Nigerian Journal of Paediatrics 1991: 18 (1) : 3 – 11

ARTERIAL BLOOD PRESSURE OF NIGERIAN URBAN RURAL SCHOOL CHILDREN

OE* ANTIA-OBONG AND LE+ ANTIA–OBONG

SUMMARY

Antia-Obong OE* and Antia-Obong LE+ Arterial Blood Pressure of Nigerian Urban Rural School Chiildren. *Nigerian Journal of Paediatrics* **1991:18 (1): 3- 11.** A survey of arterial blood pressures of 1238 (683 urban and 555 rural) school children was carried out using standard mercury sphymomanometers and ppropriate size cuffs. The mean arterial blood presures increased with age in both sexes, although the rise was more rapid in the urban children. At most ages, the mean systolic and diastolic blood pressures, the mean heights and weights of urban subjects were significantly greater than those of rural subjects Height and weight were significant correlates of both systolic and diastolic blood presure. The correlation of Quetelet index with blood pressure was poor compared to height and weight. The higher blood pressure levels of the urban children were attributed to the fact that they were heavier and taller. The prevalence of elevated blood pressure were 4.8% and 4.5% in the urban and rural subjects respectively. Furtherhmore, the prevalence of significant proteinuria was generally low in both groups of children. It is suggested that in order to evaluate the influence of environmental factors on blood pressure in children, the subjects should be matched for height and weight.

INTRODUCTION

The reports of longitudinal studies of blood pressure in childhood, [1-5] suggest an important role for early detection in enhancing a better understanding of the natural history of essential hypertension. This is especially important in Africa where reports of childhood blood pressure studies are scarce[6 7] although essential hypertension is well documented among the adults.[8 9] It has been observed that blood pressure in children show tracking[1-5] i.e. a tendency to remain in the same position in the blood pressure distribution curve. In other reports, strong correlates of blood pressure in childhood are large body mass and weight,[10 11] consequently hypertension is associated with obesity.[12] Furthermore familial aggregation of blood pressure has been reported in childhood[11 13] with its pattern similar to those in adults; indicating that facts influencing

University of Calabar, Calabar

*Lecturer Department of Paediatrics

+Senior Nursing Sister

University of Calabar Teaching Hospital

Antia-Obong OE and Antia–Obong LE

familial clustering of blood pressure are operative in childhood.

In adult Africans, environmental factors are known to influence blood pressure, with the levels of urban dwellers being higher than those of their rural counterparts.[14-16] In rural Ghana, Pobee *et al*[15] have reported that hypertension is not a significant problem. In the only study which has so far compared the blood pressures of urban and rural Nigerian children,[17] urban children had higher mean levels. The difference could not be explained on the basis of body build as the Quetelet index[18] (index of body build) calculated as weight (kg)/ Height $(cm)^2 \times 100$ the two groups were not significantly different. It was suggested that the difference was due to the influence of environment on blood pressure.

This study was designed to determine the pattern of blood pressure of urban and rural school children; to compare the blood pressure levels and anthropometric indices in the two groups of children; and to determine the prevalence of significant proteinuria.

MATERIALS AND METHODS

Primary school children aged 6-14 years in an urban and rural area of Oyo State of Nigeria were the subjects for the study.

The urban study was carried out at the Ibadan Municipal Government School I, Adeoyo with enrolment mainly from the low and middle class of the society. The rural study was in Saint Peter School Osegere, Saint John School Erinmi, Saint Matthew School Apolu, Faz Omar Mission School Idogu and Naiwa-Ur Deen School Baale Egbeda, located in Villages which were 22-26 kilometers East of Ibadan.

Each child had a general physical examination and children who were unwell were excluded. The information obtained from each child included name, age, sex, height in centimeters, weight in kilogramme, systolic and diastolic blood pressures. Heights were measured without shoes and weights without shirt, gown or shoes using the techniques described by Jelliffe.[19] Following physical examination, freshly voided urine was obtained and tested for proteinuria using "Albustix" (Ames). Proteinuria of 100mg/dl of urine (++) or more was regarded as significant.

In order to allay anxiety, the procedures of blood pressure measurements were demonstrated on the class teacher. Each child was seated for 10 minutes before the blood pressure was measured.

All measurements were done in the classroom with the whole class seated between 0900 and 1300 hours, using standard mercury manometers with appropriate size cuffs covering two thirds of the length of the right upper arm. The two investigators had previously compared and standardized their techniques of blood pressure recordings. Three measurements were made for each child and the average taken. Phase I Korotkoff's sound was taken as representing the sytolic blood pressure and phase IV was taken as representing diastolic blood pressure.

The Quetelet index was calculated for each subject as Weight (kg)/Height $(cm)^2 \times 100$. The data was then computerized and subjected to statistical analysis. Blood pressure level that was equal to or more than the sum of the mean plus 2 standard deviations for age and sex was defined as elevated.

RESULTS

The children studied totalled 1238 (651 boys and 587 girls); made up of 683 urban (357 boys and 326 girls); and 555 rural (294 boys and 261 girls) children.

The mean blood pressure of urban and rural subjects are shown in Table 1. The mean heights and weights of urban and rural children are shown in Table II. Throughout the age range studied, the mean systolic and diastolic blood pressures of boys and girls were not significantly different in either the urban and rural groups.

TABLE 1

MEAN SYSTOLIC AND DIASTOLIC BLOOD PRESSURES (mm Hg) OF URBAN AND RURAL SUBJECTS ACCORDING TO AGE

Age (Yrs)	Urban				Rural			
	Boys		Girls		Boys		Girls	
	SBP	DBP	SDP	DBP	SBP	DBP	SBP	DBP
6	81+10.4 (66)	45.2+9.2	17.8+11 (51)	44.4+9.6	74.2+11 (23)	40.3+6.1	74.1+8.8 (25)	39.7+6.4
7	81.2+10.2 (60)	46.7'8.1	82.9+11.3 (64)	47.5+8.9	79.4+10.6 (30)	42.9+8.9	79.7+9.9 (33)	44.1+6.8
8	89.9+7.0 (59)	54.9+8.9	87.5+11.4 (41)	54.4+10.3	85.5+8.0 (55)	47.4+6.4	86.5+8.0 (38)	37.9+6.8
9	93.9+10.6 (24)	61.5+10.9	9.3+9.8 (40)	58.2+ 8.0	88.3+11.0 (36)	49.8+8.8	87.6+7.4 (30)	48.9+7.9
10	95.5+7.4 (58)	60.3+7.0	98+11.6 (38)	61.7+9.6	90.6+94 (29)	51.3+8.2	90.6+6.1 (29)	52.2+4.0
11	97.2+8.9 (34)	64.8+8.0	100.2+10.4 (47)	64.5+8.1	92.1+73 (26)	54.4+7.2	90.5+7.8 (21)	52.9+3.7
12	98.4+12.0 (28)	65.2+9.5	100.8+14 (23)	69.1+10.4	91.5+11.6 (45)	53.8'11.0	95.2+9.7 (42)	53.0+9.2
13	102+10.0 (19)	67.1†8.7	106.8+14 (13)	71.2+9.8	97.7+6.6 (36)	53.4+9.5	93.4+10.8 (29)	54.9+10
14.	102.4+11.7 (9)	71.6+8.0	106+11 (9)	63.7+6.5	97.4+10 (14)	55.4+8.2	97.3+6.4 (14)	56.4+5.0

Number of subjects in parenthesis
SDP = Systolic blood pressure
DBP = Diastolic blood pressure

TABLE II

MEAN HEIGHTS (cm) AND WEIGHTS(kg) OF URBAN AND RURAL SUBJECTS ACCORDING TO AGE

Age (Yrs)	Urban				Rural			
	Boys		Girls		Boys		Girls	
	Height	Weight	Height	Weight	Height	Weight	Height	Weight
6	113.5±5.7 (66)	18.8±2.3	113.3±6.0 (51)	18.3±2.6	105.7±4.7 (23)	16.4±1.5	105.7±3.8 (25)	15.6±1.8
7	117.8±5.2 (60)	20.1±2.1	117.8±6.7 (64)	19.9±2.6	112.3±5.7 (30)	18.2±2.3	114.2±4.9 (33)	17.9±2.1
8	124.4±6.1 (59)	22.9±3.2	122.1±5.7 (41)	22.4±3.1	119.3±5.8 (55)	20.0±2.6	120.3±5.7 (38)	21.4±2.9
9	123.5±5.9 (24)	22.8±2.5	127 ±6.0 (40)	24.7±3.4	124.7±5.4 (36)	21.9±2.4	125.3±5.0 (30)	22.0±2.9
10	131.3±5.8 (58)	25.9±2.8	131.8±6.6 (3i)	26.3±3.8	126.9±5.8 (29)	22.5±2.4	130.2±7.2 (29)	24.6±3.3
11	136.3±5.8 (58)	29.7±5.2	139±6.6 (47)	29.9±5.0	131.4±6.9 (26)	25.7±2.6	134.1±5.3 (21)	26.6±3.0
12	137.4±5.0 (28)	29.9±3.5	140.6±7.9 (23(	32.5±5.6	135.7±6.7 (45)	26.9±4.2	136.9±8.9 (42)	28.6±5.7
13	142.3±6.3 (19)	33.3±5.7	151.3±2.3 (13)	43.3±6.8	136.9±9 (26)	29.6±4.1	142.4±7..5 (29)	31.0±5.0
14	147.3±5.7 (9)	36.8±6.7	152.6±4.0 (9)	45.2±4.3	147.8±8.5 (14)	30.3±4.9	153.3±8.0 (14)	38.9±7.0

Number of subjects in parenthesis

Fig. 1 shows the mean blood pressures of urban and rural children according to age.

Blood pressure increased with age in the urban and rural children of both sexes. At all ages the mean systolic and diastolic pressures of urban children were higher than those of their rural counterparts (Table 1 and Fig. 1). The mean systolic pressures in urban boys were significantly higher than those in the rural boys at ages 6, 8 and 10–13 years while the mean diastolic pressures of urban boys were significantly higher at all ages (Table 1). Among the girls mean systolic pressures were significantly higher than those of their rural counterparts at the ages of 6 and 8–14 years.

The mean heights of urban children were generally greater than those of the rural children and this reached the level of significance in boys aged 6–8 and 10–13 years as well as in girls aged 6, 7, 11 and 13 years (Table II). Similarly, the mean weights of urban children were higher than that of the rural children. This difference reached the level of significance in urban boys aged 6–8 and 10–14 years, as well as in urban girls aged 6–9 and 11–14 years (Table II).

The correlation between arterial blood pressure and Quetelet index was generally poor. Systolic and diastolic blood pressures showed significant positive correlation with height and weight ($p < 0.05$) in both urban and rural boys and girls (Table III).

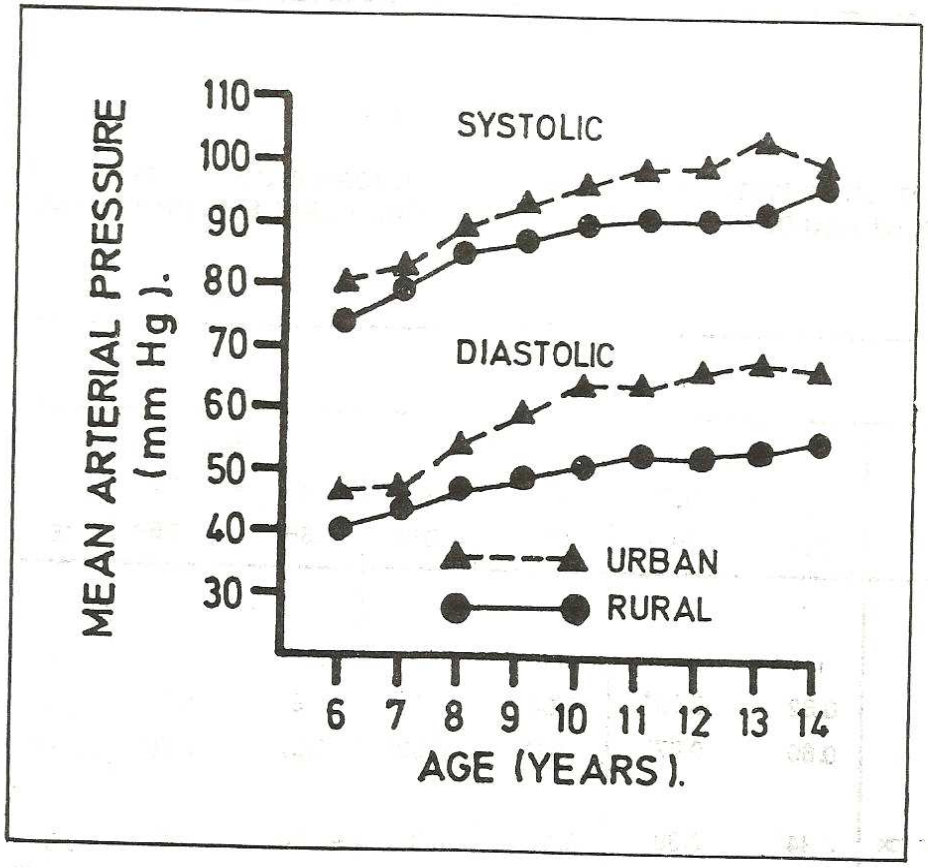

Fig 1 Mean systolic and diastolic blood pressure of urban and rural children.

The Quetelet index showed significant positive correlation with systolic and diastolic blood pressures of urban boys only, but not of urban girls, and also not of rural boys and girls.

Table IV shows the number and percentage of urban and rural children with elevated blood pressure. Thirty-three (4.8%) of 683 urban children and 25 (4.5%) of 555 rural children had elevated blood pressures Out of the 1238 subjects studied, 58 (4.7%) had elevated blood pressure.

Six of 683 (0.88%) urban children who were all boys had significant proteinuria, but none had associated elevated blood pressure. Only 1 of 555 (0.18%) rural children had proteinuria with associated elevated blood pressure. However, the aetiology of significant proteinuria in these apparently healthy children was not known as no further investigations were carried out.

TABLE III

CORRELATION OF SYSTOLIC (SBP) AND DIASTOLIC (DBP) BLOOD PRESSURE WITH HEIGHT, WEIGHT AND QUATELET INDEX IN URBAN AND RURAL SUBJECTS OF ALL AGES.

	Urban				Rural			
	Boys n = 357		Girls n = 326		Boys n = 294		Girls n = 261	
	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP
	r	r	r	r	r	r	r	r
Height	0.62	0.69*	0.64	0.62	0.51	0.43	0.50	0.48
Weight	0.60	0.67*	·54*	0.53*	0.37	0.50	0.44	0.58*
Quetelet Index	0.34*	0.39	0.01	−0.07	−0.08	0.18	0.0	0.0

r = Pearson coeffieient correlation
* = $p < 0.05$
n = number of subjects

TABLE IV

NUMBER AND PERCENTAGE OF URBAN AND RURAL SUBJECTS WITH BLOOD PRESSURE LEVELS 2SD OR MORE ABOVE THE MEAN FOR AGE AND SEX

	URBAN				RURAL				
	No. of Subjects	No. with elevated SBP	% of total	No. with elevated DBP	% of total	No, of Subjects	No. with elevated SBP	% of total	No. with elevated DBP	% of total
Boys	357	7	2.0	9	2.5	294	5	1.7	9	3.1
Girls	326	8	2.5	9	2.8	261	4	1.5	7	2.7
Total	683	15	2.2	18	2.6	555	9	1.6	16	2.9

SD = Standard deviation

DISCUSSION

The observation of increase in mean blood pressure of children with age in this study is in agreement with earlier reports of similar increases in mean blood pressure with age in children.[21 22] Among the girls, the increments in systolic and dastolic blood pressures were greater in the urban subjects. With regard to the boys, the increase in systolic blood pressure was similar in both the urban and rural, whereas the increase in diastolic pressure was greater in the urban than the rural subjects. Thus the rise in mean blood pressure was more rapid in the urban than rural subjects.

In this study, the mean systolic and diastolic blood pressures of urban boys and girls were consistently and significantly higher than those of their rural counterparts at most ages. This is similar to the findings of an earlier study,[17] although the differences in urban and rural blood pressures in that study were not subjected to statistical analysis. This observation of higher mean blood pressures in urban children than their rural counterparts is interesting because similar findings have been reported in adults.[14–16] This similarity in blood pressure pattern of children and adults in urban and rural environments would tend to lend weight to the suggestion that studies of blood pressure in children may elucidate the natural history of essential hypertension, as it had been suggested that factors in the environment that influence blood pressure may begin in early life.[23 24]

Blood pressure has been found to correlate with anthropometric measurement but those relation-

ships have varied in different reports.[11 21 22 24 25] The correlates of systolic and diastolic blood pressure in the present study are weight and height, while the correlation of blood pressure with Quetelet index is generally poor except in urban boys. Our findings thus suggest that blood pressure was less related to body build than height and weight. Since the correlates of blood pressure in this study are height and weight, and the urban children were significantly taller and heavier than their rural counterpart, it is therefore not surprising that the mean blood pressure in the urban children is higher. Our findings contrast with those of an earlier study,[17] where there was no significant difference in mean heights and weights of urban and rural children and in which the higher blood pressure of the urban subjects was attributed to environmental factors. These factors operating in the environment were however not specified.

Although the level of blood pressure of the urban and rural subjects were different, the prevalence of elevated blood pressure in the two groups of 4.8% and 4.5% respectively were similar and also agreed with those in other reports.[17, 21, 22] Furthermore the prevalence of proteinuria in the two groups of subjects was low and not associated with elevated blood pressure. This observation however does not make a renal disease an unlikely cause of elevated blood pressure.

In conclusion, the estimation of blood pressure according to age may have inherent errors which are based on the wide range of heights and weights at specific ages.

It is in this regard that Voor et al[11] have suggested that normal blood pressure should be derived from weight and body dimensions rather than age, because tall and heavy children usually have higher blood pressure levels than shorter and lighter children. Our findings support this view. In order tc evaluate the influence of environmental factors on blood pressure in children, we suggest that urban and rural subjects should be matched for weight and height.

ACKNOWLEDGEMENT

The authors are grateful to the teachers and school children for their co-operation; to Prof. J. J. Andy for guidance in the preparation of this manuscript and Mrs. Patience K. Akpabio for Secretarial assistance.

REFERENCES

1. Buck CW. The persistence of elevated blood pressure first observed at age of five. J. Chronic Dis 1973; 26; 101-4.
2. Zinner SH, Martin LF, Sacks M, Rosner B and Kass E. A longitudinal study of blood pressure in childhood. Am. J. Epidemiol, 1975; 100: 437-42.
3. Rosner B, Hennekins CH, Kass EH and Mial WE. Age specific correlation analysis of longitudinal blood pressure data. Am. J. Epidemiol 1977; 106: 306-13.
4. Clark WR, Schrott HG, Leaverton PE, Connor WE and Laner RM. Tracking of blood lipids and blood pressure in school age children. The Muscatine Study. Circulation 1978; 58:626-34.
5. De Swiet M. Fayers P and Shinebourne EA. Value of repeated blood pressure measurements in children. The Brompton Study. Br. Med. J. 1980; 280: 1567-9.
6. Akinkugbe OO. School survey of arterial pressures and proteinuria in Ibadan – Nigeria. East Afr. Med. J. 1969; 46: 257-61.
7. Einterz FM, Hutchinson T, Flegel K. Survey of blood pressure in Nigerian children. Trop. Doct. 1982; 12: 172-5.
8. Akinkugbe OO. Blood pressure in the African context. Trop. Doct. 1980; 10:56-8.
9. Abengowe CU, Jains JS and Siddique AKM. Pattern of hypertension in Northern Savanah of Nigeria. Trop. Doct. 1980; 10:3-8.
10. Lauer RM, Connor WE, Leaverton PE, Reiter MA and Clarke WR. Coronary heart disease. Risk factors in school children. The Muscatine Study. J. Pediatr. 1975; 86: 697-706.
11. Voor AW, Webber LS, Frerichs RR and Berenson GS. Body height, body mass as determinants of basal blood pressure in children. The Bogalusa Heart Study. Am. J. Epidemiol 1977; 106: 101-8.
12. Rames LK, Clarke WR, Connor WE, Reiter MA and Lauer RM. Normal blood pressures and the evaluation to sustained blood pressure elevation in childhood. The Muscatine Study. Pediatrics 1978; 61: 245-51.
13. Hennekens GH, Jesse MJ and Kiein BE. Familial aggregation of blood pressures in infants and siblings. Am. J. Epidemiol 1976; 103:457-63.
14. Akinkugbe OO and Ojo AO. Arterial pressure in rural and urban populations in Nigeria. Br. Med. J. 1969; 2: 22-4.
15. Pobee JOM, Larbi EB, Belcher DW, Wurapa K and Dodu SA. Blood pressure distribution in a rural Ghanaian population. Trans. Roy. Soc. Trop. Med. Hyg. 1977; 71:66-72.

16. Oviasu VO, and Okupa FE, Occupational factors in hypertension in the Black Africans. Trop. Cardiol. 1979; 5:73-8.
17. Oviasu VO, Alakija W and Oyarebu KA. Differences in arterial pressure and body build in the first and second decades of life in urban and rural Nigerians. Trop. Cardiol. 1981; 7: 161-5.
18. Khosla T and Lowe CR. Indices of obesity derived from body weight and height. Br. J. Prev. Soc. Med. 1976; 21: 122-8.
19. Jelliffe DB. The assessment of nutritional status of the community. WHO Monogram Series. 1966; 53.
20. Akinkugbe OO, Akinkugbe FM, Ayeni O, French K and Minear R. Biracial study of arterial pressures in first and second decades of life. Br. Med. J. 1977; 1: 1132-4.
21. Antia AU, Maxwell R, Gough A and Ayeni O. Arterial Blood pressure of Jamaican children of Negro descent. West Indian Med. J. 1980; 29: 110-15.
22. Blankson JM, Larbi EB, Pobee JOM, Pole DJ and Ikeme AC. Blood pressures levels of African children. J Chronic Dis 1977; 30: 735-43.
23. Londe S, Bourgoignic JJ, Robson AH and Goldring D. Hypertension in apparently normal children J. Pediatr. 1971; 71: 569-77.
24. Voor AW, Webber LS and Berenson GS, Time course studies of blood pressure in children. The Bogalusa Heart Study. Am. J. Epidemiol 1979; 109: 320-34.
25. Dube SK, Kapoor S, Ratner H and Tunick FI. Blood pressure studies in Black children. Am. J. Dis. Child 1975; 129: 1177-80.

Accepted Nov. 1990