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Prevalence and risk factors for hypertension among school children in Ilorin, Northcentral Nigeria

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Abstract:

BACKGROUND: The global prevalence of childhood hypertension has increased from 1% to 2% to 4%–5%, with a value as high as 9.8% reported in Nigeria. However, the various risk factors associated with childhood hypertension in Nigeria are less explored. The aim of this study was to determine the prevalence of hypertension and related risk factors (sociodemographic, family history of hypertension, history of snoring, birth order, and anthropometric indices) in primary school children in Nigeria.

MATERIALS AND METHODS: A total of 1745 school children aged 6-12 years were selected using systematic random sampling method. Blood pressure (BP) was measured using the fourth report guideline. Those with BP higher than 90th percentile had repeated BP measurements on two more occasions (2 and 4 weeks after initial measurement). Relevant history was obtained, and anthropometric measurements were taken by the standard methods. Data were analyzed using SPSS version 20.

RESULTS: Prevalence of systolic and or diastolic hypertension at the third visit was 3.0%. Prevalence of systolic hypertension (3rd visit) was more in females (3.3%) than males (1.3%), P = 0.004. Prevalence of diastolic hypertension (3rd visit) was higher in females (1.4%) than males (0.3%), P = 0.019. Hypertension showed no significant relationship with socioeconomic class, family history of hypertension, birth order, and history of snoring. Of the anthropometric indices (weight, height, body mass index (BMI), hip circumference, waist circumference, waist-to-hip ratio, and waist-to-height ratio, and only obesity (BMI $\geq$ 95th centile) was related with hypertension (odd ratio 8.3, 95% confidence interval 1.7, 40.3).

CONCLUSIONS: Prevalence of hypertension is low (3.0%), and only obesity (BMI $\geq$ 95th centile) is associated with hypertension.

Keywords:

Children, hypertension, Nigeria, risk factors

Introduction

Although the incidence of hypertension in children is low compared with adults, the prevalence is on the increase.[1] Globally, the prevalence of hypertension in children has risen from a previously reported range of 1%–2% to 4%–5%.[2-5] Some local studies on childhood hypertension in Nigeria, report a prevalence of 1.1% to 9.8%.[6-9] However, many of the Nigerian studies were limited to a single visit that gave a point prevalence of childhood hypertension rather than the true prevalence of hypertension that require at least three visits.[6,8,9]

The etiology of hypertension (primary) in childhood is multifactorial, with an interplay between nature and nurture. Genetics has been known to be important in the onset of primary hypertension as studies have demonstrated a strong positive family history among siblings with primary

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hypertension.[10,11] Furthermore, linked to the onset of childhood hypertension is obesity with increasing prevalence of childhood obesity partly responsible for this rising prevalence of childhood hypertension.[1] Other risk factors documented to be associated with primary hypertension in children included sleep disorders, including snoring, low socioeconomic status, and low birth weight of firstborns.[12] Despite the numerous studies done on childhood hypertension in Nigeria, only a few have explored the risk factors. The few local studies that evaluated risk factors for hypertension were limited to either the history of hypertension in the family and or the role of obesity/overweight.[11,13]

Hence, this study was to determine in a population of school children in Northcentral Nigeria, the prevalence of hypertension and various associated risk factors (sociodemographic, family history, history of snoring, birth order [first born] and anthropometric indices [weight, height, body mass index (BMI), hip circumference, waist circumference, waist-to-height ratio, and waist-to-hip ratio (WHR)]).

Materials and Methods

This school-based cross-sectional study was carried out between December 2014 and May 2015 on children in Ilorin, the capital city of Kwara State. The state is one of six in the Northcentral part of Nigeria.[14] Typical settlement patterns in Ilorin is that of urban, semi-urban, and rural communities spanning Ilorin East, Ilorin West, and Ilorin South local government areas (LGAs).[15] The total population of school-aged children in Ilorin was 109,492 (Ilorin West had a population of 50,297, Ilorin South had 31,610 pupils, while Ilorin East had 27,585 primary school children.[16]

The minimum sample size for the study was calculated using Yamane formula "$n = N/1 + Ne^2$"[17] at a precision of 2.5%. The details of the sample size calculation had been described in a previous publication.[18] The number of pupils recruited from each local government was based on proportions from the total population. At each of the three LGAs, a proportionate method was used to select the ratio of public to private schools for the study. The detailed steps and recruited pupils in the selected 20 schools had been described in the previous publication.[18] The inclusion criteria included primary school pupils aged between 6 and 12 years and apparently healthy. Children whose parents/guardian declined consent or with a known or history suggestive of congenital or acquired heart diseases or a known or history suggestive of endocrine disorders were excluded from this study.

Before the recruitment, an information sheet detailing the purpose of the study as well as a, consent form, and study pro forma were given to all eligible participants for completion by their respective parents/guardians. For each participant aged 8 years and above, an assent form was also provided. A pretested semi-structured study pro forma was used to obtain relevant information, including the sociodemographic characteristics of the pupils. The social class was based on Oyedeji's[19] social classification system. The Oyedeji's social classification was derived from the mean of scores given to parents or caregivers' maximum educational levels and occupations rounded up to the nearest whole number. The mean scores were further classified as upper (scores of 1 and 2), middle (score of 3), and lower socioeconomic classes (scores of 4 and 5).[19] The other information obtained included a history of snoring, birth order, and family history of hypertension.

The height was measured to the nearest 0.1 cm using a portable stadiometer (Seca® Model: 213, USA). The height of the children was measured while standing, without shoes. During the measurement, the hips and shoulders had to be perpendicular to the central axis, knees together with the heel against the footboard, arms should hang loosely at the sides, and the head in Frankfurt plane.[20] The mid-point of the distance between the acromion and olecranon processes was taken as the arm circumference (this was used for cuff selection based on The Fourth Reports).[21] The mid-point of the distance between the superior border of the iliac crest and the lowest rib in the horizontal plane around the abdomen was taken as the waist circumference. The circumference over major trochanters was taken as the hip circumference. The arm circumference, waist circumference, and hip circumference were all measured to the nearest 0.1 cm with an inelastic tape. The weight was measured with an electronic weighing scale (Camry®, Model: EB9323H, China) to the nearest 100 g.

The measurement of blood pressure (BP) was done in a quiet room between 9 am and 12:00 noon.[22] The pupils had BP measured on their right arm with a mercury sphygmomanometer after resting for a minimum of 5 min. The systolic blood and diastolic BP were determined by the 1st and 5th Korotkoff sounds, respectively. Two serial measurements were taken to nearest 2 mmHg at an interval of 1 min and the mean used for analysis.[23] The school children with BP above 90th centile (using fourth report nomogram for interpretation) had repeat measurements at the end of the 2nd and 4th weeks after the initial BP measurement.[21] Based on the "Fourth Report on High BP in Children and Adolescents," hypertension was defined as "average systolic BP and diastolic BP that was ≥95th percentile for gender, age, and height on the three visits."[21] The investigator and one of the two trained research assistants (medical doctors) took the BP measurements.

The information obtained was numerically coded and subsequently analyzed with IBM SPSS® statistics for Windows, version 20 (IBM Corp., Armonk, NY, USA). Furthermore, the WHO Anthroplus® software was used for the analysis of the anthropometric data (weight, height, and BMI). The ratio of waist-to-hip circumferences was used to compute the WHR. The waist circumference was divided by height to compute the waist-to-height (WHtR) ratio. The waist circumference, hip circumference, WHR, and WHtR were converted to Z scores. The Z scores of the height for age, weight for age, waist circumference, hip circumference, WHR, and WHtR were further classified into <−1, −1 to + 1 (normal), >+1 to <+2, and >+2, respectively. BMI for age was computed as body weight in kilograms divided by height in meters squared. The BMI was further classified as underweight (<5th centile), normal weight (5th to 84th centile), overweight (85th to 94th centile), and obesity (≥95th centile).[24] The Chi-square test and Z test for two proportions were used to assess the relationship between the various risk factors and hypertension, while the odds ratio was used to express the strength of association. *P* value was set at value < 0.05.

Ethical approval was granted by the Ethical Review Committee of the University of Ilorin Teaching Hospital, Ilorin, Kwara State. Also, obtained from the Kwara State Ministry of Education was a written approval for the study and a written informed consent from the respective parents or guardians of the children. The parents or guardians were also assured of the absolute confidentiality of the information provided, and the assurance that it would be used for research purposes only.

Results

Of the 1745 children studied, 618 (35.4%) were recruited from public primary schools and the remaining 1127 (64.6%) pupils from private primary schools. The males and females were 873 and 872, respectively. The mean age of the children was 8.77 ± 2.0 years There was no significant difference in males and females, 8.76 ± 2.0 versus 8.78 ± 1.9 years, *P* = 0.838. Of the 1702 (100%) parents of the study children with complete data for socioeconomic classification, 624 (36.7%) were in the upper-social class, 579 (34%) were in the middle-social class, while the remaining 499 (29.3%) of respondents belonged to the lower-social class.

The prevalence of systolic hypertension during the first visit was 6.2% (109/1745). During the second and third visits, the prevalence of systolic hypertension was 3.4% (60/1745) and 2.3% (40/1745), respectively. For diastolic hypertension, the prevalence at the first visit was 2.8% (48/1745), 1.2% (20/1745) at the second visit, and 0.9% (15/1745) at the third visit. The combined prevalence of systolic and or diastolic hypertension at the end of the third visit was 3.0% (53/1745). Furthermore, Table 1 shows that the systolic hypertension in the females was significantly higher than the males during the first visit (70/872 [8.0%] vs. 39/873 [4.5%], *P* = 0.002), second visit (38/872 [4.4%] vs. 22/873 [2.5%] *P* = 0.034), and third visit (29/872 [3.3%] vs. 11/873 [1.3%], *P* = 0.004). Table 1 also shows no statistically significant differences in the prevalence of diastolic hypertension in the females and males during the first visit (28/872 [3.2%] vs. 20/873 [2.3%], *P* = 0.246), and second visit (13/872 [1.5%] vs. 7/873 [0.8%], *P* = 0.176), although it was higher in females than males at the third visit,(12/872 (1.4%) vs. 3/873 (0.3), *P* = 0.019). With regard to the associated risk factors for hypertension, there was no significant association with socioeconomic class (*P* = 0.358), family history of hypertension (*P* = 0.793), and birth order (first born) *P* = 0.853. Furthermore, no significant association was found between hypertension and a history of snoring (*P* = 0.643), as shown in Table 2. The weight for age, height for age, waist circumference, hip circumference, waist-to-height ratio, and WHR were not associated with hypertension, as shown in Tables 3 and 4. BMI of 85th to 94th (over-weight) was also not associated with hypertension. However, BMI ≥95th (obesity) was significantly associated with hypertension, (*P* = 0.002, Odds ratio of 8.3, [95% confidence interval 1.7,40.3]) as shown in Table 3.

Discussion

The prevalence of hypertension (3%) at the third visit of the primary school pupils from this study was within the range documented by other researchers in and outside Nigeria.[7,9,25-29] In contrast, the prevalence in the current study is lower than the 9.5% reported in an earlier study in Ilorin,[9] and the 9.8% in private primary school entrants in Jos, Northcentral Nigeria.[7] A possible reason for the high prevalence reported in the earlier work from Ilorin could be the timing of BP measurement, which was done in the evening with the possible effects of the stresses of the day of activities.

The systolic and diastolic hypertension was significantly higher in females than males, and this is similar to other findings from Nigeria[25,26,28] and Turkey.[30] In contrast, Bugaje *et al*.[31] in Northwestern Nigeria found no difference in the prevalence of systolic hypertension in both genders, but reported a higher diastolic hypertension in females. The possible reasons for this higher prevalence in females include early puberty and weight gain in females.[32] Furthermore, studies of Nigerian school children have documented a higher level of physical activity by males compared to their female

Table 1: Prevalence of hypertension among school children in the city of Kwara, Nigeria

BP	Total (*n*=1745) *N* (%)	Boys (*n*=873) *N* (%)	Girls (*n*=872) *N* (%)	OR	95% CI	*P*-Value
Systolic						
Hypertension (1st visit)	109 (6.2)	39 (4.5)	70 (8.0)	1.9	1.2-2.8	0.002
Hypertension (2nd visit)	60 (3.4)	22 (2.5)	38 (4.4)	1.8	1.1-3.0	0.034
Hypertension (3rd visit)	40 (2.3)	11 (1.3)	29 (3.3)	2.7	1.4-5.5	0.004
Diastolic						
Hypertension (1st visit)	48 (2.8)	20 (2.3)	28 (3.2)	1.4	0.8-2.5	0.246
Hypertension (2nd visit)	20 (1.2)	7 (0.8)	13 (1.5)	1.9	0.7-4.7	0.176
Hypertension (3rd visit)	15 (0.9)	3 (0.3)	12 (1.4)	4.0	1.1-14.3	0.019

OR=Odd ratio, CI=Confidence interval, BP=Blood pressure

Table 2: Relationship between some risk factors of hypertension (family history of hypertension, birth order, sleep disorder) and hypertension among primary school children in the city of Kwara, Nigeria

Variables (*n*)	Hypertension		χ^2	*P*-Value
	Present *N* (%)	Absent *N* (%)		
Upper SEC (624)	18 (2.9)	606 (97.1)	1.995	0.383
Middle SEC (579)	18 (3.1)	561 (96.9)		
Lower SEC (499)	9 (1.8)	490 (98.2)		
Total (1702)≠	45 (2.6)	1657 (97.4))		
Family history of hypertension (139)	4 (2.9)	135 (97.1)	0.013*	0.909
No family history of hypertension (1606)	49 (3.1)	1557 (96.9)		
Total (1745)	53 (3.0)	1692 (97.0)		
Birth order-first born (420)	9 (2.1)	411 (97.9)	0.119	0.853
Second born and above (1240)	38 (3.1)	1202 (96.9)		
Total (1664)≠	51 (3.1)	1613 (96.9)		
History of snoring (336)	12 (3.6)	324 (96.4)	0.448	0.590
No history of snoring (1255)	36 (2.9)	1219 (97.1)		
Total (1591)≠	48 (3.0)	1543 (97.0)		

*Fisher's exact test, ≠Pupils who had completed data from the study pro forma. SEC=Socioeconomic class

Table 3: Relationship between hypertension among primary school children and anthropometric indices

Anthropometric measurements	Classifications	Hypertension					
		Present *N* (%)	Absent *N* (%)	*Z* test	OR	95% CI	*P*-Value
BMI	5th-84th (1682)[1]	49 (2.9)	1633 (97.1)				
	>85th-94th (40)	3 (7.5)	37 (92.5)	1.675	2.7	0.805-9.065	0.093
	≥95th (10)	2 (20.0)	8 (80.0)	3.151	8.3	1.724-40.262	0.002
Weight for age	−1-+1 *Z* score (1331)[1]	41 (3.1)	1290 (96.9)				
	>+1-<+2 *Z* score (45)	0 (0.0)	45 (100)	−1.195	0.3	0.021-5.643	0.230
	>+2 *Z* score (17)	1 (5.9)	16 (94.1)	0.661	1.9	0.255-15.186	0.509
Height for age	−1-+1 *Z* score (1623)[1]	48 (3.0)	1575 (97.0)				
	>+1-<+2 *Z* score (122)	1 (0.8)	121 (99.2)	−1.379	0.3	0.037-1.982	0.168
	>+2 *Z* score (55)	0 (0.0)	55 (55.1)	−1.294	0.3	0.1018-4.808	0.197
Waist circumference	−1-+1 *Z* score (1675)[1]	49 (2.9)	1626 (97.1)				
	>+1-<+2 *Z* score (144)	4 (2.8)	140 (97.2)	−0.101	0.9	0.337-2.667	0.920
	>+2 *Z* score (69)	4 (5.8)	65 (94.2)	1.486	2.0	0.715-5.830	0.136

OR=Odd ratio, CI=Confidence interval, BMI=Body mass index

counterparts.[33,34] Physical activities cause vasodilatation of the arteries of the skeletal muscles, a decrease in the sympathetic tone with a consequent reduction in the peripheral resistance and BP.[35,36]

The current study also showed no association with the socioeconomic status of the parents and a history of hypertension in the family with hypertension in children, which is consistent with some of the observations of previous studies.[6,13] However, in the Democratic Republic of Congo, a local study[37] documented that lower socioeconomic status was associated with elevated BP while Okoh and Alikor[11] in Port Harcourt, South-South Nigeria reported a high level of

Table 4: Relationship between hypertension among primary school children and their anthropometric indices

Anthropometric measurements	Classifications	Hypertension					
		Present *N* (%)	Absent *N* (%)	*Z* test	OR	95% CI	*P*-Value
Hip circumference	−1-+1 *Z* score (1675)[1]	50 (3.0)	1625 (97.0)				
	>+1-<+2 *Z* score (144)	3 (2.1)	141 (97.9)	−0.617	0.7	0.214-2.245	0.535
	>2+*Z* score (66)	3 (4.5)	63 (95.5)	0.724	1.6	0.470-5.097	0.472
WHR	−1-+1 *Z* score (1682)[1]	48 (2.9)	1634 (97.1)				
	>+1-<+2 *Z* score (219)	5 (2.3)	214 (97.7)	−0.483	0.8	0.313-2.020	0.631
	>+2 *Z* score (20)	0 (0.0)	20 (100)	−0.766	0.8	0.049-13.790	0.441
WHtR	−1-+1 *Z* score (1376)[1]	44 (3.2)	1332 (96.8)				
	>+1-<+2 *Z* score (173)	4 (2.3)	169 (97.7)	−0.634	0.8	0.254-2.019	0.529
	>+2 *Z* score (87)	4 (4.6)	83 (95.4)	0.711	1.5	0.5112-4.158	0.478

OR=Odd ratio, CI=Confidence interval, WHR=Waist-to-hip ratio, WHtR=Waist circumference to height ratio

hypertension in school children with a family history of hypertension. A possible explanation for the lack of association between hypertension and family history of hypertension in this study may be the lack of awareness of most parents of their hypertensive status as observed in the recent systematic review.[38] This lack of awareness of parents could have led to underreporting of the true prevalence of hypertension since they, the parents, completed the pro forma. In addition, this study did not find any relationship between a history of snoring and hypertension in primary school children, which is similar to the findings in the USA[39] and Greece.[40] In contrast, studies from Singapore[41] and Hong Kong[42] reported that snoring in children was associated with elevated BP. The reasons for lack of association between snoring and hypertension in this study may be recall bias by the parents/guardians who filled the study pro forma, and the fact that the school children recruited for this study appeared healthy.

The current study also suggests that being the firstborn is not an associated risk factor for hypertension, which is supported by the study from the United Kingdom.[43] In contrast, Siervo *et al*.[44] in southern Brazil reported that being first born is associated with increased adiposity and metabolic risk. The possible reason for the firstborn's risk for hypertension could be that the birth weight is generally lower, but weight gain is rapid later in life with subsequent cardiovascular changes. However, this is not supported by findings from this present work.

Of the anthropometrics, only obesity ((BMI $\geq$ 95th) was associated with hypertension. This is similar to the findings from Nigeria,[28] USA,[30] and Turkey.[45] This finding further underpins the earlier observation of a possible relationship between childhood hypertension and obesity. The possible mechanisms of obesity-related hypertension include insulin resistance, which leads to hyperinsulinemia with an indirect antinatriuretic effect of insulin, augmented response to vasoconstrictors, and altered smooth muscle vascular response.[46]

Conclusions

The prevalence of childhood hypertension was low (3.0%) in primary school children with obesity (BMI $\geq$95th) being the only associated factor of the anthropometrics. The parents' socioeconomic status, family history of hypertension, history of snoring, and being firstborn were not associated with hypertension.

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Conflicts of interest

There are no conflicts of interest.

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