Original Article

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Pre-hypertension and Hypertension in School Children Aged 8 to 17 Years in Southern India: A Community Based Study

Community Medicine Section

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ABSTRACT

Introduction: Pre Hypertension (pre HT) and Hypertension (HT) in childhood have strong association with cardiovascular disease in adult life. There is scarcity of this data in Indian scenario.

Aim: To determine the prevalence of HT and pre HT in school children between 8 to 17 years, in a rural set up. An attempt was also made to determine correlation between Blood Pressure (BP) and other risk factors like Body Mass Index (BMI), waist circumference, family history of HT and diabetes mellitus.

Materials and Methods: A cross-sectional, community based observational model, comprising of 500 healthy students, between 8 to 17 years of age, was adopted. A semi structured questionnaire was administered to obtain socio-demographic details which were filled by the parents. Mean Systolic Blood Pressure (SBP) and/or Diastolic Blood Pressure (DBP) greater than or equal to the 95 percentile for that particular sex, age, and height was defined as HT. Pre HT was considered when average SBP or DBP levels that were higher than or equal to the 90th percentile, but lower than the 95th percentile. Height, weight, waist circumference and hip circumference and BP were measured using prior validated and standard tools.

Results: Prevalence of pre HT was 4.2% and HT was 3.4%. BMI among the students with elevated blood pressure (pre HT and HT) and normotensives was 17.088251±2.88 and 19.796462±3.76 respectively. The Pearson's (r) correlation between SBP and BMI was 0.349 ($p<0.0001$). The r-value for DBP and BMI was 0.249 ($p<0.00001$), implying a significant positive correlation between BP and BMI. Similar significant positive correlation was observed for weight, waist circumference and BP. However, no relationship was observed between family history of hypertension, family history of diabetes mellitus and BP.

Conclusion: Pre HT and HT is an important public health problem in children and adolescence. Increased BMI is a major risk factor for childhood HT. Early identification and prevention will help reduce long term consequences due to HT.

Keywords: Cardiovascular diseases, Child, Weight

INTRODUCTION

Hypertension (HT) is a major public health problem worldwide. In India 25% of deaths are because of coronary heart disease and 57% of stroke deaths occur due to HT [1]. HT in adults has its origin in childhood, where it is often asymptomatic. HT in childhood is more significantly associated with cardiovascular complications and Target Organ Damage (TOD) like renal, retinal and cardiovascular affects as compared to the adults. Presence of TOD undermines the need for early institution of pharmacological treatment.

Pre hypertension (pre HT) has higher chances of developing HT within two to four years and cardiovascular disease complications as compared to normotensives [2]. Detection and prevention of HT and pre HT in children becomes increasingly important for reducing global disease burden due to HT. Similarly it also helps prevent long term effects.

The definition of HT in children goes as a mean SBP and/or DBP greater than or equal to the 95 percentile for that particular sex, age, and height measured on three or more occasions. Pre hypertension in children is an average SBP or DBP levels that are higher than or equal to the 90th percentile, but lower than the 95th percentile [3]. The increasing trend of HT in children and adolescence in India is attributed to the industrialization, change in life style and dietary habits.

Prevalence of HT and pre HT in school children varies with region. Prevalence of HT in childhood is 4 to 15% and that of pre HT is 5 to 25% worldwide [4]. Previous studies from India have documented the prevalence of HT in children in urban area ranging from 2% to 6% and of pre HT as 12.3% and 10.8% respectively [5-8]. Studies have documented a high prevalence of pre HT in overweight (27.9%) and obese children (17.7%) [9,10].

Since there is very little data on HT and pre HT from rural areas in India, the present study was planned in rural setup to determine the prevalence and to compare it with the urban population. The present study was planned to determine the prevalence of HT and pre HT in school children in a rural set up and the associated cardiovascular disease risk factors in children aged between 8 to 17 years. This will help in planning and adopting preventive strategies at an early age.

MATERIALS AND METHODS

This was an observational cross-sectional study with a community based observational model. The study was conducted over duration of two months from August to September 2017. The density of population of the study area was less than 400/square kilometre and one half of the male population were agriculturalist by occupation.

Institution ethical committee clearance was obtained from the institutional human ethical committee. A prior permission for conducting the study was obtained from the block education officer, the institution administrators and parents. Assent was obtained from the students >7 years of age. Written informed consent from the parents or guardians of the student was obtained after briefing the research protocol to them in a meeting in presence of principal investigator.

A semi structured questionnaire was administered to the students to get filled by parents at home.

The students were selected from Government and Private primary and higher secondary school by using stratified random sampling method. The sample size was 500. Healthy school children aged between 8 and 17 years and who were willing to participate in the study were included. Students on medications which can affect the BP or those with history of any cardiac and renal disease were excluded from the study.

Variables studied were height, weight, BP, BMI Waist Circumference, Hip Circumference, Waist To Hip Ratio.

Definition of variables

HT in children was considered if average SBP and/or DBP that is greater than or equal to the 95th percentile for that particular sex, age and height on three or more occasions based on American Paediatrics Association curves reference.

Pre HT in children was considered when average SBP or DBP levels that are greater than or equal to the 90th percentile, but less than the 95th percentile American Paediatrics Association curves reference [3].

BMI was calculated by formula weight in (kg)/height (m^2). BMI< 22.9 was considered normal weight, BMI >22.9 was considered overweight, BMI >30 was considered as obese.

A complete history including age, sex, type of school as private and government, family history of diabetes mellitus and history of hypertension among any one of the parent was included in the questionnaire. Positive history was confirmed by telephonic conversation with parents. The study was conducted in free or physical activity periods. Prior validated and standard tools was used which included electronic weighing machine, non stretchable tape and mercury sphygmomanometer; properly calibrated by ensuring that the mercury meniscus returns to zero (or within 3 mmHg of 0) when the manometer is removed from the inflation system, and of appropriate cuff size for that age.

Procedure

Height was measured with holding head straight and body touching the wall. Weight was measured without shoes and in school uniform. Blood pressure was recorded in sitting position with a mercury sphygmomanometer using standard technique. At one setting BP was recorded three times in the right upper arm with rest of 10 minutes in between. Three measurements were taken over a gap of two weeks each and the mean BP calculated. Waist circumference was recorded at the level of umbilicus. For female students a female attender was deputed. Cardiovascular risk factors were assessed including overweight, obesity, family, private versus government school, history of HT and diabetes mellitus. Prevalence of HT and pre HT was documented. Association between type of school as private and government, family history of diabetes mellitus and family history of HT and BMI was assessed.

STATISTICAL ANALYSIS

Data was expressed as mean and standard deviation and percentages. Correlation between BP and continuous variable was done by Pearson's correlation. Correlation of BP with categorical variables, like family history of diabetes mellitus, HT and physical activity was done by independent t-test. A p <0.05 was considered as statistically significant. Data analysis was performed using SPSS 18.0.

RESULTS

In the present study, 500 students between 8 to 17 years of age were screened.

Demography

Out of 500 participants, 56.4% were males and 43.6% were females. The mean age of the participants was 14±1.72 years. Maximum number of students with HT (12) and pre HT (11) were more than 13 years of age [Table/Fig-1].

Prevalence of Pre Hypertension and Hypertension

The prevalence of pre HT and HT was 4.2% and 3.4% respectively.

Age (years)	Normotensive N (%)	Prehypertensive N (%)	Hypertensive N (%)	Total
<10	98 (19.6%)	2(0.4%)	0 (%)	100 (20%)
10 to 13	187 (37.4%)	8(1.6%)	5(1%)	200 (40%)
> 13	177 (35.4%)	11(2.2%)	12(2.4%)	200 (40%)
Gender				
Males	261(52.2%)	12(2.4%)	9(1.8%)	282 (56.4%)
Females	201(40.2%)	9(1.8%)	8(1.6%)	218 (43.6%)

[Table/Fig-1]: Shows age and gender wise distribution of the participants among normotensives, Pre Hypertensives (Pre HT) and Hypertensives (HT).

Correlation of Various Risk Factors with Hypertension

The family history of diabetes mellitus was found in 1.8% of subjects with elevated BP and 19.6% of subjects with normal BP. The family history of HT was found in 3.2% of subjects with elevated BP and 26.6% of subjects with normal BP. Physical activity was documented in 86.84% of subjects with elevated BP and 91.77% of subjects with normal BP.

There was no statistically significant relationship between family history of diabetes mellitus and family history of HT with BP [Table/Fig-2]. However, a negative correlation was noted between physical activity and BP.

The Pearson's (r) correlation between SBP and BMI was 0.349 (p<0.05). The r-value for DBP and BMI was 0.249 (p<0.05). This implies a significant positive correlation between BP and BMI. Similar significant positive correlation was observed for weight, waist circumference and BP [Table/Fig-3].

DISCUSSION

HT is a clinical condition characterized by abnormal and repeatedly high blood pressure. It is one of the major causes of cardiovascular morbidity and mortality. Adult HT has its roots in childhood, where most often it is asymptomatic. Childhood HT may present only at the onset of target organ damage making management difficult. Early identification of HT and pre HT in children and adolescence can reduce the burden of disease due to HT by reducing the morbidity

	Family history of DM	Mean (SD)	p-value	Family history of HT	Mean (SD)	p-value	PA	Mean (SD)	p-value
SBP	Present	113.57 (10.1)	0.756	Present	112.39 (09.8)	0.182	Present	113.21 (10)	0.406
	Absent	113.24 (10)		Absent	113.71 (10.2)		Absent	114.37 (10.30)	
DBP	Present	71.37 (8.2)	0.864	Present	71.59 (8.2)	0.883	Present	71.42 (8)	0.446
	Absent	71.54 (8.3)		Absent	71.46 (8.3)		Absent	72.37 (8.4)	

[Table/Fig-2]: Shows relationship of family history of DM, family history of HT and physical activity with blood pressure.
Abbreviations: DM – Diabetes Mellitus, HT-Hypertension, PA-Physical Activity, Test applied – Independent t-test, p-value < 0.05 statistically significant. SD – Standard Deviation

		BMI	Weight	Waist Hip ratio
SBP	Pearson's Correlation	0.349**	0.249**	0.034
	Sig. (2-tailed)	0.000	0.000	0.454
	N	500	500	500
DBP	Pearson's Correlation	0.249**	0.198**	0.012
	Sig. (2-tailed)	0.000	0.000	0.781
	N	500	500	500

[Table/Fig-3]: Shows correlation of BMI, Obesity, Waist hip ratio and physical activity with Hypertension.
** Correlation is significant at the 0.05 level (2-tailed).

and mortality associated with it by adopting early preventive strategies [11].

The prevalence of pre HT was 4.2% and HT was 3.4% in the present study. [Table/Fig-4] shows comparison of prevelance of HT and pre HT among various studies and the present study [4,6,7,12]. A low prevalence of HT was documented by Thakor HG et al., i.e., 2.3% [13]. A slightly higher prevalence of 6.48% was reported by Buch N et al., [6]. Likewise in other studies conducted among school children, the prevalence of HT were marginally high i.e., 5.9% and 6.3% respectively [7,8]. The regional differences in the BP among healthy north Indian and south Indian population has been documented by Krishna P et al., [14]. The marginally high prevalence in studies stated above may be due following factors: 1) inclusion of private school students, most of whom belong to high socioeconomic strata and thus are inclined towards higher BMI and subsequent HT; 2) Urban population consuming high fat diet and low physical activity might have been the contributing factors [6-8].

In the present study, since it is a rural area, healthy eating habits due to lack of availability of junk foods and high physical activity could explain the low prevalence rate. This is also evident by the fact that the prevalence of obesity and overweight was 5%.

Studies done at global level showed a wide range of prevalence for HT i.e., 4 to 15% and that of pre HT to be 5 to 25% [4]. These differences are due to the changing economics, life style changes and genetic factors.

Parameters	Sharma A et al., [7]	Buch N et al., [6]	Bertrand F et al., [4]	Guo X et al., [12]	Present study
Prevalence of Hypertension	5.9%	6.3%	10.1%	20.2%	3.4%
Prevalence of Pre Hypertension	12.3%	10.8%	20.7%	15%	4.2%

[Table/Fig-4]: Shows comparison of prevalence of pre hypertension and hypertension among various studies and present study [4,6,7,12].

The major determinant of elevated blood pressure (pre HT and HT) in the present study was the weight, BMI and waist circumference.

In the present study there was a positive correlation between weight and BP. A 32% of obese children had elevated BP. Mohan B et al., observed high blood pressure in obese as compared to normal weight children [15]. Similar findings were documented by Andriska J et al., who noted that 41% of children with HT had obesity [16]. Buch N et al., observed higher prevalence of obesity (8.7%) among HT as compared to those in normal BP (1.1%) [6].

The strong association between BMI and elevated BP has been well documented in literature [9,10]. In present study a positive correlation was noted between BMI and BP.

Obesity plays a major role in development of childhood HT. However in a study by Sharma A et al., the authors did not find any association between obesity and HT [7]. Likewise, Genovesi S, in their study documented a high prevalence of HT among normal and underweight children [5].

Physical activity has a significant effect on BP. A negative correlation was brought out, in the present study wherein children lacking involvement in physical activity showed elevated BP. Physical inactivity compounded by increased intake of salt and refined sugars increase obesity and cardiovascular risk in children [4].

Family history of HT is also an important risk factor for childhood HT. Amritanshu K et al., showed in their study that childhood HT had significant relation to family history of HT [11]. Similar findings were documented by Gupta R et al., and Verma V et al., [1,8]. Contrary to this, Buch N et al., in their study did not find any such association [6]. This was in accordance with the present study where no association was seen between family history of HT and childhood HT. The possible explanation for this is that this being a rural set up, lack of awareness might have lead to insufficient screening of parents, since HT is usually asymptomatic.

LIMITATION

We did not take into consideration other risk factors like dietary habits, salt intake etc., due constraints in time and resources.

CONCLUSION

Pre HT and HT is an important public health problem in children and adolescence. Increased BMI is a major risk factor for childhood HT. Early identification and prevention will help reduce long term consequences due to HT.

BP examination should be included in routine health check up at school. Children, parents and teachers should be educated to promote life style modifications in children with pre HT to prevent HT and its complications. Further large scale studies are needed to estimate the accurate prevalence of pre HT and HT and to determine correlation of BP with other risk factors.

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