

# Blood Pressure Profile and Hypertension in Urban Adolescents: Need for Cognisance

Faujdar DS<sup>1</sup>, Kunte R<sup>2</sup>, Bhalwar R<sup>3</sup>

## Abstract

**Introduction:** High blood pressure is an established risk factor for cardiovascular diseases. Hypertension begins to develop during first two decades of life and blood pressure in children may be an important predictor of subsequent development of hypertension in adult population. The objectives of this study were to find the profile of blood pressure and the prevalence of hypertension in adolescents in an urban area. **Material and Methods:** This was a cross sectional study carried out in adolescent students in the age group of 11-17 years, in a school in an urban area of Pune, India. Their blood pressure and anthropometric parameters were measured as per recommendations of American Heart Association & WHO guidelines. **Results:** The mean SBP and DBP in both boys and girls were found to increase with increasing age and anthropometric measurements. The prevalence of hypertension was 12.23% in boys and 10.1% in girls and the prevalence of overweight as per BMI was 19.14% in boys and 18.62% in girls. The prevalence of hypertension observed in overweight children (36.1% in boys 30.8% in girls) was significantly ( $p < 0.000$ ) higher than normal weight children (6.5% in boys and 5.36% in girls). Among the anthropometric variables only weight and BMI had moderately strong correlation with SBP ( $r = 0.559$  and  $0.506$ ). **Conclusion:** Hypertension is prevalent among adolescent population and overweight/obesity has been found to play a crucial role in predicting a higher BP in them. It is recommended blood pressure monitoring be made mandatory part of school health services programme.

**Key words:** Blood Pressure, Hypertension, Adolescent, anthropometry, BMI

## Introduction

Globally, cardiovascular disease is the number one cause of death and is projected to remain so. Among the various risk factors in the development of this disease, raised blood pressure is the leading cardiovascular risk factor. In terms of attributable deaths (to which 13% of global deaths are attributed)<sup>1</sup>. Studies have reported the tracking effect of blood pressure from childhood to adulthood. Lauer et al had observed that the children with systolic blood pressure above 90th percentile, on being tracked to an adult had three times the risk of high blood pressure as compared to child at 50th percentile<sup>2</sup>.

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The longitudinal studies have suggested that systemic arterial hypertension (SAH) in adults is a disease that has its beginning in childhood. Because of the lack of routine examination and the belief that SAH is rare in childhood, many children have failed to receive the diagnosis of hypertension over recent decades<sup>3</sup>. Currently with increasing awareness of blood pressure issues in the paediatric population focus has shifted to early identification of mild to moderate

hypertension in asymptomatic, otherwise healthy children and adolescents. In the present study, we studied the blood pressure (BP) levels in adolescent school children from the urban population in Pune, India, with an aim to determine the blood pressure profile and prevalence of hypertension and its association with anthropometric variables.

## Materials and Methods

A cross sectional study was conducted during 2009-2010 among school children of adolescent age, belonging to upper socioeconomic group at an urban school in Pune. The data for this study was collected from the entire population of students studying in the Class VI-XIIth (564 boys and 435 girls) in the adolescent age group (age 11-17 years). Although WHO defines adolescent as the age group of 11 to 19 years, the task force on blood pressure in children provides guidelines for blood pressure in children upto 17 years after which guidelines as for adults is applicable<sup>4</sup>. Our study included, all students, except for six Students who were found to have underlying diseases which could have affected the outcome of the study, and 32 other students who were found to be absent even after three visits. The study was approved by institutional ethics committee.

A preformed questionnaire, pre-tested and validated during pilot study was used for gathering the child's details. Blood pressure measurements were made by using a standard mercury sphygmomanometer with blood pressure recorded in the right arm by auscultatory method with appropriate cuff size (width-11.5 cm, length-22 cm). To categorize the blood pressure levels as normal or hypertensive, the tables from the Fourth Report of the American National High Blood Pressure Education Program were used, taking into consideration the children's sex, age and height percentile<sup>5</sup>. Hypertension was defined as average SBP or DBP that is >95th percentile for gender, age, and height on at least 3 separate occasions. Accordingly children with SBP or DBP, greater than 95 percentile for their gender, age and height, were reexamined on at least 3 occasions on repeated visits. The procedure used was as per recommendations of American Heart Association & 1996 update of Task Force Report on High Blood Pressure in Children and Adolescents<sup>6,7</sup>.

The anthropometric measurements which were recorded during the conduct of the study were height, weight, BMI, waist circumference and waist hip ratio. The recording of all these measurements was carried out with the full uniform on, less the belt, sweater/blazer and without shoes and was conducted as per

the guidelines issued by World Health Organization<sup>8</sup>. For assessing prevalence of overweight children, categorization based on BMI criteria as defined by American Obesity Association was used which defines "Normal weight" at or above the sex-specific 5th percentile but less than the 85th percentile of BMI for age, while Overweight defined as BMI at 85th percentile and above<sup>9</sup>.

The statistical analysis & data management of the study was carried out using computer package "SPSS 17.0".

## Results

The results presented in Fig. 1 & 2 shows that mean value of various anthropometric measurements and systolic & diastolic BP generally increased with increasing age in both sexes. The mean value of blood pressure was higher in girls at the age of 11-12 years but post puberty; increase in blood pressure with age was much more in boys than in the girls.

As depicted in Table-1, prevalence of hypertension in children was found to be higher in boys than in girls (12.23% in boys and 10.1% in girls). However, the difference in prevalence of hypertension between boys and girls was statistically not significant ( $p>0.05$ ). The prevalence of hypertension in post-pubertal age group was higher than pre-pubertal age group in both sexes with boys having a higher prevalence of hypertension than in the girls in the age group 13 to 17 years (Fig. 3). The prevalence of systolic hypertension was higher than the diastolic hypertension in both sexes (11.52% and 3.72% in boys, 9.19% and 2.75% in girls).

The prevalence of overweight and obesity as obtained by calculating BMI (>85 percentile for age, height and gender) was 19.14% in boys and 18.62% in girls. On analysis it was observed that prevalence of hypertension in overweight children (36.1% in boys and 30.8% in girls) was much higher than normal weight children (6.5% in boys and 5.36% in girls). The association of overweight with hypertension was found to be statistically highly significant ( $p<0.000$ ). The mean value of SBP in overweight boys & girls was found to be 124.5mm of Hg & 119.43 mm of Hg respectively which was significantly higher( $p<0.000$ ) than mean values in normal weight boys & girls which was 109.73 mm of Hg & 108.64 mm of Hg respectively. Similarly, the mean value of DBP in overweight boys & girls was found to be 72.6 mm of Hg & 72.0 mm of Hg respectively which was significantly higher( $p<0.000$ ) than mean values in normal weight boys & girls which was 66.2 mm of Hg & 66.62 mm of Hg respectively.

On correlating Mean SBP and Mean DBP in students with variables age, height, weight, BMI, Waist and waist-hip ratio (Table-2), the only variables which had at least moderately strong correlation with

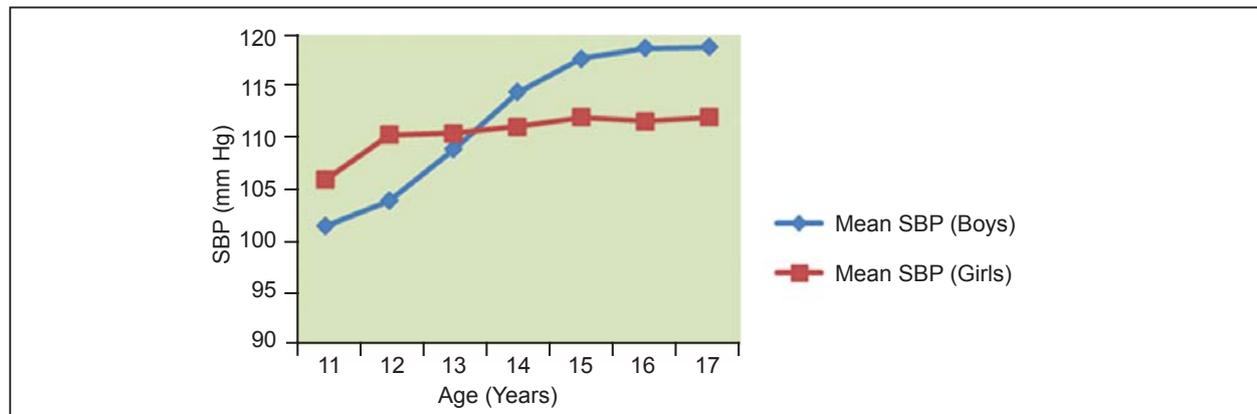
SBP were weight and BMI (which is also a function of weight), whereas none of the predictors had even moderately strong correlation with DBP, although weight was the most correlated.

**Table 1:** Prevalence of Hypertension as per Weight category among Boys and Girls

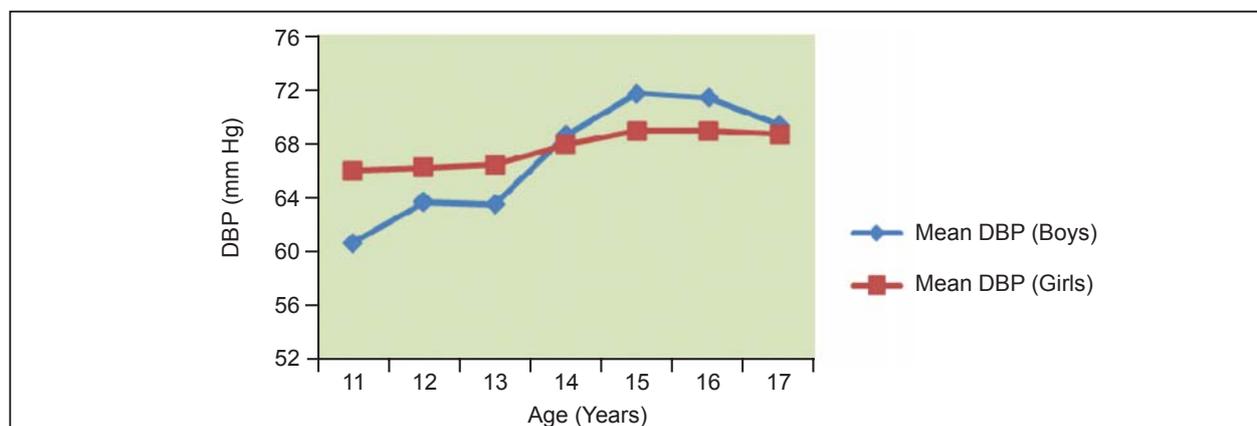
| Weight Category     | Boys : Numbers (%)   |              |       | Girls : Numbers (%)   |              |       |
|---------------------|--|--------------|-------|---|--------------|-------|
|                     | Hypertensive   | Normotensive | Total | Hypertensive  | Normotensive | Total |
| Overweight          | 39 (36.1%)   | 69 (63.9%)   | 108   | 25 (30.8%)  | 56 (69.2%)   | 81    |
| Normal Weight       | 30 (6.5%)  | 426 (93.5%)  | 456   | 19 (5.36%)  | 335 (94.64%) | 354   |
| Total               | 69 (12.23%)  | 495          | 564   | 44 (10.1%)  | 391          | 435   |
| Statistical Details | X <sup>2</sup> =68.20 ; df = 1, p <0.000<br>OR = 8.03 (95% CI = 4.51,14.28 ) |              |       | X <sup>2</sup> = 44.37 ; df = 1, p <0.000<br>OR = 7.87 (95% CI =3.88, 16.05 ) |              |       |

**Table 2:** Correlation of Age and Anthropometric variables with SBP and DBP

| Variables       | Pearson Correlation |                 |             |                 |
|-----------------|---------------------|-----------------|-------------|-----------------|
|                 | SBP (mm Hg)         |                 | DBP (mm Hg) |                 |
|                 | r value             | 95% CI          | r value     | 95% CI          |
| AGE             | 0.264               | (0.205, 0.321)  | 0.249       | (0.190, 0.306)  |
| Height          | 0.378               | (0.324, 0.430)  | 0.314       | (0.257, 0.369)  |
| Weight          | 0.559               | (0.515, 0.600)  | 0.417       | (0.364, 0.467)  |
| BMI             | 0.506               | (0.458, 0.551)  | 0.370       | (0.315, 0.422)  |
| Waist           | 0.477               | (0.428, 0.524)  | 0.350       | (0.294, 0.403)  |
| Waist-Hip Ratio | 0.022               | (-0.040, 0.084) | - 0.018     | (-0.080, 0.044) |



**Fig 1:** Age-wise distribution of Mean SBP among Boys and Girls



**Fig 2:** Age-wise distribution of Mean DBP among Boys and Girls

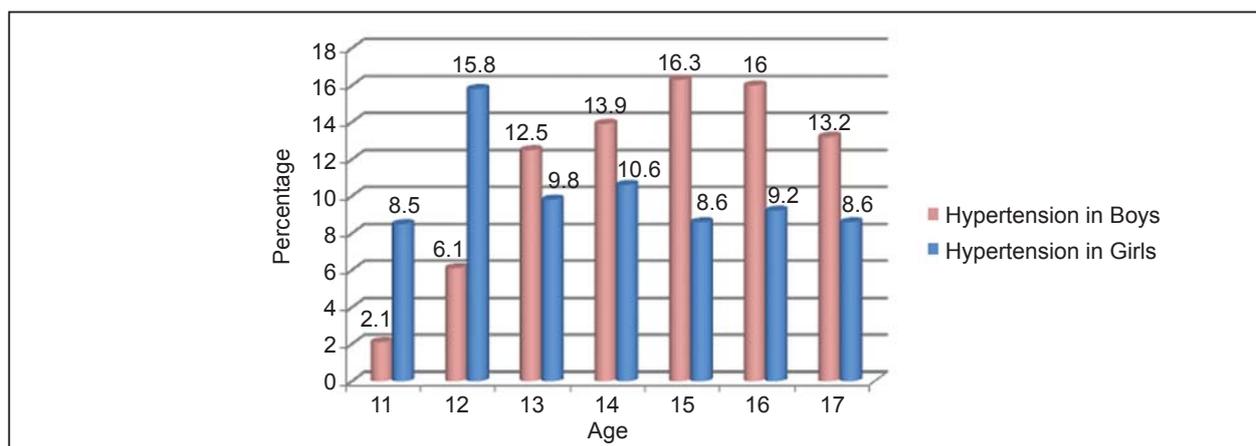


Fig 3: Age-wise prevalence of Hypertension among Boys and Girls

## Discussion

Once considered rare, primary hypertension in children has become increasingly common in association with obesity and other risk factors. Studies have shown increased prevalence of hypertension among overweight/obese children and have been identified as an important factor affecting the BP distribution in children<sup>10,11</sup>.

In our study we observed that mean SBP was greater for girls until age 12 years, after which there was a cross-over with subsequent ages (13-17 years) showing a greater SBP for boys. These gender differences in blood pressure starting in young ages have also been detected in the Task force report on Blood Pressure Control in Children of 1987. Most important seem to be differences in trend of SBP between boys and girls with regard to age. The Task force on Blood Pressure Control in Children had suggested that BP may be linked to a sex maturation phenomenon, since it is known that maturation occurs earlier in girls than in boys<sup>4</sup>.

We observed that mean SBP and DBP among overweight (> 85 percentile) was higher by 14 mm Hg and 5 mm of Hg respectively, than normal BMI students, similar observations were made by Rao et al in a study at Pune where mean SBP was found to be higher by 12 mm of Hg while mean DBP was higher by 8 mm of Hg among overweight than in normal BMI children<sup>11</sup>.

In our study, overall hypertension i.e. both SBP and DBP combined was found to be 12.3 % in boys and 10.1% in girls. In a study conducted at the urban slum by Soudarssanane et al among adolescents aged 15-19 years, the prevalence of hypertension was found to be 9.4% among boys and 7.5% among girls<sup>12</sup>. The

slightly lower prevalence of hypertension in this study may be due to dissimilarity in socioeconomic strata of the study cohort, which has an indirect bearing in terms of lifestyle related parameters. Chadha et al in a study conducted among 5-14 year age group school children at Delhi found that prevalence of hypertension (systolic, diastolic or both) was 11.9 percent in boys and 11.4 percent in girls, although the study group was of younger age than of the present study, the results were comparable to findings of our study<sup>10</sup>.

In the present study, obesity/overweight was found to be an important factor determining the prevalence of hypertension, as the percentage of hypertensive's among overweight boys and girls was found to be significantly higher ( $p < 0.000$ ) than the normal weight boys and girls which is similar to findings of Rao et al, who found that the prevalence of both systolic and diastolic hypertension among overweight adolescents was significantly higher compared to their counterparts<sup>11</sup>.

The current recommendation for diagnosing hypertension in children is to confirm that blood pressure is >95th percentile on each of three different occasions, however studies have found that BP continued to fall over a period of time and therefore varied results have been found in the studies because of varied period of follow up. The present study has the limitation of follow up of hypertensive students. The other reason for high percentage of hypertensives in the current study population may be attributed to a high percentage of overweight and obese children.

In our study, we observed that among the anthropometric variables only Weight and BMI had moderately strong correlation with SBP and DBP. Similar observation was made by Soudarssanane et al where they had observed a clear-cut rise in the prevalence

of hypertension with increasing weight<sup>12</sup>. Studies by Chadha et al and Savita et al had also observed that anthropometric variables height, weight, and body mass index are positively correlated with systolic as well as diastolic blood pressure which is similar to the findings of present study<sup>10,13</sup>.

## Conclusion

In present study it is concluded that BP in children tend to rise with age, gender wise physiologic changes, height and weight; however bodyweight seems to be the decisive factor for rise in BP in adolescent children. In urban adolescents, an increase in prevalence of hypertension has been noted which is attributed to high prevalence of overweight/obesity. As routine monitoring of blood pressure is not being done in children, hypertension in children often goes undetected, thereby putting them at higher risk of developing cardiovascular diseases as an adult. It is important that children be screened for elevated blood pressure so that those at increased risk of cardiovascular disease as adults are identified early in life and timely preventive measures or pharmacologic treatment is instituted.

## Recommendations

It is recommended that monitoring of BP should be routinely carried out during school medical examination of adolescent students for early detection of hypertension and should be made part of school health programme. The maintenance of healthy weight in adolescents should be the prime preventive strategy against high BP, which should be undertaken through lifestyle changes, including weight reduction for those who are overweight or obese; a healthy low fat diet & regular physical activity.

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**Conflict of Interest:** This article is based on the final thesis (part of compulsory MD thesis submission to the university) report submitted to Department of Community Medicine, Armed Forces Medical College, Pune-410040.

**Permission from IRB:** Yes

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