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Original Research Article

Prevalence and risk factors for pre-hypertension and hypertension amongst school going adolescents in a rural area: an observational study

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ABSTRACT

Background: Hypertension seen in childhood can progress into adulthood thereby increasing morbidity and mortality due to cardiovascular diseases in adulthood. Younger the age of onset of hypertension, the greater is the reduction of life expectancy if left untreated. With increase in incidence of elevated blood pressure and hypertension in children; it is important to measure and record blood pressure along with weight and height at least once a year as recommended by National Institute of Health (NIH) task force of USA. Aims and objectives was to determine the prevalence of pre-hypertension and hypertension and to identify the associated risk factors for them in school going adolescents.
Methods: An observational/cross-sectional study conducted among adolescents studying between Std 5th to Std 9th. A total 507 students belonging to the age group of 10-17 years were examined. Anthropometric measurements were taken to calculate Body Mass Index (BMI) and Blood pressure was measured by using mercury sphygmomanometer. Gender, age and height were considered for determining hypertension.
Results: Amongst the 507 children, prevalence of pre-hypertension was 15.4% and that of hypertension was 10.85%. The study also revealed statistically significant higher prevalence of hypertension in males than in females. Family history of hypertension and dietary habits, obesity were positively correlated with higher prevalence of hypertension. A higher prevalence of pre-hypertension and hypertension was seen in the present study group compared to the similar studies in the state.
Conclusions: The prevalence of pre-hypertension and hypertension among adolescent school children was 15.38% and 10.8% respectively. Possible risk factors for this current trend may be the increasing sedentary life style, faulty eating habits, and increased fat/salt contents of diet. The results suggest the need for more public awareness and prevention programs for childhood obesity and hypertension.

Keywords: Adolescents, BMI, Blood pressure, Hypertension, Obesity

INTRODUCTION

Adolescence is a significant period of growth and maturation with many physical and metabolic changes occurring in the body during which many adult patterns are established. Health check-up during this period is an excellent opportunity to identify various lifestyle disorders manifesting in adults.[1] India being a developing country suffers from both under and over nutrition.[2,3]

Overweight and obesity during adolescence is one of the major risk factor for non-communicable diseases which include hypertension and associated cardiovascular complications.[4] It has been observed in both genders.

Pre-hypertension and Hypertension seen in childhood can progress into adulthood thereby increasing morbidity and mortality due to cardiovascular diseases in adulthood.[5,6] There has been an increase in the incidence of pre-hypertension and hypertension in adolescence, most cases of which remain under diagnosed.[7,8] It has been observed that, the younger the age of onset of hypertension during adolescence, the greater is the reduction of life expectancy if left untreated.[9,10] Familial aggregation of blood pressure and tracking phenomena support the concept that children with hypertension are likely to be hypertensive as adults and have an increased risk for cardiovascular diseases. The prevalence of adolescent hypertension in various studies ranges from 0.02% to 25.6% amongst children and adolescent has been reported.[11-13] If the trend toward adult hypertension can be identified early, it might be possible to modify the risk factors and prevent systemic hypertension and its complications. Most of the behaviours and risk factors are preventable or modifiable if appropriate lifestyle modification is applied and thus early adolescence is the appropriate time for intervention where the lifestyle changes can be easily inculcated.

National Institute of Health (NIH) task force of USA has recommended that blood pressure measurements along with weight and height should be recorded at least once a year.

Hence, the present study was undertaken with aim of estimating the prevalence of pre-hypertension and hypertension along with its associated risk factors in the adolescent age group of 10-17 years in both government and semi-government schools situated in semi- urban area in Pune, Maharashtra.

METHODS

An observational/cross-sectional study was conducted amongst adolescents studying in std 5th to std 9th. Two schools were selected randomly; one government and one private, after obtaining prior permission and consent from the concerned authorities.

A total 507 students belonging to the age group of 10-17 years, present in schools on the day of assessment were enrolled. For the purpose of the study the students were given consent forms to secure consent from the parents/guardian. The age was determined from birth date of school registration records. Information of each student was collected in a pretested questionnaire with details of age, sex, class studying, address, duration of physical activity, dietary habits with junk foods.

Physical activity was defined as more than 1 h of outdoor activity per day for at least 5 days/week, in the form of play or walk or domestic helps like household chores. Junk food was defined as food that has high calories and low nutritional content such as chips, other fried items, and soft drinks. Increased frequency of junk foods was considered as more than two times in a week. Weight was measured with the student on bare feet and with light clothing using electronic weighing balance to the nearest 0.1 kg. From the measured weight study subjects were then classified as underweight, normal, overweight and obese.

- Underweight: A child was labeled as underweight when BMI was less than or equal to 5th percentile for that age and sex.
- Normal: A child was labeled as normal when BMI was more than 5th percentile but less than 85th percentile for that age and sex.
- Overweight: A child was labeled as overweight when BMI exceeded 85th percentile for that age and sex.
- Obese: A child was labeled as obese when BMI exceeded 95th percentile for that age and sex.

Height was measured to the nearest 0.5 cm using a non-elastic measuring tape, fastened to a vertical wall, with the student standing on bare feet. From the height and weight obtained, body mass index (BMI) was calculated using the formula, BMI = Weight (kg)/height (m^2).

Blood pressure was measured using a mercury sphygmomanometer with an appropriate sized cuff (cuff width approximately 40% of mid-arm circumference) which covered two thirds of the upper arm length with the child in the sitting position after a rest of five minutes to alley any fear or anxiety and arm at the level of the heart. Whenever the systolic blood pressure (SBP) or the diastolic blood pressure (DBP) was found to be higher than the average for the age and gender; the child was made to rest for an additional 10 minutes and 2 readings were taken and the lowest amongst the three were then used.

Those found hypertensive and/or obese were advised further evaluation. The blood pressure was grouped as normal pressure, pre-hypertension and hypertension using the blood pressure for height charts given by the Indian Academy of Pediatrics (IAP).[14]

- Normal BP in children was defined as systolic and diastolic BP less than the 90th percentile for gender, age and height.
- High normal BP or pre-hypertension was defined as systolic and diastolic BP greater than or equal to the 90th percentile but less than the 95th percentile. Adolescents with BP levels greater than or equal to 120/80 mmHg but less than 95th percentile were considered pre-hypertensive.
- Hypertension was defined as SBP or DBP that is greater than or equal to the 95th percentile.

Data entry and analysis of the variables was done using Statistical Package for Social Sciences version 16 software. Both descriptive and inferential statistics was used to analyze the data. The p-value of <0.05 was considered as statistically significant.

RESULTS

A total of 507 school children in the age group of 10-17 years from one private school and one semi-govt. school were enrolled for the study. The prevalence of hypertension in the study was 10.85% and that of pre-hypertension was 15.4%. The study also revealed statistically significant higher prevalence of hypertension in males than in females.

Table 1: Profile or characteristics of students/subjects.

Parameter		Number	Percentage
Age in years	10	109	21.49
	11	114	22.49
	12	124	24.46
	13	53	10.46
	14	50	9.86
	15	33	6.50
	16	09	1.77
	17	15	2.96
Sex	Male	283	55.82
	Female	224	44.18
Type of school	Govt.	209	41.22
	Private	298	58.77

Males recorded a higher mean SBP and DBP in comparison to females which could be attributed to puberty with rise in Testosterone which leads to the post pubertal increase of B.P There was variable change in SBP and DBP in both genders with increase in age. This may be due to physiological change in the body mass in adolescents. The prevalence of pre-hypertension and hypertension in the present study amongst the age group of 10-17 years. was 15.4% and 10.85% respectively. The prevalence of hypertension was much higher. The variations in the percentage of pre-hypertension and hypertension may be attributed to the difference in geographical location, socio-cultural and socioeconomic backgrounds. The overall prevalence of hypertension was found to be more in the age group of 12-15 years. This can be attributed to either biological change during puberty or due to increased body mass or due to hormonal changes in puberty. Higher prevalence of hypertension was observed in males. This can be attributed to body composition and mass or due to hormonal changes in puberty (Table 1).

Prevalence of hypertension increased from 7.79% in students who were underweight to 52.8% in children who were obese.

Regarding nutritional status 47.62% of obese subjects were pre hypertensive/ hypertensive whereas only 25.7% normal subjects were pre hypertensive/hypertensive, the difference was found statistically significant (Table 2).

Table 2: Prevalence of elevated BP and hypertension by BMI.

Nutritional status by BMI	Number	N (%)			p value
		Normal BP	Elevated BP	Hypertension	
Underweight	77	63	08 (10.39%)	06 (7.79%)	p<0.05
Normal	331	246	57 (17.22%)	28 (8.46%)	
Overweight	78	54	11 (14.1 %)	13 (16.66%)	
Obese	21	11	02 (9.52%)	08 (38 %)	

Table 3: Risk factors associated with prevalence of hypertension.

		N (%)			p value
		Normal BP	Pre-hypertension	Hypertension	
Junk / Salty food frequency /week	0-2	180	38	12	p = 0.000016
	2,3	155	33	23	
	4,5	22	5	13	
	>=6	18	2	6	
Physical activity	Adequate	334	68	49	p =0.69
	Inadequate	40	10	6	
Family history of hypertension	Yes	68	22	21	p = 0.001394
	No	306	56	34	

Though inadequate physical activity is one of the major risk factor for the prevalence of hypertension; in the present study the proportion of pre-hypertension and hypertension in adolescents with low physical activity was not significantly high when compared to normal subjects. In this study, 19% of children had positive

family of hypertension. The increased frequency of intake of junk and/or salty food has shown to have a strong co-relation with hypertension. Nearly 6 (23.07%) out of the 26 people who had junk food more than 6 times a week were shown to have hypertension as compared to the 12 (5.21%) out of the 230 people who had junk food less than 2 times in a week (Table 3).

Table 4: Comparison of various studies with present study pertaining to prevalence of hypertension and age groups.

		Age group in years	Prevalence of hypertension
Present Study		10-17 years	11.83%
China[15]		12-17 years	13.1%,
Singh et al[16]	Delhi	12-17 years	11.7%
Sundaret et al[17]	Chennai	12-17 years	21.5%
Chakraborty et al[18]	Kolkata	12-17 years	3.67%
Borade A et al[19]	Pune	12-17 years	10.91%
Lone et al[20]	Nagpur	12-17 years	11.77%
Borah PK et al[21]	North east India	5-14 years	7.6%

This study records a prevalence of hypertension as 11.83% in the age group 10-17 years which is comparable with many other studies mentioned.

DISCUSSION

A total of 507 school children in the age group of 10-17 years from one private school and one semi-govt. school were studied. Of these 209 were from semi-Govt. school and 298 were from private school. Study subjects comprised of 283 males and 224 females. In this study, the mean systolic and mean diastolic blood pressures observed in the present study are lower than that of Singh N et al in the comparable age groups.[22] This difference suggests that factors other than body weight, such as height, dietary habits, physical activities, geographical locality may be playing a role in the determination of blood pressure. Males recorded a higher mean SBP and DBP in comparison to female which was seen in another study as well.[23] During puberty with rise in Testosterone which leads to the post pubertal increase of BP in boys.[24] Mean SBP and DBP were higher in children studying in private school as compared to children from semi-Govt. school. There was variable change in SBP and DBP in both genders with increase in age. This may be due to physiological change in the body mass in adolescents.

The prevalence of pre-hypertension and hypertension in the present study amongst the age group of 10-17 years. was 15.4% and 10.85% respectively. The prevalence of hypertension was much higher as compared to study done earlier.[25-27] Prevalence of pre-hypertension was comparable with other studies.[28,29] Other studies done in different parts of India reported a vast range in the prevalence of hypertension in children and adolescents. The variations in the percentage of pre-hypertension and hypertension may be attributed to the difference in geographical location, socio-cultural and socioeconomic backgrounds.

The overall prevalence of hypertension was found to be more in the age group of 12-15 years. This can be attributed to either biological change during puberty or due to increased body mass or due to hormonal changes in puberty. Higher prevalence of hypertension was observed in males. This can be attributed to body composition and unhealthy dietary practices. However, Borah et al from Assam reported higher prevalence of hypertension among girls.[20] While no gender difference was seen in study done by Gupta et al.[30]

Prevalence of hypertension increased from 7.79% in students who were underweight to 52.8% in children who were obese. Regarding nutritional status 47.62% of obese subjects were pre hypertensive/ hypertensive whereas only 25.7% normal subjects were pre hypertensive/hypertensive, the difference was found statistically significant. Sorof et al, also found higher prevalence of hypertension in obese children as compared to non-obese (33% v/s 11%).[31] Though inadequate physical activity is one of the major risk factor for the prevalence of hypertension; in the present study the proportion of pre-hypertension and hypertension in adolescents with low physical activity was not significantly high when compared to normal subjects. This is in contrast to the study by Bute et al, with a significant association of low physical activity with pre-hypertension and hypertension.[32] This may be due to the difference in the duration of physical activity taken in the study. Evidence exists that hypertension tends to aggregate in families and the cause can be genetic, environmental or both. In this study, 19% of children had positive family of hypertension.

This is in accordance with the earlier study.[33]

The increased frequency of intake of junk and/or salty food has shown to have a strong co-relation with hypertension. Nearly 6 (23.07%) out of the 26 people who had junk food more than 6 times a week were shown to have hypertension as compared to the 12 (5.21%) out of the 230 people who had junk food less than 2 times in a week and this difference was statistically significant. In a similar study carried out in Bihar, among 5-19 years adolescents, by Kumar et al, hypertension was significantly associated with type of diet ($p < 0.001$).[34] A

study conducted in Kerala also had similar associations between junk foods and pre-hypertension/ hypertension.[35]

The study had some limitations. Classification of hypertension was based on measurement of BP in a single visit. It is recommended that students with BP>95th percentile on first screening should undergo a second screening 1-2 weeks later and then the third screening if BP is noted >95th percentile at the second screening. Due to academic engagements and administrative issues, we could not practice the second and third screening. Repeated blood pressure recordings on different occasions were not done, again due to time constraint.

All variables were assessed based on the responses given verbally by the students.

CONCLUSION

The prevalence of hypertension (10.85%) as well as pre hypertension (15.4%) among the adolescents was alarmingly high and thus necessitates urgent intervention in the form of life-style modification. Gender, obesity, unhealthy food habits and lack of physical activity were found to be the major risk factors of adolescent in our study. There is a need to create awareness among school students particularly in adolescent age group regarding hypertension and its complications. Blood pressure recording should be a part of school health program and therefore, school authorities should organize screening programs in their respective schools to identify and treat hypertension early to prevent its late complications.

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