

A Cross Sectional Study of Blood Pressure Profile in Adolescent School Children of North Kerala

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Received: 03-11-2021 / Revised: 21-12-2021 / Accepted: 15-01-2022

Abstract

Background: Cardiovascular Diseases (CVDs) are a major public health problem and hypertension is considered as an important risk factor for the development of CVDs. The prevalence of hypertension in children and adolescents seems to be increasing and it is often undiagnosed. We conducted this study with the aim of determining the prevalence of hypertension and its association with selected anthropometric variables in adolescent school children. **Method:** This cross-sectional study was conducted in adolescent school children aged between 12 and 16 years. Blood pressure was measured in participants between 9am and 11am in sitting position after 10 minutes of rest with an appropriately sized cuff. Three measurements were taken at an interval of five minutes each and the mean of these readings were taken as average systolic and diastolic blood pressure. Hypertension is taken as systolic and/or diastolic blood pressure >95th percentile for gender, age and height and prehypertension as 90-95th percentile and <90th percentile as normal blood pressure. **Results:** In this study 882 school children aged between 12 and 16 years were included and out of them 460 were males (52.2 %) and 422 were females (47.8 %). Based on Body mass index (BMI) 47 of them were underweight, 596 were normal weight, 239 were overweight / obese. Among them 613 (69.5 %) were having normal blood pressure, 197 (22.3%) were having elevated BP, 57 (6.5 %) were having stage 1 hypertension and 15 (1.7%) were having stage 2 hypertension. **Conclusion:** The prevalence of prehypertension and hypertension in school children is increasing in our community and BMI was found to have a significant association with elevated blood pressure. Regular screening of adolescent school children and detection of prehypertension through specific school health programme and early intervention is an urgent need to prevent hypertension and related comorbidities in young population.

Keywords: Hypertension, BMI, School Children.

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Introduction

Cardiovascular diseases (CVDs) are now a major global public health problem. Hypertension is considered as one of the major risk factors for the development of CVDs like coronary artery disease and stroke in adults. Hypertension is associated with high mortality and morbidity affecting approximately one billion individuals worldwide.¹ India is on a major epidemiological transition with regard to lifestyle diseases including CVDs. The prevalence of hypertension in children and adolescents seems to be increasing in both developed and developing countries like India.² Hypertension and prehypertension were frequently undiagnosed in paediatric population.³ The overall prevalence of hypertension though lower in children tends to develop during early adolescence and progress to adulthood. This rise in prevalence of hypertension in children is attributed to increasing prevalence of obesity and also due to lack of adequate physical activity. Blood pressure in children is regarded as a reliable predictor of their adult blood pressure level, but there are only limited studies in children based on the prevalence, profile and diagnostic criteria of blood pressure from our region. We conducted this study to find the prevalence of hypertension in adolescent school children of both sexes aged 12-16 years and to determine the association of hypertension with selected anthropometric variables.

Materials and Methods

This cross-sectional study was conducted in apparently normal adolescent school going children of the age between 12 and 16 years and both sexes were included. Children having any acute illness at the time of study and known cardiovascular and renal diseases were

excluded. Data was collected in a pre-tested proforma meeting the objective of the study. Informed consent was obtained from the concerned institutions before conducting the study. Blood pressure was measured in all participants between 9am to 11am in sitting position after 10 minutes of rest. BP was measured after applying an appropriately sized cuff. The cuff size used was with an inflatable bladder width of at least 40% of the arm circumference and bladder length of 80% of the arm circumference. Arm circumference was measured at a point midway between the acromion and the olecranon. Blood pressure was measured in the arm supported at the level of the heart. Height was measured by making the child to stand upright barefoot, on the ground with heels, buttocks and shoulder touching the wall and head in Frankfurt plane. The height was measured using a sliding stadiometer with an accuracy of 0.1mm. Weight was recorded using a standardized weighing machine with an accuracy up to 0.1 kg. Systolic blood pressure was determined as appearance of 1st Korotkoff sound and diastolic blood pressure was taken at the point of muffling of heart sounds[4]. Three measurements were taken at an interval of five minutes each and the mean of these readings were taken as average systolic and average diastolic blood pressure. Hypertension is defined as average systolic and/or diastolic blood pressure >95th percentile, prehypertension as 90-95th percentile and <90th percentile as normal blood pressure for the age, gender and height. In those children whose systolic and diastolic blood pressures were found to be more than 95th percentile for the age, sex and height, two sets of blood pressure reading were taken at an interval of 4 weeks. After recording weight and height of the school children, Body mass index was calculated and based on these values children were classified as obese if BMI >95th percentile, overweight if 85-95th percentile and normal if <85th percentile[5].

Statistical Tests: Categorical and quantitative variables were expressed as frequency (percentage) and mean \pm SD respectively. Chi-square test was used to find association between categorical

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variables. For all statistical interpretations, $p < 0.05$ was considered the threshold for statistical significance. Statistical analysis was performed by using a statistical software package SPSS, version 20.0

Results

In our study we included 882 school children aged between 12 and 16 years and out of them 460 were males (52.2 %) and 422 were females (47.8 %). Based on the age of the children 409 belonged to 14 years age, 217 to 13 years and 210 children belonged to 15 years. Age and gender wise distribution of study participants are represented in the Table 1. Among the 882 school children, a family history of systemic hypertension was found in 91 (10.3 %), diabetes in 154 (17.5 %) and combined systemic hypertension and diabetes in 124 (14.1 %). According to the socio-economic status (SES) 224 (25.4%) belonged to low SES, 586 (66.4%) belonged to middle SES and 72 (8.2%) belonged to high SES. In this study group 855 (96.9 %) were taking a mixed diet and only 27 (3.1 %) were taking a pure vegetarian diet. Among them 708 (80.3%) were having a Junk food intake less than 3 times per week and 174 (19.7%) were having a junk food intake more than 3 times per week. Based on the level of physical activity 396 (44.9%) were having a physical activity for more than 1 hour and 486 (55.1%) were having an activity less than 1 hour. The school children were classified based on BMI calculated from weight and height into different groups; 11 (1.2%) of them were severe underweight, 36 (4.1%) were underweight, 596 (67.6%) were normal weight,

158(17.9%) overweight and 81(9.2%) were obese. Among the 882 school children; 613 (69.5 %) were having normal blood pressure, 197 (22.3%) were having elevated BP, 57 (6.5 %) were having stage 1 hypertension and 15 (1.7%) were having stage 2 hypertension (Table 2). Among those 197 children with elevated blood pressure 101 were males and 96 were females, 57 children with stage 1 hypertension 36 were males and 21 were females, 15 children with stage 2 hypertension 11 were males and 4 were females. On analysis no significant difference in blood pressure was noted based on gender (Table 3). In those 215 children with a family history of hypertension; 65 (30.2 %) had elevated BP and those 667 children without family history of hypertension 204 (30.6%) had elevated blood pressure. No significant association was noted between family history of hypertension and elevated BP in this age group. In those 47 study subjects who were underweight only 4 (8.5%) had elevated BP, 596 subjects who had normal BMI 133 (22.3%) had elevated BP and those among 239 overweight/obese children 132 (55.2%) had elevated BP. Based on the statistical analysis to find the association between selected anthropometric variables to blood pressure it was found that there was a significant association between BMI and blood pressure. Other variables like age, gender, socio economic status, family history of chronic illness, dietary habits, intake of junk foods and physical activity had no statistically significant association to blood pressure in this study (Table 4).

Table 1: Distribution of age and gender of the study participants

Age	Male		Female		Total	
	Count	Percent	Count	Percent	Count	Percent
12	24	5.2	22	5.2	46	5.2
13	116	25.2	101	23.9	217	24.6
14	195	42.4	214	50.7	409	46.4
15	125	27.2	85	20.1	210	23.8

Table 2: Percentage distribution of the sample according to BP

BP	Count	Percent
Normal	613	69.5
Elevated BP	197	22.3
Stage 1 Hypertension	57	6.5
Stage 2 Hypertension	15	1.7

Table 3: Comparison of BP based on gender

BP	Male		Female		χ^2	p
	Count	Percent	Count	Percent		
Normal	312	67.8	301	71.3	5.91	0.116
Elevated BP	101	22.0	96	22.7		
Stage 1 Hypertension	36	7.8	21	5.0		
Stage 2 Hypertension	11	2.4	4	0.9		

Table 4: Association of BP with selected variables in school children aged 12 -16 years

		BP				χ^2	p
		Normal		Elevated			
		Count	Percent	Count	Percent		
Age	12	27	58.7	19	41.3	5.82	0.121
	13	162	74.7	55	25.3		
	14	283	69.2	126	30.8		
	15	141	67.1	69	32.9		
Gender	Male	312	67.8	148	32.2	1.27	0.259
	Female	301	71.3	121	28.7		
Socioeconomic status	Low	156	69.6	68	30.4	3.61	0.164
	Middle	414	70.6	172	29.4		
	High	43	59.7	29	40.3		
Family history of chronic illness	No	356	70.2	151	29.8	0.29	0.591
	Yes	257	68.5	118	31.5		
Diet	Vegetarian	16	59.3	11	40.7	1.38	0.240
	Mixed	597	69.8	258	30.2		
Junk food intake	<3 times/week	497	70.2	211	29.8	0.82	0.365
	>3 times/week	116	66.7	58	33.3		

Physical activity	<1 hour	281	71.0	115	29.0	0.72	0.396
	>1 hour	332	68.3	154	31.7		
BMI	Under weight	43	91.5	4	8.5	98.51	p<0.01
	Normal	463	77.7	133	22.3		
	Overweight /Obese	107	44.8	132	55.2		

Discussion

In this cross-sectional study of 882 school children aged between 12-16 years; 460 were males and 422 were females. Among them a family history of systemic hypertension was found in 10.3 % and combined systemic hypertension and diabetes in 14.1 %. According to the socio-economic status majority belonged to middle socio-economic group. In this study group majority were taking a mixed diet. Based on BMI 67.6% were normal weight, 17.9% were overweight and 9.2% were obese. In those 215 children with a family history of hypertension; 65 (30.2 %) had elevated BP and those 667 children without family history of hypertension 204 (30.6%) had elevated blood pressure. No significant association was noted between family history of hypertension and elevated BP in this age group in our study. In our study the overall prevalence of hypertension was found to be 8.2 %; 6.5 % were having stage 1 hypertension and 1.7% were having stage 2 hypertension. In a prospective, cross-sectional study carried in 2643 school children between 6–17 years from eight different schools in the rural areas of Wardha district the prevalence of hypertension was 5.75% (i.e., 3.25% for systolic HT and 2.49% for diastolic HT)[6]. In another study conducted in school children of Surat city of Western India aged between 6 to 18 years, total prevalence of hypertension in school going children was 6.48%[7]. In another cross-sectional study conducted by D Kishor Kumar et al to measure the prevalence of hypertension among 310 rural school children aged 11-15 years in Tamil Nadu the prevalence of hypertension and pre-hypertension were 10% and 14.2%, respectively. The prevalence of systemic hypertension in our study was found to be comparable to other similar studies from various parts of India. In this study 197 among 882 (22.3%) adolescent school children were having an elevated blood pressure (Prehypertension) between 90th-95th percentile. In another study conducted by Tony L et al in 2438 school children between 13-17 years from southern part of our state a prevalence of prehypertension was noted as 21.3%.⁸ This percentage of prehypertension detected in our study was high compared to previous studies done few decades back which reveals the fact that prevalence of prehypertension is slowly emerging in our community because of the lifestyle changes resulting in overweight/obesity among the adolescent children. Among those 197 children with elevated blood pressure 101 were males and 96 were females; 57 children with stage 1 hypertension 36 were males and 21 were females; 15 children with stage 2 hypertension 11 were males and 4 were females. On analysis we did not find any significant difference in blood pressure based on gender. In another epidemiological study of blood pressure among 10,215 school children (5-14 years) in Delhi the prevalence of hypertension (systolic, diastolic or both) was 11.9 percent in boys and 11.4 percent in girls and no significant difference was noted based on gender[9]. This points that in this adolescent age group gender alone is not an important determinant for developing high blood pressure. In our study to find the association between selected anthropometric variables to blood pressure it was found that there was a significant association between BMI and elevated blood pressure. In a study conducted by Chakraborty et al among adolescent children of Kolkata city a statistically significant association was observed between hypertension and overweight/obesity[10]. In another study done by Shah et al among adolescents of Surat city they found that prevalence of hypertension was more in obese as compared to normal children[11]. In another study conducted by Verma et al on 2560 school children of Punjab to evaluate the prevalence of hypertension in apparently healthy school children the prevalence of hypertension was much higher in obese as compared to non-obese children and this

Conflict of Interest: Nil Source of support: Nil

correlation was statistically significant[12]. It was evident from these school-based epidemiological studies that an increase in weight for height/BMI in adolescent age itself predisposes the individual to a greater risk of developing elevated blood pressure and subsequent systemic hypertension. Other variables like age, gender, socio economic status, family history of chronic illness, dietary habits, intake of junk foods and physical activity we selected had no statistically significant association to blood pressure in our study.

Conclusion

The prevalence of prehypertension and hypertension in school children aged between 12-16 years were found to be 22.3 % and 8.2 % respectively. Among the selected variables analysed BMI was found to have a significant association with elevated blood pressure. Regular screening of adolescent school children and detection of prehypertension through specific school health programme and early intervention is an urgent need to prevent hypertension and related comorbidities in young population.

Acknowledgement

I would like to thank Dr. Oommen. P. Mathew, Senior Consultant Statistician Thiruvananthapuram for guiding me in the data analysis.

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