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Original Research Article

Prevalence of hypertension in urban school children aged 5 to 10 years in North India

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ABSTRACT

Background: Blood pressure in children is a known predictor cardiovascular health and outcome in adulthood. Prevalence of hypertension in Indian adults is rising over the years. It is anticipated that the blood pressure in Indian children might have also increased over the years. This study was undertaken to document the prevalence of hypertension among urban school children aged 5-10 years in North India.
Methods: This cross-sectional study was undertaken in 28 private schools in urban Faridabad, Haryana. A total of 5636 children aged 5 to 10 years from both sexes undergone blood pressure, height and weight measurement. Prevalence of hypertension and pre-hypertension was estimated using the available reference cutoff for Indian children. The prevalence of hypertension and pre-hypertension was compared for different BMI categories and gender.
Results: Overall the prevalence of hypertension was 19.7%, while 13.4% children were in pre-hypertensive range. The prevalence of hypertension increased with BMI and age in both sexes. The prevalence of hypertension was higher in girl than boys. Hypertension was documented in 14.6% of the underweight and 20.6% of normal-weight children.
Conclusion: A high proportion of children were hypertensive or pre-hypertensive. The prevalence of hypertension in under-weight and normal-weight children indicate need for systematic documentation.

Keywords: Children, Hypertension, Pre-hypertension, Underweight

INTRODUCTION

Global burden of disease data (2015) reveal that ischemic heart disease and cerebrovascular disease are the two of top three causes of deaths in India. There has been 16.7% and 7.6% increase in the burden of deaths due to these two causes since 2005. Hypertension is the leading risk factor responsible for cardiovascular diseases and catastrophic events leading to death and disabilities.[1] In resource poor societies like India, the economic burden of non-communicable diseases (NCD) related morbidity, mortality is relatively high. Several efforts are being done for primary prevention of the NCDs in India and globally. Determining the risk factors and modifying them reduces its incidence and associated complications. Indian Academy of Pediatrics recommends annual blood pressure measurement of all children over three years of age seen in the clinics or hospitals.[2]

The symptoms of childhood hypertension are usually nonspecific, as most of the children are asymptomatic. Measuring and monitoring of blood pressure in children can help to identify underlying etiology, initiate preventive measures and early management to avoid catastrophic event. But adherence to measurement of blood pressure is limited in most pediatric outpatient practice, which may be due to the lack of attention by pediatricians. This study was planned to document the

distribution of blood pressure and correlation with the nutritional status of the school going children in urban north Indian.

METHODS

This was a cross-sectional study including urban school children aged ≥5 years and ≤10 years from Faridabad district, Haryana. We adopted intelligent two stage sampling: (1) selection of schools and (2) selection of the suitable children from the schools. Thirteen private schools were identified randomly from the list with district education office. After obtaining consent from parent, all the children in eligible age group were screened for weight, height and estimation of BMI. We restricted to 5-10 years of age only to include the pre-pubertal age groups only and to avoid the pubertal influences on the body fat composition and the blood pressure. Weight was measured to the nearest 0.1 kg using TANITA® electronic weighing scale with the child was wearing only school uniform (without shoes). Height was measured to the nearest 0.1 cm using TANITA® Leicester Stadiometer while the child standing on barefoot with head in Frankfurt plane position. Three measures for each were obtained and mean of the measure was used for body mass index (BMI) calculation. BMI, which was defined as the ratio of body weight to body height squared, expressed in kg/m^2. Every morning, the scale and stadiometer were calibrated with standard weight and height respectively. Blood pressure was measured in right arm of the children in sitting position after sitting quietly for at least 10 minutes. Blood Pressure (BP) was measured using automated OMRON HEM 7080 equipment with appropriate cuff for the arm length. Three readings were measured and mean was considered as final reading. In case of significant variations in the readings, repeat measure was taken after an interval of 10 minutes.

The research staffs were trained and certified by assessment of inter-and intra-observer agreement with the investigators. To reduce subjective error, all measurements were taken by the same person. Periodically random checks by the investigators were done in the field and the findings were matched for quality assurance. International Obesity Task Force (IOTF) references for BMI at each age and for each gender were used for classifying the children into underweight, normal-weight and overweight (BMI corresponding to <18.5, ≥18.5-<25 and ≥25 at 18 years of age respectively).[3,4] Mean arterial pressure (MAP) was estimated by formula MAP= 1/3*(2 Diastolic blood pressure-DBP + Systolic blood pressure-SBP). BP classification was done into normal (BP <95th percentile for sex, age and height), pre-hypertension (BP >90th percentile but <95th percentile for sex, age and height), hypertension stage 1 (BP >95th percentile but < 99th percentile for sex, age and height) and hypertension stage 2 (BP >99th percentile for sex, age and height) using the chart by Raj M et al for Indian children.[5] Data was recorded on a pre-designed study tools. The study protocol was approved by institutes' ethics committee. Data analysis was done by STATA using descriptive statistics (means and standard deviations), Mann-Whitney test, unpaired t-test and the chi-square test.

RESULTS

A total of 7115 children (boys: 4188 and girls: 2927) from 28 urban private schools of Faridabad were screened. Out of these children screened, 5643 (boys: 3300 and girls: 2343) children were in the target age group of 5-10 years. The children outside eligible age category (<5 years = 311, >10 years = 943), without birth record at school (n = 207) and unsupportive during measurement (n = 11) were excluded.

Table 1: Blood pressure distribution of subjects.

Age (in years)	Boys			Girls		
	N	Systolic blood pressure	Diastolic blood pressure	N	Systolic blood pressure	Diastolic blood pressure
≥5 to ≤6	597	100.80 (100.11-101.49)	64.45 (63.81-65.09)	418	100.23 (99.34-101.13)	65.34 (64.59-66.1)
≥6 to ≤7	689	102.48 (101-77-103.2)	65.82 (65.24-66.4)	492	101.19 (100.35-102.03)	65.84 (65.18-66.51)
≥7 to ≤8	681	105.77 (105.03-106.51)	67.07 (66.51-67.63)	482	105.24 (104.32-106.16)	68.32 (67.62-69.02)
≥8 to ≤9	639	107.04 (106.27-107.81)	67.28 (66.67-67.88)	488	107.57 (106.68-108.45)	68.91 (68.21-69.60)
≥9 to ≤10	688	108.40 (107.57-109.24)	68.21 (67.59-68.83)	462	109.28 (108.28-110.29)	70.09 (69.32-70.86)
Total (≥5 to ≤10)	3294	104.98 (104.63-105.33)	66.61 (66.34-66.88)	2342	104.78 (104.35-105.21)	67.74 (67.41-68.07)

Figure 1 shows the age and sex wise distribution of the children studied. The number of subjects and gender breakup was similar across all the age bands.

Table 1 reflects the SBP and DBP distribution along with the 95% percentile for the subjects according to age band and gender.

Overall the prevalence of hypertension was 19.7%, while 13.4% children were in pre-hypertensive category. The overall prevalence of systolic hypertension was 14.1% (boys: 14.3% and girls: 14%) and of diastolic hypertension was 11.5% (boys: 10.4% and girls 13%).

Table 2: Prevalence of hypertension according to age group and gender.

Age (in years)	Sex	Blood pressure category			P value
		Normal	Pre-hypertension	Hypertension	
		n (%)	n (%)	n (%)	
≥5 to ≤6	Male (n=597)	429 (71.9)	65 (10.9)	103 (17.2)	0.06
	Female (n=418)	286 (68.4)	55 (13.2)	77 (17.8)	
≥6 to ≤7	Male (n=689)	473 (68.7)	93 (13.5)	123 (17.9)	0.01*
	Female (n=492)	342 (69.5)	70 (14.2)	80 (16.2)	
≥7 to ≤8	Male (n=681)	471 (69.2)	80 (11.7)	130 (19.1)	0.001*
	Female (n=482)	293 (60.8)	67 (13.9)	122 (25.4)	
≥8 to ≤9	Male (n=639)	422 (66)	90 (14.1)	127 (19.9)	0.06
	Female (n=488)	311 (63.7)	82 (16.8)	95 (19.5)	
≥9 to ≤10	Male (n=688)	450 (65.4)	92 (13.4)	146 (21.3)	0.001*
	Female (n=462)	298 (64.5)	59 (12.8)	105 (22.7)	
Total (≥5 to ≤10)	Male (n=3294)	2245 (68.2)	420 (12.8)	629 (19.1)	0.02*
	Female (n=2342)	1530 (65.3)	333 (14.2)	479 (20.4)	

Note: *p value is significant

Table 3: Prevalence of hypertension according to BMI status.

Age (in years)	BMI category	Blood Pressure Category			P Value
		Normal	Pre-hypertension	Hypertension	
		n (%)	n (%)	n (%)	
≥5 to ≤6	Underweight (n=336)	261 (77.7)	33 (9.8)	42 (12.5)	0.001*
	Normal weight (n=603)	411 (68.2)	75 (12.4)	117 (19.4)	
	Overweight/obese (n=76)	43 (56.6)	12 (15.8)	21 (27.6)	
≥6 to ≤7	Underweight (n=380)	276 (72.6)	51 (13.4)	53 (14)	0.001*
	Normal weight (n=712)	495 (69.5)	90 (12.6)	127 (17.9)	
	Overweight/obese (n=89)	44 (49.4)	22 (24.7)	23 (25.9)	
≥7 to ≤8	Underweight (n=331)	240 (72.5)	40 (12.1)	51 (15.4)	0.000*
	Normal weight (n=732)	476 (65)	88 (12)	168 (23)	
	Overweight/obese (n=100)	48 (48)	19 (19)	33 (33)	
≥8 to ≤9	Underweight (n=335)	234 (69.8)	50 (14.9)	51 (15.3)	0.000*
	Normal weight (n=694)	449 (64.7)	102 (14.7)	143 (20.6)	
	Overweight/obese (n=98)	50 (51)	20 (20.4)	28 (28.6)	
≥9 to ≤10	Underweight (n=298)	214 (71.8)	36 (12.1)	48 (16.1)	0.000*
	Normal weight (n=723)	470 (65)	96 (13.3)	157 (21.7)	
	Overweight/obese (n=129)	64 (49.6)	19 (14.7)	46 (35.7)	
Total (≥5 to ≤10)	Underweight (n=1680)	1225 (72.9)	210 (12.5)	245 (14.6)	0.000*
	Normal weight (n=3464)	2301 (66.4)	451 (13)	712 (20.6)	
	Overweight/obese (n=492)	249 (50.6)	92 (18.7)	151 (30.7)	

The prevalence of hypertension gradually increased with age; 17.8% in 5-6 years age, 17.2% in 6-7 years, 21.7% in 7-8 years, 19.7% in 8-9 years and 21.9% in 9-10 years age. Overall prevalence of hypertension was higher in girls (20.4%) than in boys (19.1%). Similarly, more girls (14.2%) were pre-hypertensive compared to boys (12.8%). The age and gender wise breakup of prevalence is shown in Table 2.

As reflected in Table 2, the difference in prevalence of hypertension between girls and boys was significant for majority of the age bands. We also segregated the blood pressure status according to BMI categories, as shown in Table 3.

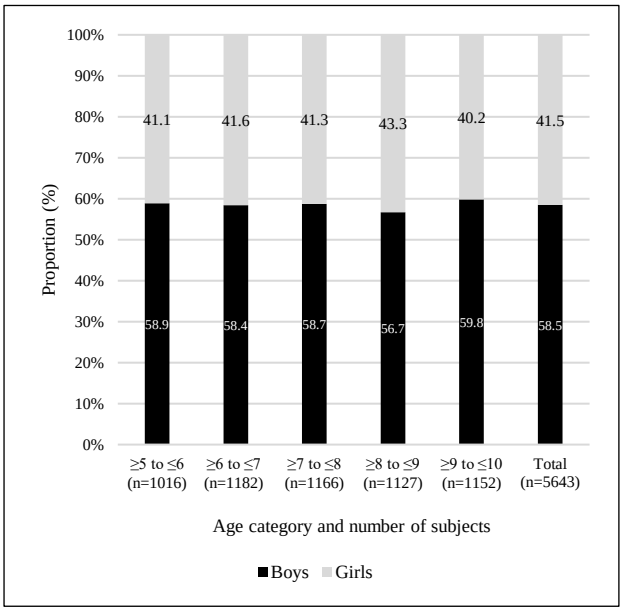

Figure 1: Age and sex distribution of the subjects.

The overall prevalence of hypertension increased with BMI status. It was also interesting to note that about 14.6% of the underweight and 20.6% of normal-weight children were hypertensive. Compared to the prevalence among the underweight children, the prevalence increased by about 1.5 times among the normal weight children and doubled among the overweight/obese children. The rise was consistent across the age bands and statistically significant.

DISCUSSION

The present study highlights the prevalence of hypertension among school children aged 5-10 years from urban Faridabad district. About one fifth (19.7%) of the children were detected to be hypertensive and 13.4% were in pre-hypertensive category. More girls were documented to be hypertensive and pre-hypertensive than boys of same age. There was progressive rise in prevalence of hypertension and pre-hypertension with age and BMI status. It was also interesting to note that a sizable proportion of under-weight and normal-weight children were also hypertensive.

A study among 5-14 years old Delhi children reported the prevalence of hypertension to be 11.9% in boys and 11.4% in girls.[6] Among 6-14 years old children in Amritsar, hypertension was documented in 7.5% of health children (boys = 8.33% and girls = 6.52%). The prevalence of hypertension increased with age in boys till 10 years of age and in girls till 11 years of age and then dropped till 14 years of age.[7] In Assam, among the children aged 5-14 years, hypertension was documented in 7.6% children (boys: 7.3%, girls: 7.8%). Both SBP and DBP revealed significant correlation with blood pressure.[8] Overall prevalence of hypertension in Surat school children aged 6-18 years was 6.48% with some male predominance (males = 6.74% versus females = 6.13%). The prevalence of hypertension increased with age in both sexes.[9] In rural Maharashtra, the prevalence of hypertension among 6-17 years old children was documented as 5.75%. There was no significant difference among boys and girls.[10] Another study from urban Maharashtra, among 6-16 years old school children overall prevalence of hypertension was 13.34% and pre-hypertension was 5.8%. The prevalence of hypertension in higher in boys compared to girls (20.83% versus 17.11%. respectively). The prevalence of hypertension increased by fourfold in overweight/obese children (50%) compared to normal-weight children (13.78%).[11] A study from urban Bangalore, among the 6-16 years old children the prevalence of hypertension was 10.7% (high SBP 8.0% and high DBP 2.7%).[12] A nationwide study in Pakistan involving children 5-14 years, the overall prevalence of hypertension was reported as 12.2% with higher prevalence among boys (15.8%) than girls (8.7%).[13] Among Brazilian school children aged 6-11 years, the prevalence of hypertension was 11.2% in normal-weight, 20.6% in overweight and 39.7% in obese children. The prevalence increased with rise in BMI status.[14] A study involving Iranian school children aged 6-18 years, the prevalence of hypertension was 6.88% with isolated systolic hypertension and isolated diastolic hypertension in 4.17% and 4.33% of participants, respectively.[15] The prevalence of hypertension among Lebanese children was documented as 10.5% and 6.9% of children were pre-hypertensive.[16]

The prevalence of hypertension from different parts of India vary widely. This may be due to the methodology used, population sample and may be also due to the variation in real prevalence. The prevalence of hypertension documents in this study is higher than that documented among the Delhi school children inn 1999. The rise may be due to the epidemiological transition over the years with change in the lifestyle and BMI status of the population. The transition in lifestyle and the risk factors may be due to the rapid urbanization influencing the dietary habits, physical activity status and social pressures.

The frequency of BP measurement and hypertension screening is poor among pediatricians. A study in USA reported that BP screening was done in 67% of routine pediatric visits, 35% of ambulatory pediatric visits and that 84% of the overweight/obese children.[17] Another report indicated that even when blood pressure was measured, 75% cases of hypertension and 90% cases of pre-hypertension in children and adolescents remained uninvestigated.[18] The study has some limitations. Only private schools from urban area were included. We did

not adjust for potential influencing factors such as diet, salt intake and physical activity.

This study indicates the high prevalence of hypertension in children of 5-10 years in urban north India. With increase in age and BMI status, the prevalence of hypertension increased in both sexes. It was interesting to note that a sizable proportion of under-weight and normal-weight children had hypertension. The findings suggest for systematic nationwide documentation of the prevalence of hypertension and its relationship with the risk actors to identify suitable preventive measures. Also, it mandates blood pressure checkup for children during routine pediatric clinical practice and school health checkup.

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