

Original article

Prevalence of sustained hypertension among adolescent school children in Puducherry

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Abstract

Introduction: Primary hypertension in adolescent children has become increasingly common in association with other cardiovascular risk factors that include obesity, insulin resistance and dyslipidemia. Hypertension in adulthood often has its origin in childhood and hence it is vital to detect it at the early stage.

Aims: The aim of this study is to determine the prevalence of sustained hypertension among adolescent school children and its association with obesity. It was also aimed to compare the obtained data between the children studying in public schools to those studying in schools run by private institutions.

Method: It is a cross-sectional, comparative study wherein a total of 1005 students (494 boys and 511 girls); 493 from private school and 512 from public schools between the ages 12-17yrs were included in the study. Height (in cm) and weight (in kg) were recorded along with blood pressure measurement using a sphygmomanometer. International Obesity Task Force classification was utilized for the estimation of overweight and obese subjects. The evaluation of hypertension was based on the Update on the 1987 Task Force Report on High Blood Pressure in Children and Adolescents.

Results: Overall prevalence of hypertension and pre-hypertension were 10.9% and 8.2% respectively (boys 39% and girls 61%). There was no significant difference between prevalence of hypertension among girls and boys and between students from public and private schools. There was significant correlation between hypertension and BMI.

Conclusion: We found that the prevalence of hypertension among the adolescents was very high, as compared to earlier studies conducted here, especially among the overweight and obese students.

Keywords: Hypertension; obesity; adolescent schoolchildren; prevalence

Introduction

Increasing trend of hypertension is a worldwide phenomenon. It is also seen in developing countries like India. Three serial epidemiological studies carried out during 1994⁽¹⁾, 2001⁽²⁾ and 2003⁽³⁾ demonstrated rising prevalence of hypertension (30%, 36%, and 51% respectively among males and 34%, 38% and 51% among females). Once considered relatively rare, primary hypertension in children has become increasingly common in association with other cardiovascular risk factors that include overweight, insulin resistance and

dyslipidemia.^(4, 5) Blood pressure tracking studies suggest that hypertension in adulthood often has its origin in childhood. Indeed, blood pressure in children is the best predictor of hypertension in later life. Hypertension is a major contributor to cardiovascular morbidity and mortality. The prevalence of hypertension among adolescents done in previous studies varies from 2.2% to 9.25% in India and abroad.^[6-13] It is also seen that from these studies, that there is a significant correlation between high blood pressure and increasing BMI in adolescents.^[6-13]

Table 1

Authors	Place	Age group	Year	Prevalence of hypertension	Correlation with BMI
Soundarssanane	Puducherry, India	15-19yrs	2002	8.5%	Yes
Mohan B et al.	Ludhiana, India	11-17yrs	2004	9.25%	Yes
Taksande et al.	Wardha, India	6-17yrs	2006	5.75%	Yes
L Saha et al.	Kolkata, India	10-19yrs	2008	2.9%	
Veena K G et al	Mangalore,India	5-16yrs	2010	2.2%	Yes
Sharma A et al.	Shimla, India	11-17yrs	2010	5.9%	Yes
Mostafa A et al.	Alexandria,Egypt	11-17yrs	2010	4%	Yes
Niece KLet al.	Texas, USA	11-17yrs	2003-2005	9.4%	Yes

Obesity is considered as the main risk factor for hypertension.^[14,15] The prevalence of systolic hypertension among underweight was 1.4% and that among obese was 12.5%.^[10,14] Prevalence of overweight/obesity among adolescents and young adults reported by various studies conducted in various Indian states were between 18%^[16] to 26%.^[17] A prevalence of 26%^[18] (BMI>25) among affluent school boys aged between 10-15yrs was reported in Pune, while the prevalence was 24%^[19] for overweight/obesity (BMI>23) among urban college going girls of age 17-18yrs in Ernakulam, Kerala(India).

Aims & Objectives:

To evaluate the prevalence of sustained hypertension based on blood pressure readings taken during three visits and To find out the association of blood pressure with BMI And further to look for possible differences in the prevalence of hypertension among students studying in the private and public schools of Puducherry.

Method:

This is a cross-sectional, comparative study, conducted in four randomly selected schools (2 private and 2 pub-lic) of Puducherry. A total of 1005 students, aged 12-17years, 493 boys and 512 girls, participated in the study, after obtaining consent from Institute Ethics Committee and school authorities. Sample size (N) was derived as 1076

by using the formula, $N = 4PQ/L^2$, where P (8.5%) is the prevalence, Q is 100-P and taking the power

of s-tudy to be 20% of prevalence (1.7) and it was approximated to 1005. Anthropometric measurements and blood pressure were measured in all the students in the four schools.

Determination of Blood pressure:

Blood pressure was measured using standard methodology as recommended by The Fourth Report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents.^[15] Average systolic or diasto-lic blood pressure greater than or equal to 95th percentile for gender, age and height is considered as hypertensi-on. Pre-hypertension is defined as average systolic blood pressure or diastolic blood pressure that is greater than or equal to 90th percentile but less than 95th percentile. Children with blood pressure levels between 120- 140 mmHg systolic and 80- 90 mmHg diastolic were also considered pre-hypertensive.^[15]

Assessment of Obesity:

WHO classification was utilized for the estimation of overweight and obese subjects. Overweight is defined as children with BMI value between 85th to 95th percentile for a specific age and sex. Similarly obesity is defined as children with a BMI value above 95th percentile for a specific age and sex.^[14]

Follow up:

Two more additional visits were done after a gap of 2 weeks to record blood pressure in those children who were found to have an elevated blood pressure in the first visit. Hypertension or Prehypertension was defined as elevated blood pressure on all three visits.

Statistical Analysis:

Data was analysed using statistical package using Microsoft excel and SPSS version 21. Descriptive statistics like mean and percentages was calculated. Chi square test was used to find the difference between the variables. P value of less than 0.05 was

Table 2

	Boys	Girls	Total
Private schools	254	258	512
Public schools	239	254	493
Total	493	512	1005

Overall, the prevalence of hypertension was 10.9% (n= 110) and that of prehypertension was 8.2% (n= 82). The mean systolic and diastolic blood pressure of hypertensive population in both public and private school students was significantly higher than systolic and diastolic blood pressure in their normotensive counterparts (public school normotensive systolic blood pressure:109 +/- 9.24mmHg, public school hypertensive systolic blood pressure: 133.67.59+/- 20.19 mmHg. Private school normotensive systolic blood pressure:

Table 3:

Variables		Hypertensive (n=110)	Prehypertensive (n= 82)	Normotensive (n= 813)	Significance (Chi Square)
Gender	Boys	43 (39%)	39	411	P= 0.075
	Girls	67 (61%)	43	402	
	Total	110	82	813	
Schools	Public	51	39	403	P= 0.787
	Private	59	43	410	
	Total	110	82	813	
BMI	Obese	29	9	29	P < 0.05
	Overweight	28	16	103	
	Normal	53	57	681	

considered statistically significant. Unpaired t test was used to compare means of the two groups.

Results

Of the 1005 apparently healthy school children who participated in the study, 493(49%) were boys, [of them 253 boys were from a private school and 241 from a public school]. 512 were girls (51%), [256 each were from private and a public school respectively]. Their mean age was 14.7 years. The baseline characteristics of the study population are represented in Table 2 & 3

Table 3

Age (years)	Total	Boys	Girls
12yrs	52	17	35
13yrs	172	82	90
14yrs	200	94	106
15yrs	274	134	140
16yrs	219	106	113
17yrs	88	60	28
Total	1005	493	512

109.41+/- 9.99 mmHg, private school hypertensive systolic blood pressure: 138.37 +/- 22.63 mmHg, public normotensive diastolic blood pressure: 75 +/- 9.21 mm Hg, public school hypertensive diastolic blood pressure: 85.60 +/- 9.74 mmHg , private school normotensive diastolic blood pressure:71.58 +/- 9.55 mmHg, hypertensive diastolic blood pressure: 83.23+/- 11.66 mmHg). Number of hypertensive boys were found maximum the 12yrs and 17yrs (12%), while for girls it was seen in the 14yrs age (22%).

	Total	110	82	813	
Exercise	Yes	16	11	178	P= 0.052
	No	94	71	635	
	Total	110	82	813	
F/H of Hypertension	Yes	48	31	216	P < 0.05
	No	62	51	597	
	Total	110	82	813	
Junk Food	Yes	29	37	309	P < 0.05
	No	81	45	504	
	Total	110	82	813	

Significant association of BMI and hypertension

Table 4 illustrates the correlation of blood pressure with the BMI and other variables and their significance using Chi square. The overall prevalence of obesity was 6.6% (n = 67) and that of overweight students was 14.6% (n = 147), of them 57 (26.6%) were hypertensive and 25 (11.5%) were prehypertensive. The mean BMI of the students was 19.78 kg/m². Of the obese subjects, boys and girls were 33 and 34 in number respectively.

Number of overweight and obese students was significantly higher among private schools with a p value of < 0.05. There was significant increase in prevalence of hypertension in public and private school children with increased body mass index (overweight & obese), [p < 0.001]. Family history of hypertension was met with in significantly higher (p < 0.05) number of children with sustained hypertension (n=48) as compared to normotensive students (n=216).

Although not statistically significant, more number of students who said that they consumed junk food regularly (atleast 3 times weekly) were found to be hypertensives (p of 0.019). No correlation was elicited between hypertensives who exercised regularly and those who did not do so.

Discussion

Hypertension is a major risk factor for cardiovascular and cerebrovascular diseases. Studies indicate that BP increases with age (12–16). Population-based epidemiological studies

show that primary hypertension is more common among apparently healthy children^[9]. Although the prevalence of hypertension is far less in children than in adults,^[9-17] there is enough evidence to suggest that the roots of essential hypertension extend into child-hood. Obesity and weight gain are strong, independent risk factors for hypertension. It has been estimated that 60% of hypertensives are overweight. There is a well-documented association between obesity (body mass index >30 kg/m²) and hypertension. Further, cross-sectional studies indicate a direct linear correlation between body weight (or body mass index) and blood pressure. Centrally located body fat is a more important determinant of blood pressure elevation than is peripheral body fat. In longitudinal studies, a direct correlation exists between change in weight and change in blood pressure over time. It has been established that 60–70% of hypertension in adults may be directly attributable to adiposity. The constellation of insulin resistance, abdominal obesity, hypertension, and dyslipidemia has been designated as the *metabolic syndrome*

In the present study among adolescents aged 12-17 years in private and public school children of urban Puducherry, the overall prevalence of hypertension was found to be 10.9%, which was higher in females (61%) than males (39%). Elsewhere, studies on population of 13-18 years^[18], 15-24 years^[19] and 15-25 years^[20] had observed the same findings. It was seen that the private school

children had a higher number of hypertensives 11.5% as compared to those from government schools 10.3%, although not statistically significant. This could be due to increased urban, sedentary lifestyle and unhealthy food habits in the children across all groups. Previous studies showed it was more in urban children due to the difference in the socio-economic status of both the groups as also reported by Gilbert et al^[21]. Life style modification between the upper the lower socio-economic classes could have had an indirect bearing on blood pressure levels.

The present study is evident that increase in BMI predisposes the adolescent individual to higher blood pressure and subsequent hypertension. A similar finding was also reported elsewhere in India,^[22] Hungary^[23] and France^[24]. Shah et al had reported the prevalence of overweight and obesity to be 9.25% and 5.55% respectively in an urban area of Bhavnagar city, Gujarat^[25]. Obesity in children is associated with an increased incidence of hypertension, diabetes, coronary artery disease, osteoarthritis and an overall increase in morbidity and mortality during adult life.^[26] The various reasons found out for hypertension in obese children are increased cardiac output, high sodium intake, increased steroid production and alteration in the reception for various substances^[23]. A statistical significance was found between overweight/obesity and hypertension in the present study. Previous studies done in India have confirmed this finding.^[24,25,26] Thus the present study strengthens the fact that overweight and obesity is an important association of hypertension. This study also reveals that age and family history of hypertension are significantly related to the hypertensive child. Unhealthy diet has also been found to be significantly associated with hypertension in the study population.

- **The limitation** of this study is that the certainty of the causal direction of the associations observed and the findings associated with hypertension cannot be clearly arrived at, due to the study's cross-sectional design. A longitudinal study with repeated measures of body composition and blood pressure would be desirable in the future. Secondly, the secondary causes of hypertension were not excluded by conducting appropriate investigations.
- Waist circumference, which is an ideal indicator of central obesity, was not measured.

Recommendations:

Hypertension screening and follow-up with regular blood pressure measurements should be introduced in the routine school health programs. Assessment of obesity should also be included in the above along with offering health education regarding adversities of obesity and methods to curb it at an early stage in one's life. Cardiovascular risk factors should be detected and prevented as early as the childhood itself. Programs and policies to limit sedentary behaviours and promote activity and healthy nutrition among school children are recommended.

Conclusion

Obesity is considered as the main risk factor for hypertension. In this study the prevalence of hypertension was found to be higher as compared to the previous similar study in Puducherry adolescents which points to the alarming rate of increase in the components of metabolic syndrome. This study will also be helpful to re-emphasize the need for preventive measures to control overweight / obesity in children which is considered as the risk factor for hypertension, cardiovascular disease and diabetes. This study can focus upon the fact that hypertension is not a rare phenomenon in

adolescents; hence by detecting high blood pressure measurements at a young age and taking precautionary measures and appropriate and optimal treatment can go a long way in postponing the onset of complications or even preventing the onset of hypertension at a later age. This study focuses upon the fact that hypertension is not a rare phenomenon among adolescents. They may not present with the signs and symptoms of hypertension, but detecting hypertension by means of regular school health programmes at an early

age does help in better blood pressure control which goes a long way in preventing complications. This study also re-emphasizes the need for preventive and control measures of overweight/obesity in children which is considered as the risk factor for hypertension, coronary artery disease & Type 2 DM.

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