



Blood Pressure Survey in Residential School Children

KEYWORDS

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ABSTRACT This study was conducted among 501 residential school children (266 boys and 235 girls) of age (10-15 years) of Chaitanya Central School and Kesava Reddy High School to evaluate relationship of blood pressure with variables like age, sex, height, weight and body mass index (BMI) and to find out the prevalence of hypertension in children and its correlation with BMI. In the present study, the mean SBP and mean DBP showed a positive correlation with age, height, weight, and BMI from 10 to 15 year of age. The average annual increase of 2.1 mm Hg in both. SBP and DBP in boys and the average annual increase of 3.1 mm Hg in SBP and 2 mm Hg in DBP in girls. The overall prevalence of prehypertension was 11.2% and that for hypertension was 7.4%. In boys, overall prevalence of prehypertension was 11.7% that was 10.6% in girls and the prevalence of Hypertension in boys was 7.9% and that in girls was found to be 6.8%. It was observed that 81 % of obese patients had hypertension, 9.5 % had pre hypertension and remaining 9.5 % were normotensive. In over weight group 40.4 % patients had hypertension, 40.4% had pre hypertension and 9.2% were normal.

INTRODUCTION

In children, measurement of blood pressure is a neglected part of physical examination. Hence it is important to measure the blood pressure in routine physical examination of children in all age groups, as much part of the vital statistics like height and weight and the studies which pertain to the BP of the school going Indian children are limited.⁽¹⁾ Hypertension is a leading cause of the burden of disease worldwide. Most prevention and control strategies target adults.⁽⁴⁾ Hypertension, which occurs in approximately 3-6% of the adult population, places the affected individuals at an increased risk of cerebrovascular accidents, ischaemic heart disease and renal failure.⁽¹⁾ The long, slow and steady course of hypertension in adults also suggests that it perhaps had its origin in childhood, but had probably gone undetected during this period, only to manifest itself during adulthood.⁽¹⁾ Early diagnosis and preventive interventions beginning early in life may reduce these risks of hypertension. Hence blood pressure measurement plays an important role in diagnosis of hypertension.⁽⁵⁾ In the recent years, the prevalence of hypertension in the school-aged children appears to be increasing, perhaps as a result of the increased prevalence of obesity. Hypertension runs in families and a parental history of hypertension increases the risk of developing hypertension, especially if both the parents are hypertensives.^(1,2) Some studies have also shown that hypertension tends to increase with increase in age and with no sexual predilection. Elevated blood pressure at a young age is a predictor of blood pressure elevation later in life.⁽⁶⁾ There is a wide variation in the prevalence of hypertension in Children. The prevalence of Childhood hypertension varies from 1% to 16.2%. The diversity in prevalence of Childhood hypertension may be due to varying cut off blood pressure levels by various authors.⁽³⁾ The prevalence of hypertension in children amongst Indian studies varies between 6.6 % to less than 1 %. The prevalence may be high in South India, because of increased genetic inheritance secondary to more number of consanguineous marriages in south India, and also due to

altered dietary habits and life style.⁽³⁾ Therefore, it is important to identify the children and the adolescents at increased risk of developing essential hypertension as adults.⁽¹⁾ However, the criteria for the diagnosis of hypertension in pediatric population is yet to be evolved and a prerequisite for that would be establishment of normal distribution of blood pressure of different age groups. Unfortunately there are not many studies on normal distribution of blood pressure in Indian children especially from Andhra Pradesh. It was felt that the measurement of blood pressure in a school age population offers the opportunity to delineating normative values for age and sex.

AIM:

To study Prevalence and determinants of Hypertension among the school going children aged 10-15 years.

OBJECTIVES:

1. To study prevalence of hypertension among school going children aged 10-15 years.
2. To evaluate relationship of blood pressure with variables like age, sex, height, weight and body mass index (BMI).

MATERIALS AND METHODS

- Standard methodology, as recommended by the fourth report on diagnosis, evaluation and treatment of high blood pressure in children and adolescents will be used to measure blood pressure.
- Before recording the blood pressure, children in groups of 10 will be taken to a separate room away from noise, and they will be explained in detail, the procedure of blood pressure recording and they will be reassured that the procedure is neither painful, nor harmful.
- All efforts will be made to eliminate factors which might affect the blood pressure such as anxiety, fear, crying,

laughing, recent activities in order to facilitate the blood pressure recording under simulated "basal" or "near basal" conditions. Blood pressure will be recorded only when the child had become accustomed to the observer, instrument and surroundings.

- After giving rest for 5-10 minutes blood pressure will be recorded in sitting position with his back supported, feet on the floor and right arm supported with cubital fossa at heart level. Right arm was used for consistency and for comparison with standard tables and because of the possibility of coarctation of the aorta, which might lead to false (low) readings in the left arm.
- Blood pressure recordings were expressed to the nearest 2 mm Hg. Two blood pressure recordings were taken from each child at 0 and 30 minutes using auscultatory method. Average of two readings will be taken as blood pressure of the individuals.
- All blood pressure recordings will be taken on the same time of the day, i.e. during afternoon hours and recorded by the same person and by same instrument.
- Systemic examination will be done to exclude cardiovascular, renal and other diseases which could affect blood pressure.

Table I: Classification of Hypertension in Children and Adolescents

	SBP or DBP Percentile
Normal	<90th
Pre-Hypertension	90 th to <95 th or if BP exceeds 120/80 mm Hg even if below 90 th percentile upto <95 th percentile
Stage 1 Hypertension	95 th percentile to 99 th percentile plus 5 mm Hg
Stage 2 Hypertension	>99 th percentile plus 5 mm Hg

Table II: BMI Percentile Interpretation

Percentile < 5:	Underweight
Percentile >= 5 and < 85:	Healthy weight
Percentile >= 85 and < 95:	Overweight
Percentile >= 95:	Obesity

RESULTS AND DISCUSSION

Hypertension is a major risk factor for cardiovascular and cerebrovascular diseases. Studies indicate that BP increases with age.⁽⁹⁻¹³⁾ Population-based epidemiological studies show that primary HTN is more common among apparently healthy children.⁽¹⁴⁾ Although the prevalence of HTN is far less in children than in adults,^(15,16) there is enough evidence to suggest that the roots of essential HTN extend into childhood.⁽¹⁶⁻¹⁹⁾

In the present study, the SBP and DBP showed a positive correlation with age, height, weight, and BMI which is consistent with the previously reported studies on BP in children. ⁽¹⁶⁻¹⁹⁾ Sarin et al, ⁽¹⁹⁾ reported a significant correlation between BP and weight.

Table III: Mean SBP and DBP of Boys and Girls in Relation to their Height

Height (cms)	BOYS		GIRLS	
	Mean SBP	Mean DBP	Mean SBP	Mean DBP
120 – 130	82	52	78	55
131 – 140	92.8	61.6	94.23	60.9
141 – 150	99	65	97.29	63.9
151 – 160	101.3	65.9	103.1	66.69
161 - 170	108.9	70.1	110.5	71.27
171 - 180	112.3	75	114	74

Fig 1: Mean and Standard Deviation of SBP and DBP of Boys in Relation to their Height

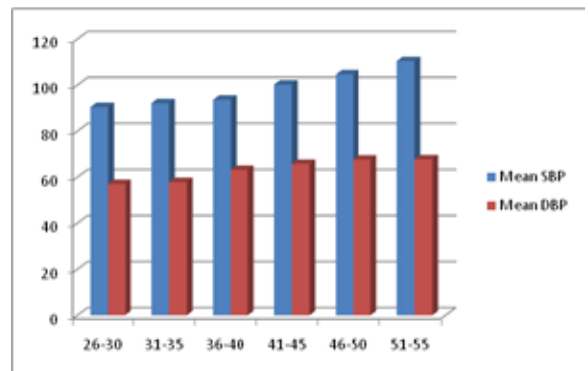
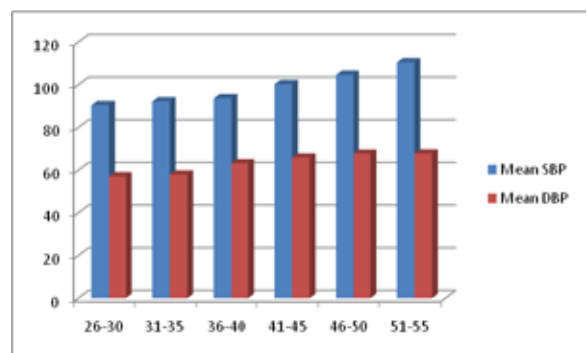


Fig 2: Mean and Standard Deviation of SBP and DBP of Girls in Relation to their Height

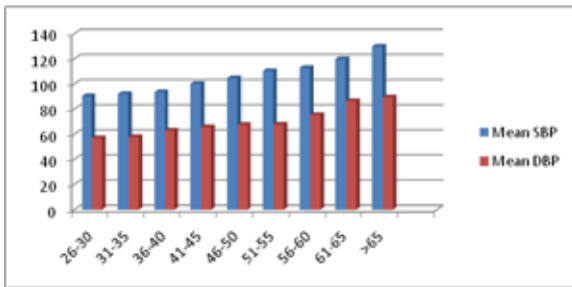


There is significant linear increase in SBP and DBP of girls between 10 – 15 yrs in relation to their height.

Table IV: Mean SBP and DBP of Boys and Girls in Relation to their Weight.

Weight (kg)	BOYS		GIRLS	
	Mean SBP	Mean DBP	Mean SBP	Mean DBP
21 – 25	91	60	-	-
26 – 30	91.4	60.6	90.5	57.16
31 – 35	93.33	61.61	92.24	57.9
36 – 40	99.24	63.39	93.7	63.2
41 – 45	101.11	66	100.38	65.8
46 – 50	104.05	66.4	104.7	67.7
51 – 55	112.4	73.8	110.5	67.8
56 – 60	112.6	75.33	113	75.5
61 – 65	118	81	120	86.6
>66	120.4	85.2	130	89.5

Fig 3: Mean and Standard Deviation of SBP and DBP of Boys in Relation to their Weight



There is significant linear increase in SBP and DBP of boys between 10 – 15 yrs in relation to their weight.

Fig 4: Mean and Standard Deviation of SBP and DBP of Girls In Relation to their Weight

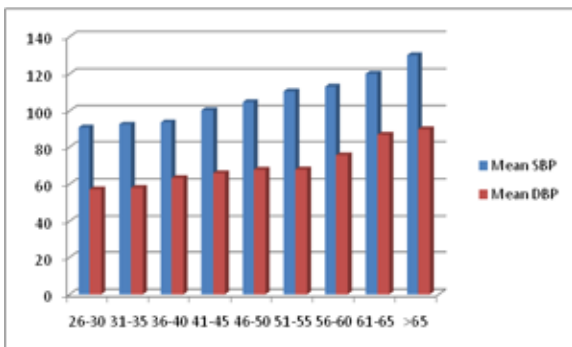
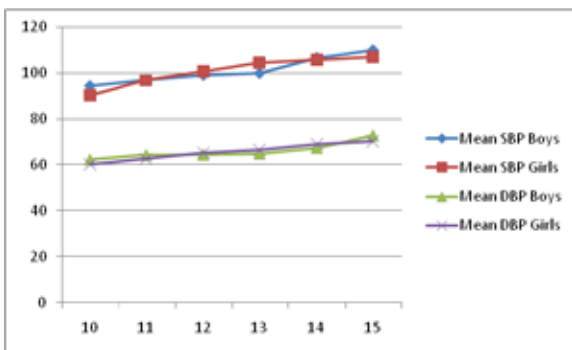


Table V: Mean and Standard Deviation of SBP in Boys and Girls of the Age Group 10 – 15 Yrs

Age in yrs	Mean SBP		Mean DBP	
	Boys	Girls	Boys	Girls
10	94.5	90.34	62.4	60.27
11	97	96.8	64.4	62.65
12	99.2	100.6	64.6	65.22
13	100.05	104.4	65.1	66.45
14	106.7	105.6	67.6	69.15
15	110.08	107	73.04	70.33
F value	11.19	9.27	5.97	5.46

Fig 5: Comparison of SBP and DBP in Boys and Girls between age 10 – 15 Yrs



The average annual increase of 2.1 mm Hg in SBP and DBP in boys and the average annual increase of 3.1 mm Hg in SBP and 2 mm Hg in DBP in girls in this study which was similar to other studies.

Table VI: Comparison of Studies by Average Annual Increase of Mean Blood Pressure

	Average Annual Increase of Mean Blood Pressure (mm Hg /Year)			
	Male SBP	Male DBP	Female SBP	Female DBP
PRESENT STUDY				
10-15 Years	2.1	2.1	3.1	2.0
LAKSHMANUDU et. al.	2.20	1.71	2.05	1.49
10-17 Years				
AGARWAL et. al.	1.18	0.95	1.45	0.77
3-15 Years				
AGARWAL et. al	1.73	1.23	1.63	1.22
5-15 Years				
BROTONS et. al.	1.69	0.64	0.85	0.65
6-18 Years				
WHO, TRS	2.00	0.50-1.00	1.00	0.50-1.00
0-20 Years				

The relationship between body size and blood pressure has been observed and reported by various authors.^(20,21) The age related increase in BP may be attributable in part to increase in body mass. In the present study, increasing height and weight had a significant positive relationship with SBP and DBP. Voors et al,⁽²¹⁾ reported that BP correlates more closely to height and body mass than age. A trend of increase in SBP and DBP with age in the present study was observed in both sexes. An increase in SBP and DBP with age has also been reported in Indian children by other authors.⁽²²⁻²⁵⁾ Gupta et al,⁽¹³⁾ observed a spurt in SBP between 13 - 15 years in both sexes. The spurt in SBP between 13 - 15 years are mainly related to certain biological and psychosocial factors, and puberty timing.^(26,27)

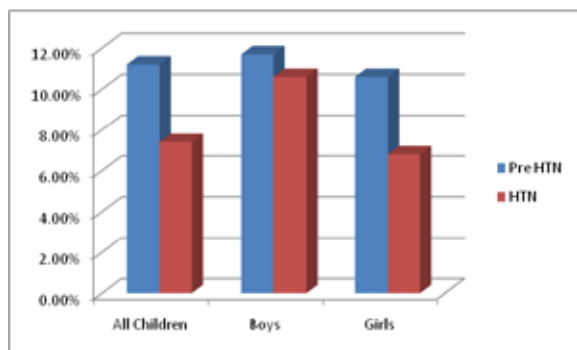
Early signs of a change in gender based blood pressure distribution among adolescents are emerging. Comparison of data sets from US adolescents demonstrated an increasing trend for high blood pressure among adolescent girls in contrast to a decreasing trend for the same in adolescent boys.⁽²⁸⁾ The onset of sexual maturation is associated with increases in systolic and diastolic blood pressures.^(29,30) The timing of sexual maturity is different for boys and girls with the latter attaining it relatively earlier. This difference could contribute to differences in blood pressure progression during adolescence. The same reason could explain the lack of difference in systolic blood pressure and the comparable values in diastolic blood pressure between the genders by age 16, a time at which majority of the boys too have attained significant sexual maturity.

The prevalence of pre-hypertension and hypertension in our study was 11.2% and 7.4% which indicates it is major public health problem and immediate intervention is needed. The prevalence in other various other Indian studies ranges from 0.46% to 11.9%.⁽³¹⁻³⁴⁾ This wide difference may be due to different standards used for diagnosis of hypertension and also, due to regional variation. Some studies have adopted fourth phase of korotkoff sounds to define diastolic blood pressure and some have not included height for grading BP.⁽³⁴⁾ Also there is a higher prevalence of hypertension in Southern India⁽³⁵⁾ probably because of influential factors like genetic inheritance, dietary habits and lifestyle factors.

Table VII: Prevalence of Hypertension

AGE	BOYS			GIRLS		
	N	Pre HTN	HTN	N	Pre HTN	HTN
10	14	2 (14.3%)	1 (7.1%)	29	2 (6.8 %)	1 (3.4%)
11	67	6 (8.95%)	4 (5.97%)	64	5 (7.8 %)	3(4.7 %)
12	55	4 (7.27%)	3 (5.45%)	49	5 (10.2 %)	3 (6.1%)
13	40	4 (10%)	2 (5%)	31	3 (9.7%)	2 (6.4 %)
14	44	6 (13.6%)	4 (9.09%)	38	6 (15.8 %)	4 (10.5%)
15	46	9 (19.3%)	7 (15.2%)	24	4 (16.6 %)	3 (12.5%)
Total Prevalence		11.7%	7.9%		10.6%	6.8%

Fig 6: Prevalence of Hypertension



The overall prevalence of prehypertension was 11.2% and that for hypertension was 7.4%. In Comparison to our study, Thakor et al in 1998 in Surat city ⁽³⁶⁾, found much less overall prevalence of hypertension (2.3%) amongst school children. The overall prevalence of hypertension in this study was found higher than that reported by Anand et al and Anjana et al but it was almost equal to that found by Moura et al ⁽⁴⁰⁾ in the city of Maceió in Brazil.

In boys, overall prevalence of prehypertension was 11.7% that was 10.6% in girls. In this study, the prevalence of Hypertension in boys was 7.9% and that in girls was found to be 6.8%. The findings were nearer to the findings of Chadha et al ⁽³¹⁾ in 1999 where the prevalence of hypertension was a little more in boys than the girls.

Table VIII: Comparison of Indian Studies by Prevalence of Pre-Hypertension and Hypertension

STUDIES	Pre-Hypertension	Hypertension
Our Study	11.2%	7.4%
Vivek Verma et al ⁽⁶⁾	10.8%	9.2%
M.R.Savitha et al ⁽⁴¹⁾	-	6.1%
Jasmine S Sundar et al ⁽⁵⁾	-	21.5%
Chandrashekhar .T et al ⁽⁷⁾	12.2%	13.4%
Amar Taksande et al ⁽⁴³⁾	-	5.7%
Arnaud Chiolero et al ⁽⁴⁾	-	2.2%
Anisha M. Durrani et al ⁽⁴²⁾	-	9.4%
Vikram Singhal et al ⁽¹⁾	-	11%
Avinash Sharma et al ⁽⁶⁾	12.3%	5%

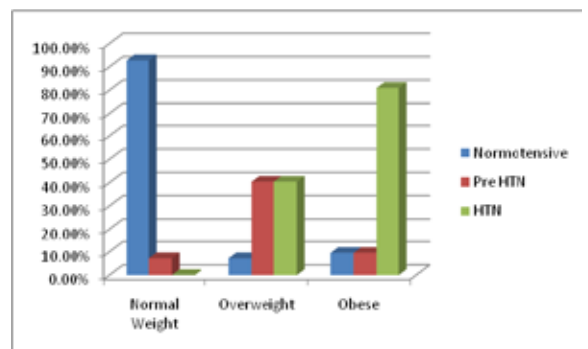
The present study is consistent with many other Indian studies such as Vivek Verma et al⁽⁶⁾, Chandrashekhar .T et al⁽⁷⁾ and Avinash Sharma et al⁽⁸⁾.

An association was found between BP and anthropometric measurements such as BMI. It was observed that children with more body weight had increased SBP and DBP. The relation of body size to BP has been established in a number of cross-sectional studies.^(37,38) In Bogalusa Heart study, it was established that BP is correlated with height and BMI. In present study, the prevalence of pre-hypertension and hypertension is very high in obese and overweight children compared to children with normal weight. In our study, the statistical significant correlation was observed between BMI with SBP and DBP (p <0.001). In a study done by Supreet Kaur et al.⁽³⁹⁾ there was a statistical significant correlation was observed between BMI and systolic and DBP (P<0.001). The statistical significant correlation was observed between BMI and systolic and diastolic blood pressure. (p <0.001) in our study.

Table IX: Relation between Weight and HTN in Children

	Normotensive	Pre HTN	HTN	Total
Underweight	82(98.8%)	1(1.2%)	0	83(16.5%)
Normal	320(92.8%)	25(7.2%)	0	345(68.8%)
Overweight	10(7.2%)	21(40.4%)	21(40.4%)	52(10.3%)
Obese	2(9.5%)	2(9.5%)	17(81.1%)	21(4.1%)

Fig 7: Relation between Weight and HTN in Children



In the present study it was observed that 81 % of obese patients had hypertension, 9.5 % had pre hypertension and remaining 9.5 % were normotensive, the incidence of HTN in obese was significantly (p<0.001) more compared to overweight, underweight and normal weight group. In over weight group 40.4 % patients had hypertension, 40.4% had pre hypertension and 9.2% were normal. In children with normal weight 92.8% were normotensive, 7.2% were pre hypertensive. In children with underweight 98.8% were normotensive and 1.2 % children were pre hypertensives.

In the present study, we found an association between BP and anthropometric measurement like BMI in children in the age group of 10-15 years of age. Hence, it would be logical to advise the families with obese children to change their lifestyles with respect to the diet, exercise

and the reduced salt intake, to get their children accustomed to the life styles which are favorable for the maintenance of normal blood pressures.

CONCLUSION AND SUMMARY

- The prevalence of hypertension among the adolescent age group was alarmingly high.
- Obesity and overweight were found to be the major determinants of Adolescent hypertension.
- There is much difference in prevalence of pre-HTN and HTN among many studies.
- Awareness about hypertension was very low among the study participants
- BP increases with age.
- The SBP and DBP showed a linear increase with age, height, weight, and BMI.
- The average annual increase of 2.1 mm Hg in SBP and DBP in boys and the average annual increase of 3.1 mm Hg in SBP and 2 mm Hg in DBP in girls.
- The prevalence of pre-hypertension and hypertension was 11.2% and 7.4%.
- In boys, overall prevalence of prehypertension was 11.7% that was 10.6% in girls.
- The prevalence of Hypertension in boys was 7.9% and that in girls was found to be 6.8%.
- The prevalence of pre-hypertension and hypertension is very high in obese and overweight children compared to children with normal weight
- 81 % of obese children had hypertension, 9.5 % had pre hypertension and remaining 9.5 % were normotensive.
- In over weight group 40.4 % children had hypertension, 40.4% had pre hypertension and 9.2% were normal.

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