Hypertension and Its Correlates Among School Adolescents in Delhi

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ABSTRACT

Background: Hypertension is fast emerging as a major health problem amongst all school adolescents, particularly in urban areas. Regular screening of the students for this is required for preventing the emergence of complications later in life. Therefore, the present study was undertaken with the objective to determine the prevalence of hypertension amongst urban school adolescents and its correlation with anthropometric measurements.

Methods: A cross-sectional study was conducted in a school in Central Delhi involving all 315 students of 9th and 11th standard. A preforma was filled by the students and anthropometric measurements along with blood pressure (BP) measurements were taken for each student. Data was analyzed using Epi-info 2005 and SPSS 16.0.

Results: Out of the total 315 students, 208 (66%) were boys and 107 (34%) were girls and the mean age was 14.31 ± 0.96 years. Overall prevalence of malnutrition was 24% and boys were found to be more obese as compared to girls. There were 5 students (1.6%) who were found to have systolic hypertension while 17 (5.4%) were found to have diastolic hypertension while 4.1% (n = 13) of the participants were systolic pre-hypertensive and 26% (n = 82) were in stage of diastolic pre-hypertension. Body mass index and gender were found to be independent predictor for systolic hypertension.

Conclusions: Prevalence of hypertension and pre-hypertension was high amongst the school children. BP check-up for children and adolescents is thus recommended to take remedial action on time.

Keywords: Body mass index, diastolic hypertension, malnutrition, pre-hypertension, systolic hypertension

Brief Communication

INTRODUCTION

India is undergoing an epidemiological transition where non-communicable diseases (NCDs) are on rise. According to World Health Report 2002, cardiovascular diseases (CVDs) will be the largest cause of death and disability by 2020 in India.[1] The growing burden of CVDs is being contributed largely due to multitude of risk factors with hypertension being one of them.

Hypertension is one of the diseases which is diagnosed and treated in 25% of the cases only making it largely an under-diagnosed problem.[2] There is plenty of evidence to suggest that hypertension begins in childhood and adolescence.[3-5] The asymptomatic nature of hypertension in early phases of its onset during adolescence increases the chances of developing complications during adulthood.[6] Therefore, detection of hypertension during childhood is of potential value in identifying those, who are at increased risk of primary hypertension as adults, and who might benefit from earlier intervention and follow-up.[7]

Several studies in India have reported the prevalence of hypertension to be ranging between 0.46% and 11.7% amongst children and adolescents.[8,9] Further, a number of environmental factors have been found to be associated with hypertension in children and adolescents.[10] Thus, early detection of hypertension and its aggravating factors becomes imperative. The data on blood pressure (BP) profile of school adolescents is scanty in India.[10,11] Considering the detection of hypertension in adolescence as the best possible preventive intervention to avoid complication later in life, the present study was undertaken to determine the prevalence of hypertension amongst urban school adolescents and its correlation with anthropometric measurements.

METHODS

Study settings and participants

It was a cross-sectional study conducted in a public school in Central Delhi. The school authority and study subjects were explained the purpose of the study and assured privacy and confidentiality of the information provided by them. The assent from each student and informed consent from their respective parents were obtained, before taking detailed information and anthropometric measurements. The study was approved by institutional ethical committee. Based on the prevalence of hypertension as 10% amongst adolescents based on previous study[6] with 95% confidence interval and precision taken as 5%, sample size was calculated to be 142.[12] However, all the 315 students of 9th and 10th standard consented to participate and hence were included.

Study tools

Before the start of physical examination, students were briefed about the whole procedure. Any significant past history in last 1 year along with family history of NCDs like hypertension, diabetes and coronary heart disease, was asked from the participants and appropriately recorded.

Height and weight were measured for each student using validated techniques,[13] body mass index (BMI) was calculated and all the students were classified according to BMI for age scores as per Centers for Disease Control and Prevention (CDC) 2000.[14]

BP measurements were also taken according to recommended guidelines.[15] For each subject, two recordings were taken at an interval of 30 min and the average of two readings was taken and it was considered to be the final reading.[6] Adolescents with BP levels at 120/80 mm Hg or above or average systolic blood pressure (SBP) or diastolic blood pressure (DBP) levels greater than equal to 90th percentile, but less than the 95th percentile, were classified as pre-hypertensive. The children were considered to be hypertensive if their SBP or DBP or both were equal to or more than the 95th percentile for age, sex and height.[15]

Statistical analysis

The collected data was analyzed using Epi-info 2005 software and SPSS 16.0. Statistical analysis was performed using Chi-square test for categorical data and the Student *t* test for means where appropriate. $P < 0.05$ was considered to be significant. Possible interactions between the risk factors were also examined by calculating the correlation coefficients and their association with presence or absence of systolic and diastolic hypertension was quantified using univariate analysis. Variables with $P \leq 0.15$ were included in multivariate binary logistic regression analysis to determine their independent contribution to development of hypertension.

RESULTS

Out of the total 315 students, there were 208 (66%) boys and 107 (34%) girls. The mean age of the participants was 14.31 ± 0.96 years (range = 12-17 years). There were 37 adolescents (11.7%) (Boys = 26 (11.5%); Girls = 11 (10.3%); $P = 0.45$) who were classified

as underweight while 25 (7.9%) (Boys = 17 (8.2%); Girls = 8 (7.5%); P = 0.69) were found to be at risk of overweight (Weight >85th percentile but <95th percentile) and 14 students (4.4%) (Boys = 12 (5.8%); Girls = 2 (1.9%); P = 0.09) were found to be overweight.

Overall the mean SBP was 108.38 ± 9.56 mm Hg and DBP was 72.38 ± 7.12 mm Hg [Table 1].

The 5th percentile and 95th percentile of SBP for 13 years of age 90.4 mm Hg and 126.4 mm Hg respectively, and for DBP 60 mm Hg and 80 mm Hg respectively. At 16 years of age, the 5th and 95th percentiles for SBP were 92.4 and 128.4 mm Hg and for DBP, it was 53.2 and 81.2 mm Hg respectively. Percentiles were not computed for age 12 and 17 as there were very few participants in these age groups [Table 2].

There were only five students (1.6%) who were found to have systolic hypertension while 17 (5.4%) were having diastolic hypertension. While 4.1% (n = 13) of the participants were found to be systolic pre-hypertensive, 26% (n = 82) were in stage of diastolic pre-hypertension [Table 3].

Variables such as younger age and BMI ≥23 were found to be significantly associated with diastolic hypertension while female gender and BMI ≥23 were found to be significantly associated with systolic hypertension [Table 4]. Putting the variables into logistic regression showed both gender (Odds ratio (OR) =8.01 (1.24-51.8); P = 0.028) and BMI (OR = 265.19 (20.73-3392.31); P < 0.001) to be an important predictor of SBP while only BMI (OR = 3.87 (1.30-11.2); P = 0.015) was found to be significantly associated with diastolic hypertension.

SBP showed positive correlation with BMI, age, height and weight (Pearson's correlation coefficients: 0.29, 0.12, 0.40, 0.33, respectively) (P < 0.05). DBP was also found to positively correlated with BMI, age, height and weight (Pearson's correlation coefficients: 0.23, 0.04, 0.29, 0.185 respectively) (P < 0.05 except for age).

DISCUSSION

BP has been found to track from childhood with stronger tracking seen in older ages of childhood and in adolescence, to predict hypertension in adulthood.[16] In the current study, the prevalence of hypertension among the study group was found to be 7% (n = 22). The finding is consistent with other studies reported from India.[17,18] The prevalence of pre-hypertension was 30.1% which is higher than reported by Sharma *et al*.[11] in Simla in 2010 and surveys conducted in US.[19] The finding signifies an alarming situation as almost two in five children require some form of intervention as recommended by Fourth Task Force.[20]

Though, overwhelming evidence from observational studies suggests that SBP is more important prognostic determinant of CVDs end points than diastolic pressure,[21] this cannot be generalized for adolescents. In younger people, the predominant BP abnormality is a high DBP.[22] In the current study too DBP (5.4%) was found to be more common as compared to isolated systolic hypertension (1.6%).

The tendency of the BP to rise with age is supported by the findings from a Turkish study[23] among the age group of 13-18 years and a study on Zambian school children (7-16 years).[24] Both SBP and DBP also showed positive correlation with height and weight thereby re-affirming the relationship between body size and BP as shown in other studies.[25]

The association between elevated BP and BMI as noted in the present study, has also been reported by other authors from this part of the world.[6,10,11,17,25,26] In the current study, both SBP

Table 1: Anthropometry and blood pressure recordings (mean±SD) of the study participants

Variable	Male	Female	Total
Mean age of students (years)*	14.39±0.992	14.16±0.881	14.31±0.961
Mean height of the students (cm)*	162.1±9.526	154.1±6.159	159.37±9.33
Mean weight of the students (kg)*	50.59±12.51	46.21±7.235	49.10±11.18
Mean BMI of the students (kg/m^2)	19.09±3.62	19.48±2.98	19.23±0.961
Mean SBP of the students (mm/Hg)	109.03±9.640	107.10±9.313	108.38±9.56
Mean DBP of the students (mm/Hg)	72.55±7.681	72.06±5.882	72.38±7.12

*P<0.01, BMI=Body mass index, SBP=Systolic blood pressure, DBP=Diastolic blood pressure

and DBP were found to be significantly correlated with BMI. Present study results, obtained after multivariate analysis, strengthen the independent association of BMI with BP. Another interesting finding of the current study was the higher risk of girls developing systolic hypertension. This finding assumes particular importance as women are at greater risk of cardiovascular death than men for a particular age.[27] Therefore, detecting and intervening at an earlier age hold the key to this public health problem.

The familial tendency to develop hypertension is well known. However, no significant association was found between the family history of NCDs and hypertension in adolescents. The possible reason could be the fact that we analyzed history of NCDs with hypertension in adolescents and not specifically the children with family history of hypertension.

Table 2: Blood pressure percentiles among the study population (*n*=315)

Age (years)	Percentiles							
	5th		50th		90th		95th	
	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP
13 (*n*=63)	90.4	60	110	70	120	80	126.4	80
Girls	90.8	63.2	106	70	120	80	126	86
Boys	90	58.5	110	72	117.2	80	128.3	81.2
14 (*n*=121)	90	60	110	70	120	80	120	80
Girls	91.5	60	108	70	120	80	126.8	80
Boys	90	50	110	70	120	80	120	80
15 (*n*=97)	90	60	110	74	120	80	126.2	80.8
Girls	90	61.4	104	70	119.2	80	120	82.4
Boys	98	60	112	77	122	80	128	86
16 (*n*=27)	92.4	53.2	110	70	124.4	80	128.4	81.2
Girls	104	68	109	71	130	80	130	80
Boys	91.2	51.6	110	70	122.4	80	125.6	81.6

SBP=Systolic blood pressure, DBP=Diastolic blood pressure

Strengths and limitations of the study

The sample included in the study was from a single school of urban Delhi and therefore, may not reflect the true nature of the problem. Secondly,

Table 3: Magnitude of hypertension amongst study population (*n*=315)

Classification of hypertension	Male (*n*=208) (%)	Female (*n*=107) (%)	Total
<90th percentile (normal)			
SBP	198 (95.2)	99 (92.7)	297 (94.3)
DBP	137 (65.9)	79 (73.8)	216 (68.6)
90th-95th percentile (pre-hypertension)			
SBP	9 (4.3)	4 (3.7)	13 (4.1)
DBP	60 (28.8)	22 (20.6)	82 (26.0)
95th-99th percentile +5 mmHg (stage I)			
SBP	1 (0.5)	3 (2.8)	4 (1.3)
DBP	8 (3.8)	5 (4.7)	13 (4.1)
>99th percentile +5 mmHg (stage II)			
SBP	-	1 (0.9)	1 (0.3)
DBP	3 (1.4)	1 (0.9)	4 (1.3)

SBP=Systolic blood pressure, DBP=Diastolic blood pressure

Table 4: Univariate analysis of association between risk factors and hypertension

Risk factors	Systolic hypertension (*n*=5) (%)	Odds ratio, *P* value (%)	Diastolic hypertension (*n*=17) (%)	Odds ratio, *P* value (%)
Age (in years)				
12-14 (*n*=186)	4 (2.2)	0.29 (2.81-66.87), 0.651$	14 (7.5)	3.42 (0.90-15.31), 0.044*
15-17 (*n*=129)	1 (0.8)		3 (2.3)	
Gender				
Boys (*n*=208)	1 (0.5)	0.12 (0.01-1.20), 0.047*,$	11 (5.3)	0.94 (0.31-2.95), 0.905
Girls (*n*=107)	4 (3.7)		6 (5.6)	
BMI				
≥23 (*n*=44)	4 (9.1)	27 (2.74-650.92),<0.001*	6 (13.6)	3.73 (1.15-11.77), 0.019*$
≤22.9 (*n*=271)	1 (0.4)		11 (4.1)	
Family h/o NCD				
Present (*n*=158)	1 (0.6)	0.24 (0.01-2.34), 0.21$	7 (4.4)	0.68 (0.23-2.01), 0.446
Absent (*n*=157)	4 (2.5)		10 (6.4)	

$Fischer exact test applied; **P*<0.05; BMI=Body mass index, NCD=Non-communicable diseases

other factors such as salt intake, smoking, stress, physical activity and dietary habits also influence BP, but they have not been systematically studied in this study. However, application of validated methods for anthropometry and BP adds to strength of the study.

CONCLUSIONS

Limitations notwithstanding, the study does not defeat its purpose and gives a useful insight into the problem of hypertension particularly diastolic amongst the school adolescents. The study further deciphered some interesting findings such as association of gender with development of systolic hypertension not reported elsewhere from India. Thus, to conclude, it is evident that levels of hypertension and pre-hypertension were high among the school going children reflecting the changing scenario of CVDs in the current times. Further, pathogenesis of hypertension is being influenced by lifestyle factors such as BMI. Therefore, there is a need to institute regular screening of children and adolescents for BP so as to prevent them from developing cardiovascular complications later in life.

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