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Original article

Study of blood pressure profile of school children 6–15 years in a rural setting of Maharashtra

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ABSTRACT

Background: High blood pressure in childhood is a major risk factor for heart disease and stroke in adulthood. There is enough evidence to suggest that the roots of essential hypertension in adults extend into childhood. There is a paucity of literature on the blood pressure measurements amongst children. This study was done to study blood pressure profile of school children in rural area of Maharashtra.

Aim & objectives: This cross sectional study was carried out to determine the prevalence of hypertension in children 6–15 years and to study the association between selected variables and blood pressure.

Material & methods: This study was done using a predesigned questionnaire and making measurements of height, BMI and Blood pressure using standardized physical instruments following standard guidelines. The data was collected and analyzed using appropriate statistical tests.

Results: The prevalence of hypertension in the study was found to be 4.4% with 3.5% in females and 5.1% in males.

Conclusion: In the study, hypertension in students was found to be significantly associated with higher BMI and with family history of hypertension. Age, height and BMI were found to correlate positively with Blood pressure levels in this study.

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Introduction

By 2015, it is estimated that almost 20 million people will die from CVDs, mainly from heart disease and stroke. These are projected to remain the single leading cause of death.¹ India is undergoing an epidemiological transition and is on the

threshold of an epidemic of cardiovascular diseases. Demographic projections suggest a major increase in cardiovascular mortality as life expectancy increases and the age structure of growing population changes.²

High blood pressure in childhood is a major risk factor for heart disease and stroke in adulthood.³ There is enough

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Table 1 – Distribution of mean SBP & DBP (SD) according to age and sex.

Age cat		Total number	Mean DBP (SD)	p value ^a	Mean SBP (SD)	p value ^a (Z Test)
6–8	F	32	48.75 (5.48)	0.12	83.38 (5.73)	0.79
	M	31	51.74 (9.19)		82.87 (9.32)	
9–11	F	66	56.73 (7.9)	0.69	91.79 (11.48)	0.69
	M	81	55.85 (7.51)		91.09 (9.18)	
12–14	F	115	63.88 (7.32)	0.92	106.16 (11.48)	0.03 ^a
	M	135	62.95 (8.64)		103.02 (11.05)	
>14	F	17	66.59 (9.71)	0.83	108.00 (10.79)	0.93
	M	45	67.20 (10.30)		108.27 (10.79)	
Total	F	230	59.92 (9.32)	0.53	99.00 (13.73)	0.52
	M	292	60.45 (9.93)		98.38 (13.10)	

a Significant at value <0.05.

evidence to suggest that the roots of essential hypertension in adults extend into childhood.⁴ The American Heart Association recommends that all children aged 3 years and older should have yearly blood pressure measurements. The long-term health risks for hypertensive children and adolescents can be substantial; therefore, it is important that measures be taken to reduce these risks and optimize health outcomes. Early detection of high blood pressure will improve health care of children.

Material & methods

This cross sectional study was carried out to determine the prevalence of hypertension in children 6–15 years and to study the association between selected variables and blood pressure. For the study 522 children of Government Primary School and Private Secondary School in the age group 6–15 years were selected. Sample size of 347 was calculated using the formula for sample size calculation for single population proportion from a Study,⁵ where the prevalence of hypertension was 5.75% rounded to 6%. Any child with a known medical condition having direct influence on blood pressure was excluded. One student was excluded being a case of Marfan's Syndrome with mitral regurgitation.

The physical instruments used in the study were a weighing machine, portable anthropometric rod and mercury sphygmomanometer with different cuff sizes. Calibration of

the instruments was carried out. Different cuff sizes as recommended by the 2004 update of American Academy of pediatrics on hypertension⁶ were used. Hypertension is defined as average SBP and/or diastolic BP [DBP] that is >95th percentile for gender, age, and height on three or more occasions. Pre-hypertension in children is defined as average SBP or DBP levels that are >90th percentile but <95th percentile.⁵

A preformed questionnaire was designed and pre-tested on 35 students (excluded from study) on a school in the nearby village and validated during pilot study. The English questionnaire was translated to Marathi. If the blood pressure was found to be greater than 90th percentile, it was repeated twice at the same visit at an interval of 5 min to test the validity of the reading. For those whose SBP or DBP was found >95th percentile for that gender, age and height, they were re-examined on at least three occasions on repeated visits.

Results

The age ranged from 6 to 15 years with mean age of students 11.81 years (S.D. 2.44). The children were studied according to their BMI, birth weight, salt intake, dietary habits and history of hypertension amongst their parents. It was seen that majority of children (90.4%) had BMI < 85th percentile and 84.5% had birth weight >2500 g. More than 2/3rd subjects were non-vegetarians and children from households with salt consumption >150 g/capita/month. The overall mean SBP in girls was 99.00 mm of Hg and 98.38 mm of Hg in boys. The difference was not significant in the two sexes (Table 1).

The subjects were studied for mean SBP and DBP according to defined variables (Table 2). The mean SBP was significantly higher in subjects who had BMI >85th percentile, birth weight >2500 g, non-vegetarians and those with history of hypertension amongst their parents. The SBP and DBP were studied in terms of percentiles in 3 categories (>95 percentile, 90–95 percentile and <90 percentile). Majority of students had SBP & DBP <90th percentile while 17 (3.3%) and 8 (1.5%) had SBP & DBP respectively higher than 95th percentile falling into category of hypertension (Table 3).

Overall prevalence of hypertension in the population (Table 4) studied was found to be 4.4%. A total of 15 boys out of 292 (5.1%) had hypertension as compared to 8 girls out of 230 (3.5%) girls. However, the difference in prevalence of high blood pressure between boys and girls is not significant (p

Table 2 – Mean SBP and mean DBP according to different classes of variables (BMI, Birth weight, Diet and history of hypertension in parents).

Variable	Classification	Number	Mean SBP (SD)	Mean DBP (SD)	p value ^a (Z Test)
BMI percentile	≥85	50	104.00 (20.21)	64.32 (13.64)	SBP – 0.04 ^a
	<85	472	98.09 (12.32)	59.78 (9.05)	DBP – 0.02 ^a
Birth weight (Gms)	≥2500	441	99.28 (13.39)	60.63 (9.66)	SBP – 0.01 ^a
	<2500	81	95.23 (12.80)	57.93 (9.38)	DBP – 0.02 ^a
Diet	Non-veg	365	99.59 (13.27)	60.99 (9.76)	SBP – 0.01 ^a
	Veg	157	96.47 (13.39)	58.41 (9.20)	DBP – <0.01 ^a
History of hypertension in parents	Present	7	113.14 (13.99)	72.00 (6.92)	SBP – 0.01 ^a
	Not present	515	98.46 (13.27)	60.05 (9.59)	DBP – <0.01 ^a

a Significant at value <0.05.

Table 3 – Distribution of students as per SBP & DBP percentiles.

Percentile	SBP	DBP
	Total number (%)	Total number (%)
≥95 (Hypertension)	17 (3.3)	8 (1.5)
≥90 to <95 (Pre-hypertension)	26 (5.0)	26 (5.0)
<90 (Normal)	479 (91.8)	488 (93.5)
Total	522 (100.0)	522 (100.0)

Table 4 – Prevalence of high blood pressure in study population.

Sex	Hypertension		Total
	Present	Absent	
M	15 (5.1%)	277	292
F	8 (3.5%)	222	230
Total	23 (4.4%)	499	522

Chi square 0.84; df = 1; p value 0.35 NS.

value 0.35). The study showed that greater the height more was the prevalence of hypertension and this showed a significant linear trend on statistical analysis by chi square test for linear trend (Table 5). BMI was found to be an important factor for hypertension. It was seen that prevalence of hypertension amongst those with BMI >85th percentile was significantly higher (Table 5). The prevalence of hypertension amongst those with Birth weight >2500 g was higher but not significantly different compared to those with birth weight <2500 g (Table 5). It was observed that the children with history of hypertension amongst one or both parents had significantly higher prevalence of hypertension (Table 5).

In the study of 522 children it was found that age and height had a moderate to good linear relationship with both SBP and DBP. BMI however had a fair degree of linear relationship with SBP and DBP (Table 6). On doing multiple regression analysis it was seen that height (β coefficient

Table 6 – Correlation of different variables with SBP and DBP.

Variables	SBP	p value	DBP	p value
	'r' value		'r' value	
Age	0.64	<0.01	0.56	<0.01
Height	0.64	<0.01	0.55	<0.01
BMI	0.43	<0.01	0.39	<0.01

values 0.503, 95% CI values 0.341–0.666 and 0.268, 95% CI 0.138–0.399 respectively) and BMI (β coefficient 1.67, 95% CI 1.16–2.18 and 1.12, 95% CI 0.718–1.527 respectively) were significantly related to both SBP and DBP. Age (β coefficient 0.146, 95% CI being –0.88 to 1.117 and 0.342, 95% CI being –0.499 to 1.14) did not show significant relationship on regression to SBP or DBP.

Discussion

The mean SBP and DBP of boys was lower as compared to study of Blood Pressure in school going children in different studies from India.^{6,7} The mean SBP of girls was lower as compared to other studies.^{5,7} The mean DBP of girls is lower when compared to other studies^{5,7–9} in ages from 6 to 9 years. In the study on school children in Amritsar a trend of increase in mean values of SBP & DBP with age was noted similar to our study findings.⁷ In the study¹⁰ which pooled age and sex specific mean values of 129 surveys worldwide showed almost universal overall upward progression of blood pressure levels between ages 6 and 18 years, separately for systolic and diastolic blood pressure. As per WHO technical report series on blood pressure in children, the average annual increase in systolic blood pressure from birth until age of 20 is about 2 mm Hg in boys and about 1 mm Hg in girls. Between ages 10–14 however the average rise is greater for both diastolic and systolic blood pressure, however there is no major difference between boys and girls.⁴ In the present study there was an increase in the SBP with height in different categories with a variation of 12.29–4.13 and similar pattern is seen in DBP with a variation of 6.70–2.53.

Table 5 – Study of association of selected variables with hypertension.

Variable	Classes of variable	Hypertension		Total	Test	Value	p value ^a
		Present	Absent				
BMI percentile	≥85	12	38	50	X ²	50.40	<0.01 ^a
	<85	11	461	472			
Birth weight (Gms)	≥2500	21	420	441	X ²	0.85	0.35
	<2500	2	79	81			
History of hypertension in parents	Present	2	5	7	X ²	9.83	<0.01 ^a
	Not present	21	494	515			
Height (cm)	124–140	2	151	153	X ² for linear trend	9.19	0.002 ^a
	141–157	9	177	186			
	>157	12	120	132			

^a Significant at <0.05.

The present study found that both mean SBP and DBP were found to be higher in students with 2000 CDC BMI percentile ≥ 85 . In a study in Minneapolis school children aged 10–15 years, it was found that overweight children had higher mean SBP and DBP.¹¹

In the present study the mean SBP and DBP was found to be higher in students with birth weight ≥ 2500 g as compared to those with birth weight < 2500 g. This is similar to findings in a study to explore if Birth Weight influences blood pressure values and variability in children and adolescents.¹² A study on Birth Weight and Body Mass Index in Childhood, Adolescence, and Adulthood as predictors of Blood Pressure at age 36 found that low birth weight < 2500 g was associated with higher mean SBP and DBP at different ages.¹³

In the present study both mean SBP and DBP were higher in students consuming non-vegetarian foods. In the present study mean SBP and DBP was higher in students in whose households per capita salt intake was > 150 g per month similar to a study conducted to study Dietary Salt Intake and Hypertension in an Urban South Indian Population.¹⁴ In the present study mean SBP of students with history of hypertension in parents was higher than those with no such history by 14.54 mm of Hg and the mean DBP of students with history of hypertension in parents was higher than those with no such history by 11.95 mm of Hg. Study in an urban slum of Puducherry¹⁵ found mean blood pressure in children with positive family history of hypertension was found to be significantly higher than those with negative history.

The prevalence of overall hypertension in the present study was found to be 4.4%. Higher prevalence of hypertension has been reported in other studies,^{5,7,8} While the prevalence of hypertension was reported lower in two studies.^{16,17}

The correlations have been described in the results section (Table 6) which is similar to other studies by Manu et al⁹ and a study from rural Maharashtra.⁶

Conclusion

The prevalence of hypertension in the study was found to be 4.4% with 3.5% in females and 5.1% in males. In the study, hypertension in students was found to be significantly associated with higher BMI and with family history of hypertension. Multiple factors (age, height and BMI) were found to correlate positively with Blood pressure levels in students.

Recommendations

The phenomenon of tracking makes it easy to screen and identify children who need follow up and intervention. Besides those children who are hypertensive there are a considerable number of children who have a BP between 90th and 95th percentile that may need regular screening and advice on lifestyle modifications. The annual school health medical examination must include BP measurement to achieve this.

Intellectual contribution

Study concept: Lt Col A S Kushwaha, Maj Diva Reddy.

Drafting and manuscript revision: Lt Col A S Kushwaha, Col Atul Kotwal, SM.

Statistical analysis: D R Basannar.

Study supervision: Col Atul Kotwal, SM, Air Cmde Ajoy Mahen.

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