SHORT COMMUNICATION

Prevalence of Hypertension Among Schoolchildren in Shimla

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This cross-sectional study was done to find the prevalence of sustained hypertension and prehypertension among school children aged 11-17 years. A total of 1085 apparently healthy students from rural and urban schools in hills of northern India were examined using standard methods. Students with blood pressures above the 90th centile were re-examined after four weeks. The mean BMI of the students was 17.5±2.7 kg/m^2, 5 (0.4%) were obese, and 39 (3.5%) overweight. After two evaluations, hypertension was identified in 62 (5.9%) children and prehypertension in 130 (12.3%). Urban and rural children had comparable rates of elevated BP (hypertension and prehypertension). Rates of elevated BP were significantly higher (46.5% *vs* 17%, P<0.001) among those with high BMI (overweight and obese) compared to those with normal BMI. In conclusion, nearly 20% of the school children had elevated blood pressures.

Keywords: *Blood pressure, Body mass index, India, Obesity, Prehypertension.*

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Hypertension is a major public health problem worldwide and is one of the risk factors for coronary artery disease and cerebrovascular disease. Development of adult hypertension may start very early in life, and children maintain their position in the blood pressure distribution over time(1). As the symptoms of childhood hypertension are largely nonspecific, most children with essential hypertension are likely to be asymptomatic(2). The data on prevalence of prehypertension and sustained hypertension in school going children is scanty in India(3-7). The present study was designed to determine the prevalence of sustained hypertension and prehypertension among apparently healthy school children residing in the hills of northern India.

METHODS

This cross-sectional, school-based survey was carried out from November 2005 to December 2006 by the Departments of Pediatrics and Cardiology, Indira Gandhi Medical College, Shimla. The study was approved by the institutional ethics committee. We enrolled children aged 11-17 years from both urban and rural schools in and around Shimla, which is situated in the moderate altitudes of Himalayas (800-2000 m). After obtaining informed consent from the parents, all children present on the day of first contact in a particular school were enrolled. Those on anti-hypertensive medication and known to have chronic heart, renal or hepatic disease, and those who were absent on first day were excluded. Information on age, sex and family history of hypertension and cardiovascular disease was recorded. Family history was taken to be a history of hypertension in the parents or the grandparents. Height and weight were measured, using "Detecto" stadiometer (UNICEF) with beam balance, with sensitivity of 0.1 cm and 0.1 kg, respectively. Zero error was set after every 10 measurements. Body mass index (BMI) was calculated and cut-off values for adolescents proposed by Cole, *et al.*(8) were used

for defining overweight and obesity. Before blood pressure measurements, students were familiarized to the instrument and the nature of the procedure was explained. Blood pressure was determined by auscultation in right arm after a minimum rest of 30 minutes, by standardized method using the mercury gravity sphygmomanometer(9,10). For each student, the blood pressure was measured thrice in the same visit with a minimum of 30 seconds rest between each determination and mean blood pressure was calculated. The systolic blood pressure was determined by the onset of the "tapping" Korotkoff-1 sound and the diastolic at its disappearance (Korotkoff-5). The children were considered hypertensive if the systolic or diastolic blood pressure or both were equal to or more than the 95th percentile for height for age and sex. Prehypertension was defined as systolic or diastolic blood pressure or both between 90th and 95th percentile for height for age and sex, or if the systolic blood pressure was more than 120 mm of Hg or the diastolic blood pressure was more than 80 mm of Hg(9). Height for age standards was determined using the CDC 2000 growth charts(11). Students found to have hypertension or prehypertension on first visit were contacted to undergo a second set of blood pressure measurements at least four weeks later. Three further sets of reading were taken on second contact, 4 weeks or later after the first measurement. The pre stated norms were then used to conclude the presence or absence of hypertension or prehypertension. All anthropometric and blood pressure measurements were made by a single observer.

With an estimated prevalence of elevated blood pressure (prehypertension and hypertension) at 0.1 and precision for upper and lower 95% CI at ±0.02, the sample size required was 865. SPSS-15 software was used for the analysis of data. Since the measurements were normally distributed, mean and standard deviation were calculated for height, weight, age, blood pressure and body mass index. Continuous variables were compared using student-t test. Dichotomous variables were compared using chi-square test; P <0.05 was considered significant.

RESULTS

Of the 1085 students (570 boys) enrolled on first contact, 518 (47.7%) were from rural schools (***Table* 1**) and 30 students were not available for evaluation at the second contact. Hypertension was significantly more prevalent among urban students compared to rural students (7.1% *vs.* 4.3%, P=0.047). Among 62 students with hypertension, 19 (30.7%) had a family history of hypertension. Significantly more urban children had a family history of hypertension. The prevalence of hypertension was significantly higher in those with a family history of hypertension (8.6% *vs* 5%, P=0.04). The prevalence of prehypertension was

TABLE I ANTHROPOMETRIC DATA AND BLOOD PRESSURE MEASUREMENTS

Variables	Rural			Urban			Total
	Boys (n=259)	Girls (n=259)	Total (n=567)	Boys (n=311)	Girls (n=256)	Total (n=567)	(n=1085)
Prehypertension	42	32	74 (14.3%)*	29	27	56 (9.8%)	130 (12.3%)†
Hypertension	10	12	22 (4.3%)*	17	23	40 (7%)	62 (5.9%)†
Elevated blood pressure††	52	44	96 (18.5%)	46	50	96 (16.9%)	192 (18.2%)
Lost to follow up	4	4	8 (1.5%)	14	8	22 (3.8%)	30 (2.7%)
Obese	0	0	0*	2	3	5 (1%)	5 (0.4%)
Overweight	1	3	4 (0.1%)***	15	20	35 (6.2%)	39 (3.5%)
High BMI (Obese and overweight)	1	3	4 (0.1%)***	17	23	40 (7%)	44 (4%)

** P <0.05, *** P <0.001 for rural vs urban using Chi square test. There were no significant differences between boys and girls, †- percentage calculated after exclusion of those lost to follow up,††- Elevated blood pressure includes those with hypertension and prehypertension; BMI: body mass index.*

WHAT THIS STUDY ADDS?

- Prehypertension or hypertension was found in nearly 20% school children in Shimla.

significantly higher among rural children (***Table* I**). Among 39 overweight students, 10 had hypertension and 7 had prehypertension. Among five obese students, two had hypertension and one had prehypertension. Rates of elevated blood pressure (prehypertension and hypertension) were significantly higher (46.5 *vs* 17%, $P < 0.001$) among those with high BMI (overweight and obese) compared to those with normal BMI.

DISCUSSION

It is important to determine the prevalence of hypertension and prehypertension in children, not only because it varies from one community to the other(12), but also because it is essential to identify the population at risk. Early identification translates into early interventions and possibly prevention of later morbidity and mortality(9). In the studied school children, 5.9% had hypertension and an additional 12.3% had prehypertension. This reflects an alarming situation, where overall almost 1 out of every 5 children needs some intervention as guided by the Fourth Task Force recommendations(9).

The rates of high blood pressure in this study are marginally higher than those reported in a recent survey in United States, wherein 13.6% of boys and 5.7% of the girls aged 8-17 years were classified as pre-elevated blood pressure and 2.6% of the boys and 3.4% of the girls were having elevated blood pressure(13). In a large survey of 5641 Pakistani children aged 5 to 14 years, the overall prevalence of high blood pressure was 12.2%. The authors observed that despite lower BMIs of south Asian children, the prevalence of hypertension was substantially greater than the 5% predicted prevalence of high blood pressure in children in the United States based on same criteria(12). It is possible that there exist different risk factors among children of South Asia. Within India, regional differences in blood pressure among children older than 13 yr of age were highlighted by Krishna, *et al*.(3). North Indian boys and girls had significantly higher systolic blood pressure compared with south Indian children.

In this study, on first evaluation, 31.3% of the students were hypertensive, but on repeat measurement only 5.9% were hypertensive. In the Muscatine study enrolling 6,622 students, 13% of school children had hypertension when first examined, but on repeated measurements less than 1% had their blood pressure in the hypertensive range(14). Similar has been the observations of other researchers(4,15). A more precise clinical estimate would include blood pressure measurements on ≥3 separate occasions. However, multiple readings of blood pressure from the same day are considered appropriate for epidemiological studies(16).

We found significantly more urban students to have hypertension and more rural children to have prehypertension. This could be a chance finding, as the prevalence was comparable when hypertension and prehypertension were combined, and viewed as elevated blood pressure. In the study from Pakistan, similar high rates of hypertension were observed among rural children(12).

The association between elevated blood pressure and high BMI observed by us has been noted by various workers including few from this part of the world(5,6,13,17). The Muscatine study reported 56.1% out of 41 hypertensive subjects to be obese(14). Sorof, *et al.*(15) also showed more prevalence of hypertension in obese children as compared to non-obese (33% *vs* 11%). In a survey of two schools catering to urban affluent high socioeconomic class in Pune, the prevalence of high systolic blood pressure was 12.0% in boys and 9.7% in girls and increased with increasing levels of BMI, weight, triceps skin fold thickness and percent body fat(7). Interestingly, our study showed a high prevalence of hypertension and prehypertension among students despite a low prevalence of obesity.

There were some limitations of this study. All measurements were made by a single observer,

which may be a source of bias. A third or fourth measurement of blood pressure could have possibly lowered the number of hypertensive children. Furthermore, we have not systematically studied or adjusted for factors such as salt intake, physical activity and dietary habits, which would be pertinent for future surveys. Findings of the present study suggest a need for larger population based studies to accurately estimate the prevalence hypertension among children in our country.

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