



Screening of Hypertension using Blood Pressure-to-Height Ratio in children living in area of bhuj, kutch, Gujarat, India- A cross-sectional study

KEYWORDS

Adolescent, Diagnosis, Prehypertension, Schoolchildren

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ABSTRACT **Aim:** To test whether blood pressure-to-height ratio (BPHR) can be used to screen for hypertension in children living in bhuj, kutch, Gujarat, India.

Methods: Present study was performed on 8 to 16 year school going children in bhuj, kutch, Gujarat by assistant professors attached with Department of Pediatrics, Gujarat Adani institute of medical science, Bhuj,. Data regarding blood pressure and other variables was recorded for 2699 school children between the ages of 10-16 years as a part of a nutritional survey.

Results: The optimal thresholds for defining hypertension in boys were 0.76 for systolic BPHR and 0.50 for diastolic BPHR; the respective threshold in girls were 0.80 and 0.52. There was a negative correlation between SBPHR and age, weight and a positive correlation with BMI. In the same way a negative correlation was seen between DBPHR and age, weight and a positive correlation with BMI.

Conclusion: BPHR can be used as an effective screening test for diagnosing both hypertension and prehypertension in children aged 10-16 years.

Introduction

Most people think of high blood pressure, also known as hypertension, as a condition that affects older people. This may have been true in the past, but these days, high blood pressure affects people of all ages -- including young children. Hypertension/high blood pressure (HBP) is an emerging health issue of considerable importance in children and adolescents due to its rising prevalence in many areas and associated consequences. Although the worldwide prevalence in youths is not precisely known, high rates reported for various age groups, regions and races all indicate a global problem¹. There is increasing evidence that elevated BP in childhood is associated with target organ damage, notably left ventricular hypertrophy, which may result in premature cardiovascular morbidity and mortality in adults² and commonly leads to hypertension in young adulthood. Because HBP in childhood is often asymptomatic and, thus, is easily overlooked, almost 75% of cases reportedly go undiagnosed.³ However, given the complexity of defining paediatric-onset HBP, the technical issues involved and the paucity of available diagnostic guidance, it is understandable why current detection rates are low.

Hypertension has a prevalence of less than 1% in children but is seen in 30% children with BMI more than the 95th centile^{4,5}. Hypertension in children can cause increased carotid medial and intimal thickness as well as left ventricular hypertrophy⁶⁻⁸. Blood pressure-to-height ratio (BPHR) has been proposed as a useful screening test for estimation of high blood pressure in children⁹⁻¹⁴. The aim of this study was to confirm whether BPHR can be used as a screening test for diagnosing hypertension in children living in bhuj, kutch, Gujarat.

METHODS

Present study was performed on 8 to 16 year school going children in bhuj, kutch, Gujarat by assistant professors attached with Department of Pediatrics, Gujarat Adani institute of medical science, Bhuj. Ethical clearance was taken from the institutional ethics board. Consent for this

study was taken from the school heads as well as from the parents. Children with known medical conditions or drug use causing dyslipidemia, diabetes or hypertension were excluded from the study. Weight was measured in the upright position to the nearest 0.1 kg using a calibrated electronic balance. Height was measured without shoes to the nearest 0.1 cm using a calibrated portable stadiometer. Blood pressure was measured in the right arm, with the individual in a sitting position and at rest for at least 5 min, using standardized mercury sphygmomanometers and appropriate-sized cuff. Following indexes were computed by using the equations: SBPHR = SBP (mmHg)/height (cm) and DBPHR = DBP (mmHg)/ height (cm). Hypertension was defined as SBP/DBP \geq 95th percentile. Prehypertension was defined as SBP/DBP \geq 90th but \leq 95th percentile or SBP/DBP \geq 120/80 mm Hg^{15,16}.

Statistical analysis: Data The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 15 (SPSS Inc. Chicago, IL, USA) Windows software program. Descriptive statistics included computation of percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively. Correlation analysis was performed between SBP percentile and SBP-height ratio and for DBP percentiles and DBP-height ratio.

RESULTS

There were 2699 children with 7.7% boys and 9.5% girls having hypertension. Prehypertension was present in 17.9% boys and 17.1% of girls. SBP-height ratio correlated strongly with SBP percentiles both in boys ($r=0.799$, $P<0.001$) and girls ($r=0.844$, $P<0.001$). Similar results were obtained with DBP-height ratios and DBP percentiles. ROC analysis showed a very steep progression of sensitivity and specificity above cutoff values. The optimal SBPHR cut-offs for diagnosing systolic hypertension were ≥ 0.76 in boys and ≥ 0.80 in girls; the cut-offs of DBPHR for diastolic hypertension were ≥ 0.50 for boys and ≥ 0.52 for girls. The ROC values for the accuracy of both SBPHR and DBPHR in

diagnosing hypertension in both sexes ranged from 0.82-0.87 and 0.89-0.94, respectively. The optimal cut-offs of SBPHR for diagnosing systolic prehypertension were ≥ 0.75 in boys and ≥ 0.76 in girls; the values of DBPHR for diastolic prehypertension were ≥ 0.47 for boys and ≥ 0.48 for girls.

There was a negative correlation between SBPHR and age, weight and a positive correlation with BMI. In the same way a negative correlation was seen between DBPHR and age, weight and a positive correlation with BMI.

Table 1: Optimal thresholds of systolic and diastolic blood pressure-to-height ratio (bphr) and pre-hypertension in children aged 10-16 years

Gender Specific value	Hypertension					Prehypertension				
	Threshold	Sensitivity	Specificity	PPV	NPV	Threshold	Sensitivity	Specificity	PPV	NPV
SBPHR(Boys)	0.76	100	88.5	28.5	100	0.76	92.1	84.5	19.7	99.7
SBPHR(Girls)	0.80	94	95.6	60.8	99.7	0.75	96.5	83.8	30.4	99.8
DBPHR(Boys)	0.49	91.2	0.6	38.7	9.5	0.48	82.4	71.8	40.8	94.6
DBPHR(Girls)	0.51	99.4	93.8	54.7	99.8	0.49	96.5	85.1	59.2	99.2

DISCUSSION

Present study showed that BPHR is a precise method of screening for hypertension and prehypertension in children aged 8-16 years. BPHR is strongly and positively linked with systolic and diastolic blood pressure, but is not dependent on height or age, as shown in our study. The inverse correlation between SBPHR, DBPHR and height implies that the overall outcome of height on both these indices is nil and neither tall subjects are misclassified as hypertensives nor short subjects are misclassified as normotensives. Similarly the inverse correlation between SBPHR and DBPHR with age and weight imply that both these factors have no effect on these indices. The high Negative predictive value of 99.6 and 100 of cut-offs in our study shows that children with hypertension and prehypertension are unlikely to be missed by these cut offs. However, the Positive predictive value are low suggesting that some children with normal BP may be classified as prehypertensives or hypertensives, suggesting that BPHR is just a screening method and cannot replace existing nomograms for diagnosing or classifying severity of hypertension. PPV is directly proportional to the prevalence of disease. As prevalence of hypertension is low in children, therefore PPV remained low in our study as in other studies^{11,12}.

Similar to present findings, Galescu, et al.¹² reported BPHR cutoff of 0.75/0.46 and 0.75/0.48 for diagnosing systolic and diastolic pre hypertension in US boys and girls, respectively. Ejike, et al.¹¹ found a BPHR cutoff of 0.75/0.51 and 0.77/0.50 for diagnosing hypertension in Nigerian boys and girls, respectively, with sensitivity and specificity ranging from 0.98-1.00. The minor differences in cut-offs as compared to current study could be because of genetic or racial factors.

The limitations of our study are that it only incorporated children in the age group of 8-16 years and more studies enrolling children in all age groups are needed to corroborate the results.

Conclusion

Present study demonstrated a strong correlation between BPHR with blood pressure centiles in both boys and girls. This suggests that BPHR can be used as an effective screening test for diagnosing hypertension and prehypertension in the study population.

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