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Original Article

Paediatrics Section

Prevalence of Hypertension and its Risk Factors Among School Going Adolescents of Patna, India

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ABSTRACT

Introduction: Hypertension (HT) has its origin in childhood and adolescent period but it goes undetected due to absence of sign and symptoms, unless specifically looked for during this period. It has been seen that one with raised blood pressure level in this period will also have raised Blood Pressure (BP) level in their adulthood and elderly period.

Aim: The present study was conducted to estimate the prevalence of HT and its risk factor among apparently healthy school going adolescents of Patna district.

Materials and Methods: A cross-sectional study among 2913 school going adolescents of eighth to 10th standard was conducted from April 2014 to August 2015 by adopting a two stage cluster sampling technique. The questions pertaining to risk behavior in relation to cardiovascular diseases from WHO's Global School based Student Health Survey were used for this study.

Results: The mean systolic and diastolic blood pressure of study population was 107.4 mm of Hg (95% C.I. 106.93-107.77) and 67.4 mm of Hg (95% C.I. 67.26-67.54), respectively. Prevalence of pre-HT and HT was 10.9% and 4.6% in school going adolescents while prevalence of overweight/obesity was 1.5%. Both systolic and diastolic blood pressures had positive and significant correlation with age, height and body mass index. The proportion of children who had ever taken tobacco was 5.3%, cigarette smoking 4.3%, alcohol consumption 2.1%, and excess salt intake 22.3%. Only 49.1% children were doing physical activity at least one hour a day in past seven days for maintenance of good health.

Conclusion: The present study recommends that regular screening of blood pressure level must be initiated in adolescents so that remedial measure can be initiated as early as possible.

Keywords: Cardiovascular diseases, Dietary habit, Life style, Obesity

INTRODUCTION

The developing countries are experiencing an epidemiological transition from communicable diseases to non-communicable diseases. Developed countries have already gone through this transition while developing countries are following this trend. Modern life style pattern leads to increased risk of HT and cardiovascular diseases. Systemic HT has an estimated prevalence of 1–2% [1] in the developed countries and 5–10% in developing countries like India [2]. The risk factors for HT include obesity, family history of HT, change in dietary habits, decreased physical activity, and increasing stress [3]. Although the overall prevalence of HT is lower in children, studies suggest that it tends to develop during the first two decades of life [4]. So, the elevated BP in children and adolescents may be an early indication of essential HT in adulthood.

HT is a major health problem in developed and developing countries associated with high mortality and morbidity affecting approximately one billion individuals worldwide [5]. Since sign and symptoms generally do not appear during childhood and adolescence so it goes undetected during this period. Prevalence of HT increases with age and in adolescence as well. It is multifactorial disease, influenced by genetic, racial, geographic, cultural and dietary patterns [6].

BP normally increases with growth and development. It has been seen that individual with raised blood pressure level in childhood tend to have raised blood pressure level in their adulthood and elderly period [7]. The chances of ischemic heart disease increases in hypertensive. BP is considerably lower in children than in adults but usually increases steadily throughout the first two decades of life [8-11]. In a study by Nelson MJ et al., juvenile BP measured from age six years onward was found to be a positive predictor of BP at age 30 years. BP measured at age 50 years was predicted best by juvenile-pressures measured at early school age and early puberty [12].

The BP varies with age, sex, weight, height, Body Mass Index (BMI), social economic status, family history of HT and dietary habits. It is very difficult to record reliable BP in children below six years by conventional methods; hence the ideal age would be 6–16 years, i.e., school children. National Institute of Health (NIH) of USA has also recommended that BP measurement should be recorded along with other anthropometric measurements, to be done in children at least once a year. But, even today in many parts of world including India, this practice has not been implemented [13].

The present study was conducted to evaluate the prevalence of HT and pre-HT among apparently healthy school going adolescents of Patna district and to assess the magnitude of various risk factors of Cardio-Vascular Diseases (CVD) among them.

MATERIALS AND METHODS

The study was a cross-sectional study conducted from April 2014 to August 2015 among students of various government high schools at Patna, Bihar, India of adolescent age group studying in eighth, ninth and 10th standards.

Considering, 11.7% prevalence of HT among school children [4] with 15% relative error, the sample size was calculated to be 1342 by using the formula $N=4pq/L^2$. Taking the design effect of two into account and non-response of 10%, the sample size comes out to be 2952.

Sampling Method: All government schools in Patna district were considered eligible for the study. The study subjects were drawn by two stage stratified cluster sampling, the strata being schools and classes in the schools. The students of class eighth, ninth and 10th standard were taken for the study. Fifty students from each class were randomly selected from the list of students for each class.

So, total 150 students were selected from each school. Finally, 3000 students from 20 schools were enrolled and interviewed for the study. In the process of data entry 87 data were incomplete so those were excluded from final analysis. Finally, data of 2913 students was analyzed.

Study Instruments: A pre-designed, pre-tested, semi-structured, self-administered questionnaire, containing identification data i.e., age, sex and class, questions pertaining to risk behavior in relation to cardiovascular diseases. The questions pertaining to awareness and risk behavior in relation to CVD were taken from WHO's Global School based Student Health Survey (GSHS), which includes questions on eating behavior (like eating junk food, etc.,), physical activity, obesity, tobacco, alcohol use and their awareness about these [14]. In addition, questions were designed for awareness about high salt intake and skills in avoiding all these risk factors. The questionnaire was translated into Hindi by a trained Hindi translator. The questionnaire was pre-tested in both languages on twenty students in government schools and suitable modifications were done before finalization. The questionnaire was self administered and the investigators were present to solve any query at the time of filling up of questionnaire by students.

All adolescents were clinically examined with special emphasis on evaluation of cardiovascular system. Anthropometric measurements were recorded as per the recommendations [15]. The weight was recorded to the nearest 0.1 kg by weighing scale and the height was noted to the nearest 0.5 cm using a measuring scale. BMI was calculated by the formula: BMI=Weight (in kg)/ Height (in m^2). Then all the students were classified according to BMI scores using CDC 2000 classification for BMI for age for children into Underweight, Normal and Overweight/Obese. Underweight was defined as BMI-for-age less than fifth percentile and overweight as more than 85th percentile while obese if BMI was more than 95th percentile of reference. Normal BMI-for-age was taken as values equal or more than fifth percentile but equal or less than 85th percentile of the reference data.

BP was measured using standardized sphygmomanometers with appropriate size cuff. The BP was measured with the child in a sitting position, mostly at the end of interview session, so that students remain relaxed. The cuff was inflated to a level at which the distal arterial pulse was not palpable. It was then deflated at a rate of 2-3 mmHg per second. In this way, systolic and diastolic blood pressures were recorded. Three BP readings of each student were taken at two minutes intervals. The average of the three readings was recorded for both systolic and diastolic blood pressures of each student. All the three readings were taken by the same trained person.

Blood pressure is taken as normal when systolic and diastolic blood pressure is <90th percentile for gender, age and height. Pre HT is defined as Systolic Blood Pressure (SBP) or Diastolic Blood Pressure (DBP) between the 90th and 95th percentile. Adolescents having blood pressure >120/80 mmHg, but below the 95th percentile were also included in this category. HT is defined as SBP or DBP exceeding the 95th percentile for age, gender, and height [16].

STATISTICAL ANALYSIS

The data was entered and analyzed by using SPSS software version 22.0. Simple frequency and percentage were used wherever required. Chi-square test was applied to see the significance for categorical variables. Mean systolic and diastolic blood pressure was calculated for boys and girls and for different age. Analysis of variance (ANOVA) test was applied to see the significance of distribution of blood pressure among students in different age. Pearson correlation co-efficient was used to see the correlation among systolic and diastolic blood pressures, body weight, height and BMI. The p-value for significance was set at 0.05.

The study protocol was approved by ethical committee of All India Institute of Medical Sciences (AIIMS), Patna. A prior consent for the study was taken from school administration and from the parents. At the time of the initiating the study each participant was informed about the study protocol and informed consent was obtained.

RESULTS

The present study included 2913 adolescents which included 1168 males (40.1%) and 1745 females (59.9%). Total prevalence of HT in our study was 4.6%. The prevalence of pre-HT was 10.9%. Prevalence of HT in males was 5.0% and in females was 4.3%. We observed that prevalence of HT increases with age and it was significant statistically (p<0.01) [Table/Fig-1].

For the boys, the prevalence of HT among underweight was 1%, among normal was 6%, among pre-obese was 12.5% and among obese was 33.3%. For the girls the prevalence of HT among underweight was 1.9%, among normal was 4.6%, among pre-obese was 7.7% and among obese was 8.3%. So, as we go from underweight to obese the percentage of HT increases [Table/Fig-2]. As the age increased the mean systolic blood pressure and mean diastolic blood pressure also increased which was significant statistically [Table/Fig-3,4].

The result revealed that systolic and diastolic BP have a positive correlation (p<0.01) with age. Correlation coefficient of systolic BP with age was found to 0.122, and that of diastolic blood pressures 0.122. Similarly, a positive and significant correlation of SBP and DBP were present with height and BMI [Table/Fig-4].

The proportion of adolescents who had ever chewed tobacco

Variables	Normal	PHT	HT
Age (years)			
13	740(90.0)	55(6.7)	27(3.3)
14	901(85.2)	114(10.8)	43(4.1)
15 and above	822(79.6)	148(14.3)	63(6.1)
Total	2463(84.6)	317(10.9)	133(4.6)
Test of significance χ^2 =39.38, df=4, p=0.000			
Gender			
Male	973(83.3)	137(11.7)	58(5.0)
Female	1490(85.4)	180(10.3)	75(4.3)
Test of significance	χ^2 =2.32, df=2, p=0.31		

[Table/Fig-1]: Age and gender wise distribution of hypertension among study subjects (N=2913).
(Figures in parenthesis denote percentage; PHT: Prehypertension, HT: Hypertension, df= degree of freedom)

BMI	Boys (n=1168)			Girls (n=1745)		
	Normal	PHT	HT	Normal	PHT	HT
Underweight	280(96.2)	8(2.7)	3(1.0)	330(91.2)	25(6.9)	7(1.9)
Normal	683(79.1)	128(14.8)	52(6.0)	1425(84.4)	185(11.0)	78(4.6)
Pre-obese	6(75.0)	1(12.5)	1(12.5)	21(80.8)	3(11.5)	2(7.7)
Obese	4(66.7)	0(0)	2(33.3)	6(50.0)	5(41.7)	1(8.3)

[Table/Fig-2]: Distribution of hypertension according to nutritional status (N=2913).
The figures in parenthesis denote percentage; PHT: Prehypertension, HT: Hypertension, df= degree of freedom)

Age	SBP		DBP	
	Mean	(95% C.I.)	Mean	(95% C.I.)
13 years(n=822)	105.6	104.94-106.26	65.8	65.24-66.36
14 years(n=1058)	107.4	106.8-108.0	67.5	67.15-67.85
15 years(n=1033)	108.7	108.07-109.33	68.6	68.43-68.77
Total (N=2913)	107.4	106.93-107.77	67.4	67.26-67.54
Test of significance (ANOVA)	F=22.37, p=0.000		F=22.36, p=0.000	

[Table/Fig-3]: Age group wise distribution of systolic and diastolic blood pressure among study subjects (N=2913).
The figures in parenthesis denote percentage

was 5.3% (9.0% among boys and 2.9% among girls), cigarette smoking 4.3% (8.3% among boys and 1.6% among girls), alcohol consumption 2.1% (3.8% among boys and 1.0% among girls), and excess salt intake was also quite high (22.3%). Majority of them were not doing physical activities for maintenance of good health [Table/Fig-5].

DISCUSSION

The present study was conducted to find the prevalence of HT and risk factors of cardio-vascular diseases among school going students. The prevalence of HT among school going adolescents in present study was 4.5%. It was 5.0% among boys and 4.3% among girls. Taksande et al., in their study in Wardha district, found prevalence of HT in children to be 5.75% [17]. Various studies reported prevalence of HT in children between 0.46% to 11.7% [4,18,19]. The reason for low prevalence of HT in some studies may be because of use of means and standard deviation for HT assessment rather than using the more acceptable criterion of 95th percentile of BP-values. Chadha SL et al., in their study reported, prevalence of HT in school children was 11.7% [4]. Similarly, Anjana et al., reported prevalence of HT among boys and girls, as 8.33% and 6.52%, respectively [7]. Both the above studies were conducted in urban schools, where dietary habits and lack of physical activity could have contributed to a higher incidence.

In the present study, the SBP and DBP showed a positive correlation with age, height and BMI which is consistent with the previously reported studies on BP in children [20-23]. In the present study, both SBP and DBP show a significant correlation with increase in age, height and BMI but not with weight. Voors et al., reported that BP was correlated more closely to height and body mass than age [24].

The positive correlation of both systolic and diastolic blood pressure with height in the present study confirms the presence of primary HT among children and suggests that such children are at risk of developing HT at latter stages. The finding recommend that these children should be considered for high risk for developing CVD and type 2 diabetes and must be screened for a close follow up for modification of risk factors.

Healthy dietary patterns developed in childhood are important for prevention of Cardio-Vascular Diseases (CVD) in adulthood. The evidences regarding the effectiveness of long term dietary intervention for the reduction of risk factors for CVD in children is limited, but the available data suggest that changes in specific dietary macronutrients (e.g., dietary fat and carbohydrates) and micronutrients (e.g., sodium and calcium) have an impact on the risk of Cardio-vascular diseases [25]. Unhealthy dietary practices such as junk food and cold drink consumption, less vegetable and fruit intake was found in many school going students in present study. These habits should be prohibited from early age.

In the present study, only 34.8% adolescents were doing regular physical activity to maintain their health. Results of other observational studies on children and adolescents (4–18 years of age) and young adults (19–21 years of age) demonstrate associations between increased time spent in sedentary activities and decreased levels of physical activity, increased levels of obesity, related cardiovascular risk factors, including HT and insulin resistance. Longitudinal data from the Cardiovascular Risk in Young Finns Study and the Muscatine Study, similar to observations of adults, indicate that minimum cardiovascular risk profiles are seen in individuals who are consistently physically active [26,27].

In the present study, 5.3% of the adolescents have admitted to tobacco chewing which was almost similar to 3.05 percent as observed in another school based study by Prajapati et al., [27]. The children, who have tried tobacco in the present study, would have a high risk of becoming regular tobacco users in future, which would lead to an increase in their risk of developing CVD and other non-communicable diseases.

Regarding alcohol consumption, alcohol was seen to be consumed at least once by 3.8% of boys and 1.0% of the girls. In a similar study by Singh AK et al., in a private school of New Delhi, alcohol was seen to be consumed at least once by 30.1% of boys and 26.8% of the girls [28]. The higher percentage of alcohol consumption may be found due to metro culture and life style pattern of New Delhi.

Regarding extra salt in food/salad, it was seen that 24.4% boys

Age (years)	BOYS (n=1168)			GIRLS (n=1745)		
	Fre-quency	Mean	95% C.I.	Fre-quency	Mean	95% C.I.
Systolic Blood-Pressure (SBP)						
13	333	104.5	103.39-105.61	489	106.4	105.60-107.20
14	394	107.2	106.19-108.21	664	107.6	106.85-108.35
15	441	109.9	108.90-110.90	592	107.9	107.11-108.69
Total	1168	107.5	106.89-108.11	1745	107.3	106.83-107.77
Diastolic Blood-Pressure (DBP)						
13	333	64.3	63.29-65.31	489	66.8	66.07-67.53
14	394	67.3	66.42-68.18	664	67.6	66.97-68.23
15	441	69.3	68.38-70.21	592	68.1	67.30-68.90
Total	1168	67.2	66.65-67.75	1745	67.6	67.18-68.02

[Table/Fig-4]: Gender and age groupwise distribution of systolic and diastolic blood pressure among study subjects (N=2913).
(Pearson correlation coefficient of SBP with age, height, weight and BMI were 0.122 (p=0.000), 0.062(p=0.001), 0.010(p=0.607), and 0.128(p=0.000), respectively while Pearson correlation coefficient of DBP with age, height, weight and BMI were 0.122(p=0.000), 0.044(p=0.017), 0.001(p=0.955), and 0.092(p=0.000) respectively)

Risk/Protecting factors of CVD	Boys (n=1168)	Girls (n=1745)	Total (n=2913)
Ever smoked cigarette	97(8.3)	28(1.6)	125(4.3)
Ever chewed tobacco	105(9.0)	50(2.9)	155(5.3)
Ever taken alcohol	44(3.8)	18(1.0)	62(2.1)
Extra salt in food/salad	285(24.4)	366(21.0)	651(22.3)
Junk food consumption everyday in past seven days	24(2.1)	69(4.0)	93(3.2)
Doing physical activities to maintain health (at least one hour a day in past seven days)	362(31.0)	651(37.3)	1013(34.8)
Cold drink consumption one or more time in past seven days	398(34.1)	686(39.3)	1084(37.2)
Did not eat fruits in last seven days	520(44.5)	518(29.7)	1038(35.6)
Did not eat vegetables in last seven days	84(7.2)	68(3.9)	152(5.2)

[Table/Fig-5]: Distribution of study subjects according to presence of risk factors and protective factors of cardio-vascular diseases (N=2913).
The figures in parenthesis denote percentage.

Researcher	Year of study	Study area	Age group (in years)	Prevalence of HTN
Mohan B et al., [3]	2004 (published)	Ludhiana, Punjab	11-17	5.68
Buch N et al., [6]	2011	Surat, Gujarat	6-18	6.48
Sayeemuddin M et al., [13]	2010	Secunderabad, Telangana	6-16	2.42%
Durrani AM et al., [18]	2006-07	Aligarh, Uttar Pradesh	12-16	9.4%
Anand NK and Tandon LL[19]	1996 (published)	Amritsar, Punjab	5-17	0.46%
Shetty SK et al., [20]	2009-10	Manglore, Karnataka	13-17	6.75%

[Table/Fig-6]: Table showing prevalence of hypertension among school going adolescents from various part of India.

and 21.0% girls were taking extra salts. A higher salt intake was also found in a study by Singh AK et al., in a school of New Delhi were 31.5% boys and 16.5% girls were consuming extra salt [28]. Prevalence of HT among school going adolescents from various part of India is shown in comparative table [Table/Fig-6].

LIMITATION

In the present study, we had taken students of government schools in which mostly students of lower and middle socioeconomic group study. In the private and convent schools, mostly students of upper socioeconomic group study who have generally more unhealthy dietary practices related to CVD. So, the prevalence of HT might have increased if we had taken private and convent schools.

CONCLUSION

It is clear that risk factors for cardio-vascular diseases can develop during childhood and adolescence. These factors may be either genetic or environmental. When risk factors start to develop at an early age, they are likely to tail along as the age increases. This tracking is reinforced by ongoing and new adverse health behaviors. All children and adolescents must be screened regularly for blood pressure so that remedial measure can be initiated as early as possible. Restrictions on advertising, promotion, and availability of tobacco products, alcohol and junk foods to children and adolescents should be constituted. As a part of preventive strategies, schools must formulate policies for addressing junk foods consumed in the school premises as well as outside, for promotion of sports and recreational activities and for tobacco frees settings.

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