BIOPHYSICAL PROFILE OF BLOOD PRESSURE IN SCHOOLCHILDREN

M. Verma
J. Chhatwal
S.M. George

ABSTRACT

The study was conducted in an industrial and prosperous city of Punjab to evaluate the biophysical profile of blood pressure (BP) in apparently healthy school children. A total of 2560 children between the ages of 5-15 years were enrolled. Their age, religion, dietary and family history were recorded. Weight and height of all children were measured and body mass index (BMI) calculated. A value of 2.26 or more was taken as obesity. BP measurements were made as per recommendations of the American Heart Association. Systolic as well as diastolic BP increased with age in both sexes, correlation coefficients being 0.59 and 0.6, respectively. A statistically significant linear relationship between BP and weight and height was noted. Children with BMI of >2.26 had a significantly higher BP (P<0.01). The mean BP did not vary among different religions. The BP of vegetarians and non-vegetarians also did not differ. A family history of hypertension was associated significantly with elevated BP (p <0.01). It is concluded that obesity and a family history of hypertension in children are associated with elevated BP and such children may be at risk for developing hypertension at a later date. They should be followed up and considered for modification of risk factors.

Keywords: *Blood pressure, Biophysical profile, School children.*

Primary prevention of one of the leading health problems, *i.e.,* hypertensive and ischemic heart disease in adults necessitates a scientific evaluation of the predictors in children. Blood pressure studies in children provide important epidemiological information which may help in controlling or modifying the coronary risk factors. In normal children, blood pressure varies not only with age but also with sex, height and weight. The underlying process of growth and maturation is closely linked to the blood pressure (BP) in children. A number of socio-cultural factors also influence the BP. India is a vast country with divergent customs, dietary habits and socio-economic background. The data on blood pressure profile in Indian school children is inadequate with few studies showing different patterns of normal blood pressure(1-5). The present study was conducted in Ludhiana, an industrial and prosperous city of Punjab, to evaluate the biophysical profile of blood pressure in apparently healthy school children.

Material and Methods

A total of 2560 school children between the ages of 5-15 years were the subjects of the study. Their age, religion, dietary and family history were recorded. All children were weighed on a

From the Department of Pediatrics, Christian Medical College, Ludhiana.

Reprint requests: Dr. M. Verma, Professor and Head, Department of Pediatrics, Christian Medical College and Hospital, Ludhiana 141 008, Punjab.

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standardized weighing machine. The height in (cm) was recorded using a calibrated bar. Body mass index (BMI) was calculated [weight (g)/height $(cm)^2$] for all children. A value of 2.26 or more was taken as obesity(6).

Blood pressure measurements were made by using a standard mercury sphygmomanometer. The cuff sizes used and the procedure were as per recommendations of the American Heart Association(7). All measurements were made by a single person in a quiet room. The child was seated and the blood pressure was recorded in the right arm. An average of three readings was taken as the BP of the child. The data was analyzed by Student 't' test, correlation coefficient and ratios and proportions test.

Results

Systolic BP (SBP) and diastolic BP (DBP) increased with age in both sexes. The correlation co-efficient for both girls and boys for systolic and diastolic BP was 0.59 and 0.6, respectively. The mean systolic and diastolic BP did not show any statistically significant difference between the two sexes. Among girls, systolic BP showed a steep rise between 11-13 years of age while in boys this increase was seen between 12-13 years. This increase was statistically significant ($p < 0.001$) in both sexes. This trend was not evident in diastolic BP. The percentile curves of SBP and DBP for both sexes are shown in *Figs. 1 & 2*. The diastolic BP percentiles were lower in girls although the difference was not significant ($p > 0.05$).

The systolic and diastolic BP in both sexes showed a significant linear relationship with increasing body weight and height *(Figs. 3 & 4)*. To assess the correlation of obesity and elevated BP, body mass index (BMI) was calculated for all children. Five per cent of the total children were classified as obese (BMI ≥ 2.26). The mean systolic and diastolic BP of the obese children was significantly higher, man non-obese ($p < 0.001$) *(Table I)*.

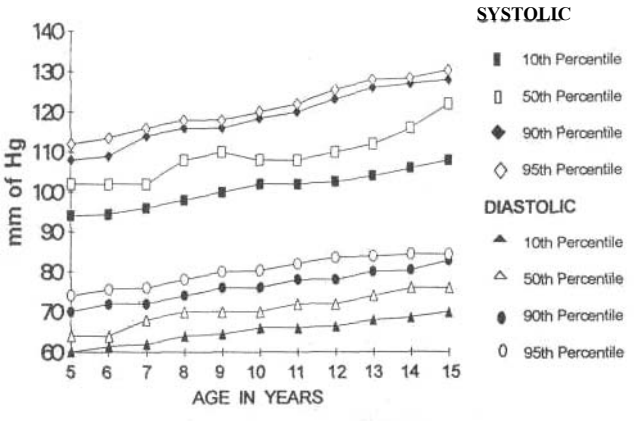

Fig. 1. Blood pressure percentiles for boys.

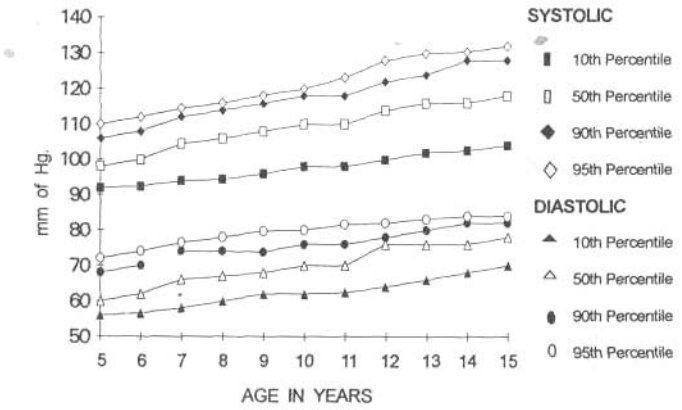

Fig. 2. Blood pressure percentiles for girls.

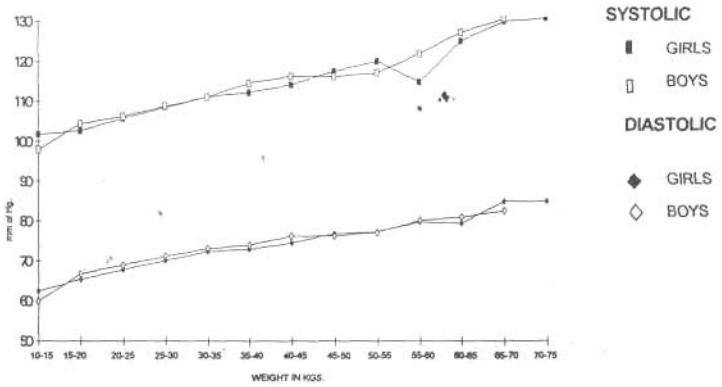

Fig. 3. Mean systolic and diastolic BP according to weight.

No correlation was noted between different religions and mean blood pressure ($p > 0.05$). The children were classified as vegetarian or non-vegetarians according to history and their BP correlated with diet pattern. There was no significant ($p > 0.05$) difference between the two groups. A family history of parental hypertension was significantly associated with an elevated BP ($p < 0.01$).

Discussion

A dominant aspect of the epidemiology of BP in both adults and younger populations is its relation with age. An

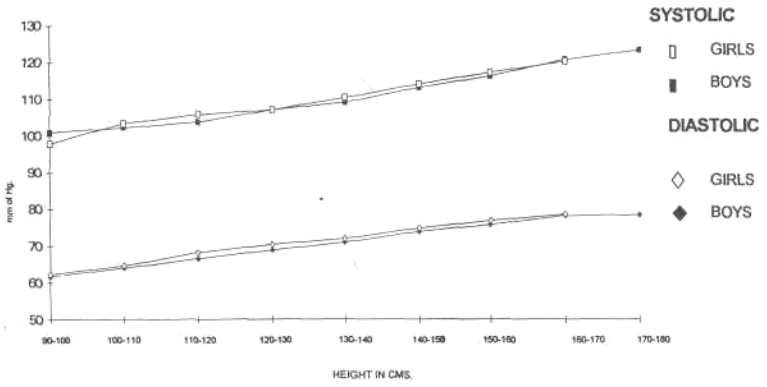

Fig. 4. Mean systolic and diastolic BP according to height.

TABLE I–*Mean Blood Pressure of Obese and Non-obese Children*

Category	n	%	MSBP (mm Hg)	MDBP (mm Hg)
Obese	131	5.1	120.52*	78.71*
Non-obese	2429	94.9	109.14*	70.70

* p <0.001; significant.

increase in mean systolic and diastolic BP with age has been well documented and the current study further exemplifies the same(l-5,8-10). This uniform pattern implies the BP is as much as part of growth and development as other parameters like weight and height. Voors *et al.* (11) reported that the effect of age largely disappeared when adjustment for height was carried out; hence suggesting that the relationship between age and BP is a correlate of height and a part of biologic maturation. An attempt to correlate other maturational indices like, menarche, FSH or serum gonadotropin levels failed to show any association(12,13).

The relationship between body size and blood pressure has been observed and assessed by various authors(14-17). It has been noted that the age related increase in BP may be attributable to increase in body mass. This was documented in the current study also where increasing height and weight had a significant positive relationship with mean SBP and DBP. Similarly, Voors *et al.* (14)

reported that BP correlates more closely to height and body mass than age. Lauer *et al(5)* also confirmed the relationship of height, relative weight and triceps skinfold thickness to BP in children. In another study, Lauer *et al.* (16) assessed the relationship between blood pressure, age and body size. They concluded that precocious level of BP for age is associated with excessive body weight or precocious height, whereas having high BP for height but not for age is associated with being short for age. In the present study, BMI of ≥ 2.26 was associated with a significantly higher BP. In the NCHS surveys of USA also, the Spearman correlations of systolic BP and Quetelet index were of the range of 0.21 to 0.50 in children 12tol5years old(17).

Religion influences dietary and cultural practices and could thus indirectly affect the health parameters like blood pressure. We found no significant correlation between religion and blood pressure. Sachdev has also reported similar findings(3). In western studies, racial differences have been noted in BP although the reasons for this are debatable and may be more related to environment(10).

Dietary practices, especially sodium intake have been documented to influence BP. Various other factors such as protein, fibre, saturated fats and alcohol intake have also been implicated in the etiology of hypertension while calcium and magnesium may be having a protective effect. Alexandrov *et al.* have stated that in childhood no evidence is available on these putative determinants(8). We tried to correlate BP with type of diet, *i.e.,* vegetarian or non-vegetarian but no relation could be observed. Similar observations were made by Sachdev also(3).

Evidence exists that hypertension tends to aggregate in families and the cause can be genetic, environmental or both. In the present study, elevated BP in children was significantly associated with family history of hypertension. Hansen *et al.* (18) concluded that by the age of 8 to 10 years the BP level is already significantly higher if the child has a parent on antihypertensive treatment. The difference in BP persists even after adjustment for weight and age. These findings would suggest that these children should be considered as high risk for developing future coronary heart disease(18). Other workers have also suggested that modification of risk factors like elevated blood pressure should start in childhood(19,20).

It can be concluded that body mass has a positive correlation with childhood BP. Increased body mass and a positive family history together form a high risk profile while religion and type of diet do not significantly influence the BP in childhood. The high risk children need to be considered for a close follow-up modification of risk factors.

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