Paramaribo, Suriname. *BMC Cardiovasc Dis*. 2009;19:9-19.
9. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ. Overweight, ethnicity, and the prevalence of hypertension in pre-school children. *Pediatrics*. 2004;113:475-482.
10. Londe S, Burgoigme JJ, Robson AM, Goldring D. Hypertension in apparently normal children. *J Pediatr*. 1971;78:569-577.
11. Rocchini AP. Adolescent obesity and hypertension. *Pediatr Clin North Am*. 1993; 40:81-92.
12. William GH. Hypertensive vascular disease. In Wilson JD, Braunwald E, Isselbacher KJ eds. *Harrisons Principles of Internal Medicine*. 16th ed. New York: Mc Graw Hill. 1991;1001.
13. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: Analysis of world wide data. *Lancet*. 2005;365:217-223.
14. Guyton AC. Blood pressure control—Special role of the kidneys and body fluid. *Science*. 1991;252:1813-1816.
15. John EH, Leland M, Drew AH, Michael WB. Abnormal pressure natriuresis- a cause or a consequence of hypertension. *Hypertens* 1990;15:547-559.
16. Omvik P, Tarazi RC, Bravo EL. Regulation of sodium in hypertension. *Hypertens* 1980;2:515-523.
17. Coleman TG, Guyton AC, Young DB, DeClue JW, Norman RA, Manning RD. The role of the kidney in essential hypertension. *Clin Exp Pharmacol Physiol*. 1975;2:571-581.
18. Roman RJ, Cowley AW. Abnormal pressure-diuresis-natriuresis response in

- spontaneously hypertensive rats. *Am J Physiol.* 1985;248:199-205.
19. Parfrey PS. Salt and hypertension. In: Sleight P, Freis ED, editors. *Hypertension.* London: Butterworth. 1982;322-339.
 20. Akinkugbe OO. Hypertension. In: Akinkugbe OO, ed. *Non communicable diseases in Nigeria Series 3. Report of National Survey, prepared by National expert committee on NCD 1992.* Lagos: Spectrum Books. 1992;5.
 21. Anderson DR, Sweeny DJ, Williams TA. Sampling and sampling distribution; determining the size of sample. In: *Introduction to statistics, concepts and application. Second edition.* West Publishing Company. New York. 1991; 215-264.
 22. Steyn K, de Wet T, Richter L, Cameron N, Levitt NS, Morrell C. Cardiovascular disease risk factors in five-year-old urban South African children - the Birth to Ten study. *S Afr Med J.* 2000;90:719-726
 23. Oyediji GA. Socioeconomic and cultural background of hospitalized children in Ilesha. *Nig J Paed.* 1985;12:111-117.
 24. Ogunkunle OO, Odutola AO, Orimadegun AE. Pattern of blood pressure in apparently healthy Nigerian children aged 1-5 years. *Nig J Paediatr.* 2007;34:14-23.
 25. de Swiet M, Fayers P, Shinebourne EA. Blood pressure in the first 10years of life: The Brompton study. *Br Med J.* 1992;7: 244-248.
 26. Hashimoto N, Kawasaki T, Kikuchi T, Uchiyama M. Criteria of normal blood pressure and hypertension in Japanese preschool children. *J Hum Hypertens.* 1997;11:351-354.
 27. Park MK, Menard SW, Yuan C. Comparison of auscultatory and oscillometric blood pressures. *Arch Paediatr Adolesc Med.* 2001;155:50-53.
 28. Abdulrahman MB, Ochog SA. Casual blood pressure in school children in Kaduna, Nigeria. *Trop Geogr Med.* 1978; 30:325-329.
 29. Amul PA, Saxena D, Shah H, Sharma V, Singhal D. Impact of weight, height and age on blood pressure among school children. *Int J Fam Prac.* 2009;7:44-50.
 30. Liming LI, Yangying W, Weihua C, Fujie X, Jiaqi C. Longitudinal studies of blood pressure in children. *Asia Pac J Public Health.* 1995;8:130-133.
 31. Szklo M. Determination of blood pressure in children. *Clin Exp Hypertens.* 1986;8: 479-493
 32. Alabi A, Alikor EAD, Ogunkunle OO. The basal blood pressure in adolescents in Port Harcourt Metropolis. *TNHJ.* 2006;6:357-362.
 33. Brady TM, Fivush B, Parekh RS, Flynn JT. Racial difference among children with primary hypertension. *Pediatr.* 2010;126: 931-937.
 34. Arnaud C, Pascal B, Gilles P, Fred P. Has Blood Pressure increased in children in response to the obesity epidemic. *Pediatr.* 2007;119:544-553.
 35. Senbanjo IO, Adejuyigbe EA. Prevalence of overweight and obesity in Nigerian preschool children. *Nutr Health.* 2007;18: 391-399.
 36. Haslam DW, James WP. Obesity. *Lancet.* 2005;366:1197-1209.
 37. Hamidu LJ, Okoro EO, Ali MA. Blood pressure profile in Nigerian children. *East Afr Med J.* 2000;77:180-184.
 38. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. *Pediatrics.* 1999;103:1175-1182.
 39. Stamler J. Epidemiologic findings on body mass and blood pressure in adults. *Ann Epidemiol.* 1991;1:347-362.
 40. Sinaiko AR, Donahue RP, Jacobs DR Jr., Prineas RJ. Relation of weight and rate of increase in weight during childhood and adolescence to body size, blood pressure, fasting insulin, and lipids in young adults. The Minneapolis Children's Blood Pressure Study. *Circulation.* 1999;99:1471-1476.
 41. Ronald JP, Jonathan MS, Juie RI. *Pediatric Hypertension.* New Jersey: Humana Press; 2004.
 42. National High Blood Pressure Education Program Working Group on Hypertension Education in Children and Adolescents: Update on the 1987 task force on high blood pressure: A working group report from the National High Blood Pressure Education Program. *Pediatrics.* 1996;98: 649-658.
 43. Rosner B, Prineas R, Daniels SR, Loggie J. Blood pressure differences between blacks and whites in relation to body size among US children and adolescents. *Am J Epidemiol.* 2000;151:1007-1019.

44. Sorof JM, Poffenbarger T, Franco K, Bernard L, Portman RJ. Isolated systolic hypertension, obesity, and hyperkinetic hemodynamic states in children. *J Pediatr.* 2002;140:660-666.
45. Lande MB, Kaczorowski JM, Auinger P, Schwartz GJ, Weitzman M. Elevated blood pressure and decreased cognitive function among school-age children and adolescents in the United States. *J Pediatr.* 2003;143:720-724
46. Falkner B, Daniels SR, Flynn JT. National high blood pressure education program working group on high blood pressure in children and adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Paediatrics.* 2004;114 (2 Suppl):555-76.
47. Blankson JA, Larbi EB, Pobee JDM. Blood pressure levels of African children. *J Chron Dis.* 1977;30:735-743.
48. Oviasu VO, Alakija W, Oyaredu KA. Differences in arterial blood pressure and body build in the first and second decades of life in urban and rural Nigeria. *Trop Cardiol.* 1978;4:113-125.
49. Balogun JA, Obajuluwa VA, Olaogun MO et al. Influence of parental socio-economic status on casual blood pressure of Nigerian school children. *Int J Cardiol.* 1990;29:63-69.
50. Epstein L, Tamir A, Pearlman S. Blood Pressure and hypertension in high school students. *J Chron Dis.* 1981;34:321-329.
51. Akinkugbe FM, Akinwolere OA, Kayode CM. Blood pressure pattern in Nigerian adolescents. *West Afr J Med.* 1999;18: 196-202.
52. Barker JP. Birth weight and hypertension. *Hypertens.* 2006;48:357-358.
53. Wadsworth ME, Cripps HA, Midwinter RE, Colley JRT. Blood pressure in a national birth cohort at the age of 36 related to social and familiar factors, smoking and body mass. *Br Med J.* 1985;291:1534-1538.
54. Giacomo DS, Rainer S, Martin K, Georg FH, Franz S, Elke W. Determinants of blood pressure in preschool children. *Circulation.* 2011;123:1-7.
55. David JP. Birth weight and hypertension. *Hypertens.* 2006;48:357-358.
56. Coeli AP, Nascimento LR, Mill JG, Molina MC. Preterm birth as a risk factor for high blood pressure in children: A systematic review. *Cad Saude Publica.* 2011;27:207-218.
57. Poplawska K, Dudek K, Koziarz M, Cieniawski D, Drożdż T, Śmiałek S, et al. Prematurity-related hypertension in children and adolescents. *Int J Pediatr.* 2012;12:537-539.
58. Lee YH, Rosner BG, Gould JB. Familial aggregation of blood pressure of new born infants and their mothers. *Pediatrics.* 1976; 56:722-729.
59. Wang SY, Ma SB, Zheng XZ. Epidemiological survey of blood pressure of pre-school children. *Ann Trop Paediatr.* 1987;7:244-248.
60. Mijinyawa MS, Iliyasu Z, Borodo MM. Prevalence of hypertension among teenage students in Kano, Nigeria. *Niger J Med.* 2008;17:173-178.

© 2018 Tabansi et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<http://www.sciencedomain.org/review-history/22742>