

Elevated Blood Pressure and Its Associated Risk Factors among Adolescents of a North Indian City - A Cross-sectional Study

Senthamizh Prasad, Jamal Masood¹, Anand Kumar Srivastava¹, Prabhaker Mishra²

Department of Community Medicine, Chettinad Academy of Research and Education, Chennai, Tamil Nadu, ¹Department of Community Medicine and Public Health, King George's Medical University, ²Department of Bio-statistics and Health Informatics, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Abstract

Context: Amidst the uncertainty in childhood blood pressure (BP) thresholds, besides the ambiguity in levels and duration of BP elevation causing organ damage, hypertension is present in substantial number of asymptomatic children and adolescents with only a few studies disclosing the setup. With projection of deaths due to noncommunicable diseases in 2030 rising to 52 million, it is necessary to know about the knowledge of present adolescents about BP and its modifiable risk factors. **Aims:** (1) To assess the prevalence of elevated BP among adolescents and to ascertain the associated risk factors. (2) To assess adolescent's knowledge about BP and its modifiable factors. **Settings and Design:** A community-based cross-sectional study was conducted on school going adolescents of Lucknow, from September 2014 to August 2015. **Subjects and Methods:** BP, height, and weight were measured following standard protocols, Centers for Disease Control and Prevention charts for finding respective cut-off values and oral questionnaire for assessing lifestyle risk factors were used. **Statistical Analysis:** Chi-square, unpaired *t*-test, and logistic regression were used. **Results:** Of the 1041 participants, elevated BP (BP percentile ≥ 90) was prevalent in 24.2%. On regression, factors such as obesity (adjusted odds ratio [aOR] = 5.8, 95% confidence interval [CI] = 3.6–9.4), low fruit diet (aOR = 3.3, 95% CI = 2.1–5.4), and frequent junk food consumption (aOR = 1.9, 95% CI = 1.3–2.8) raised the odds of elevated BP while it was lowered by being physically active (aOR = 0.67, 95% CI = 0.46–0.97). Of 86.3% of children ($n = 898$) who were fathomed of BP, only less than third (33% and 21.9%) acquainted of BP raising and lowering practices, respectively. **Conclusions:** Prevalence of high BP is colossal with only a few children knowing its amendable nature. Strenuous efforts targeting detrimental behaviors and imparting the sense of healthy lifestyle enhancing practices are vital to control this epidemic.

Keywords: Adolescents, elevated blood pressure, knowledge

INTRODUCTION

Elevated blood pressure (BP) leads to 54% of strokes, 47% of ischemic heart disease (IHD), and 7.6 million premature deaths (13.5% global deaths) annually.^[1] Barring treatment and control, the awareness of hypertension are very low in low- and middle-income countries, with the Prospective Urban Rural Epidemiology study reporting that only 46.5% of hypertensive participants were aware of their status.^[2] Evidence for early fount of risk factors during adolescence and left-sided shift of age distribution in IHD mortality is increasing. Besides, data on BP levels, high BP prevalence, and the knowledge of this growing epidemic are deficient among children.

Objectives

1. To assess the prevalence of elevated BP among adolescents and to ascertain the associated risk factors

2. To assess adolescent's knowledge about BP and its modifiable factors
3. To describe the cut-off values of BP for adolescents.

SUBJECTS AND METHODS

The community-based cross-sectional study was conducted on 13–18-year-old adolescents of Lucknow district, from September 2014 to August 2015. It was performed in conformity with ethical principles of Helsinki's declaration

Address for correspondence: Dr. Senthamizh Prasad,
No: 21, Type-IV Qrs, Block-13,
Neyveli - 607 803, Tamil Nadu, India.
E-mail: prasadsenthamizh@gmail.com

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and its updates and was approved by the Institutional Review Board. Sample size was calculated referring previous prevalence study of hypertension (9.4%)^[3] with allowable error 2.3% and Z-value at two-tailed α -level of 0.05. Multistage sampling done, and hence, design effect of 1.75 was included in this study. BP was measured by mercury sphygmomanometer that was standardized daily. With children's right arm extended over the table at the level of heart and ensuring cuff of appropriate size,^[4] three readings of systolic and diastolic BP (SBP and DBP) were taken and the average noted. With children's heels, knees, buttocks, shoulders and back of the head touching the wall, and their head held in Frankfurt plane, height was recorded to the nearest centimeter. Using weighing scale (OMRON-HN286-AP), participants were weighed to the nearest 100 g. Body mass index (BMI) was calculated using Quetelet's Index. Readings were plotted in Centers for Disease Control and Prevention BP percentile charts and BMI-for-age charts.^[5,6]

Based on the fourth report from the National High BP Education Program, "hypertension" is defined as average SBP and/or DBP that is $\geq 95^{\text{th}}$ percentile for sex, age, and height on three or more occasions. "Prehypertension" is defined as average SBP or DBP levels that are $\geq 90^{\text{th}}$ percentile, but $< 95^{\text{th}}$ percentile. Adolescents with BP levels $\geq 120/80$ mmHg should be considered prehypertensive. Elevated BP constitutes both prehypertension and hypertension. BMI-for-age obtained was classified as obesity when age- and gender-specific BMI values are $\geq 95^{\text{th}}$ percentile.^[7]

Low vegetable or fruit intake incorporated eating vegetables or fruits less than thrice a week. Adding extra salt to food that already had salt added was considered preference to salt dishes. Physical activity (PA) included involvement in moderate to vigorous intensity activities for at least 60 min daily. Screen time meant following sedentary habits such as watching TV, playing video games, or computer. Nonleisure time PA included walking, cycling or playing in break time (at school), stair stepping (at home or school), and household PAs.

Knowledge

Knowledge acquired by hearing and reasoning was assessed. Semi-structured, pretested questionnaire that derived responses for awareness of BP and its alterability was used. Knowledge score "0" indicates those who were unmindful of the term BP. Score "1" was given to those who were knowledgeable of BP and its measurability. Further correct responses to BP lowering and augmenting practices fetched scores of "1" each. Scores were then added and compared.

Statistical analysis

Categorical data were presented as frequency and proportions. Univariate logistic regression (LR) analysis followed by multivariate LR with backward LR procedures was used to find associations between groups. $P < 0.05$ was taken as level of significance.

RESULTS

Of the 1041 adolescents included in the study, elevated BP was prevalent in nearly one-fourth [Figure 1]. The mean age of the study population was 15.1 ± 1.4 years. Univariate analysis used to find the association of demographic variable and lifestyle behaviors with elevated BP is shown in Table 1. Obesity and low fruit intake significantly increased the odds of both hypertension as well as prehypertension.

In Table 2, the predictors of elevated BP were determined by the multivariate model proposed. After adjusting for stage of adolescence, sex, residence, and school enrolled, the model predicts that obesity, low fruit diet, and frequent junk food intake independently increased the chances of elevated BP. However, being physically active significantly lowered the chances of BP elevation ($P < 0.05$).

Maximum of the children heard about BP from doctors (55.6%) followed by parents (51.4%), whereas school teachers

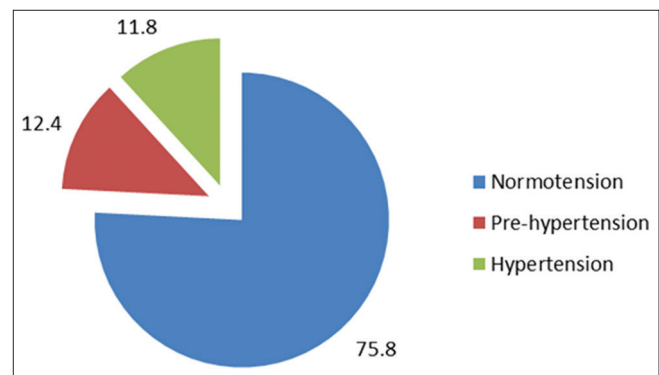


Figure 1: Blood Pressure distribution in adolescents

Table 1: Univariate regression of factors elevating blood pressure levels

Variables ^a	Unadjusted OR (95% CI)		
	Prehypertension	Hypertension	Elevated BP ^b
Early adolescence	2.0 (0.6-6.9)	6.4 (0.8-48.2)	3.1 (1.1-9.0)
Mid adolescence	2.7 (0.8-9.0)	7.6 (1.1-56.4)	3.9 (1.4-11.2)
Urban residence	3.1 (1.9-5.2)	3.1 (1.9-5.3)	3.1 (2.2-4.6)
Studying in government schools	0.8 (0.5-1.2)	0.5 (0.4-0.8)	0.7 (0.5-0.9)
Male gender	0.5 (0.4-0.8)	0.8 (0.5-1.2)	0.6 (0.5-0.9)
Obesity	3.6 (2.0-6.5)	14.3 (8.7-23.4)	7.8 (5.1-12.1)
Preference to salty dish	0.8 (0.5-1.3)	2.0 (1.3-3.0)	1.3 (0.9-1.9)
Frequent junk food intake	0.9 (0.5-1.5)	4.2 (2.8-6.3)	2.2 (1.5-3.0)
Low fruit intake	3.4 (1.9-6.1)	3.9 (2.1-7.2)	3.6 (2.3-5.6)
Low vegetable intake	1.3 (0.9-1.9)	1.5 (1.1-2.2)	1.4 (1.1-1.9)
Nonleisure time PA	0.6 (0.4-1.0)	0.7 (0.4-1.1)	0.6 (0.4-0.9)
Physically active daily	1.1 (0.7-1.5)	0.3 (0.2-0.6)	0.6 (0.4-0.9)
Screen time > 2 h/day	1.4 (0.9-2.0)	1.6 (1.1-2.4)	1.5 (1.1-2.0)

^aThe outcome variables are compared to normotensive group, ^bElevated BP includes BP percentile ≥ 90 . Numbers which are bold indicates level of significance at $P < 0.05$. CI: Confidence interval, BP: Blood pressure, PA: Physical activity, OR: Odds ratio

contributed to only about one-fourth (25.5%). Furthermore, only 5% of them were judicious of the role of PA in BP control. The picture of adolescent’s comprehension about BP and its flexibility is shown in Figure 2. The mean knowledge score of the population was 1.93 ± 1.2 .

DISCUSSION

Overall the prevalence of elevated BP among adolescents is huge and the knowledge of BP and its changeability is below par. BP percentile values with respect to age and sex have also been formulated [Table 3] which describes the loci of present BP level of children.

Variables ^a	Adjusted OR (95% CI) ^b	P
Obesity	5.8 (3.6-9.4)	<0.001
Preference to salty dish	1.1 (0.8-1.7)	0.42
Frequent junk food intake	1.9 (1.3-2.8)	<0.001
Low fruit intake	3.3 (2.1-5.4)	<0.001
Low vegetable intake	1.1 (0.7-1.4)	0.86
Nonleisure time PA	0.9 (0.6-1.4)	0.83
Physically active daily	0.6 (0.4-0.9)	0.038
Screen time >2 h/day	1.2 (0.9-1.7)	0.11

^aStage of adolescence, sex, location, type of school were taken as constant, ^bThe outcome variables are compared to normotensive group. Nagelkerke R²=25.6%. Bold values indicate significance at P<0.05. CI: Confidence interval, PA: Physical activity, OR: Odds ratio

In this study, the prevalence of hypertension is 11.8% and is not dissimilar with results of previous studies.^[8,9] In contrary, other studies in India as well as in other parts of the world report prevalence ranging from 0.46% to 21.8%. The reason might be because neither the study group’s age or ethnicity nor the methodology used was similar.^[10] It is worth emphasizing that some studies performed only one measurement while the others did repetitive measurements and there is evidence that prevalence decreased from 13% to 1% between the first and third visits.^[11]

The risk factors independently associated with high BP in this study are obesity, altered food habits, and physical inactivity. The findings from Cinteza and Balgradean and Rahman *et al.* support the association of obesity with high BP.^[12,13] In obese children, activation of sympathetic nervous system shifts the arterial pressure control mechanism of diuresis and natriuresis

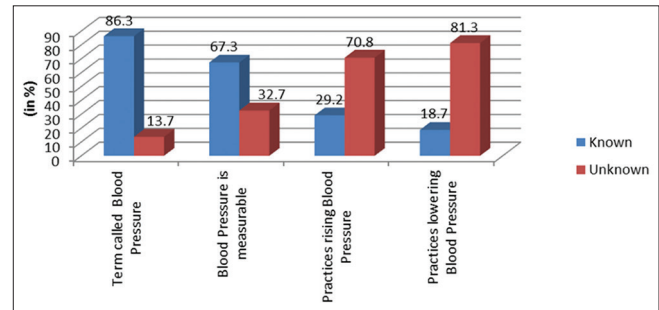


Figure 2: Awareness about Blood Pressure in adolescents

	Gender												
	Boys age (years)						Girls age (years)						
	13	14	15	16	17	18	13	14	15	16	17	18	
SBP percentiles													
3	82.00	80.00	84.00	83.28	90.00	84.00	83.92	84.00	83.24	83.46	90.08	83.92	
5	82.00	84.00	84.00	87.60	90.00	84.60	86.00	86.00	86.00	85.70	92.80	86.00	
10	86.00	90.80	88.00	90.00	90.00	93.20	87.20	88.00	90.00	89.40	95.60	87.20	
15	88.00	92.00	90.00	94.00	92.00	98.00	90.00	90.00	92.00	92.00	100.0	90.00	
25	96.00	98.00	98.00	96.00	96.00	100.0	92.00	94.00	100.0	98.00	102.0	92.00	
50	106.0	106.0	104.0	106.0	106.0	104.0	100.0	102.0	110.0	108.0	110.0	100.0	
75	116.0	118.0	118.0	114.0	114.0	110.0	110.0	112.0	120.0	114.0	120.0	110.0	
90	124.0	126.0	130.0	122.8	122.0	114.4	120.8	124.4	125.2	124.0	124.0	120.8	
95	128.0	131.6	136.4	130.0	129.0	118.0	125.4	130.0	130.0	124.3	128.0	125.4	
DBP percentiles													
3	49.60	44.32	42.00	49.28	45.50	56.00	42.00	49.68	50.00	51.64	58.00	42.00	
5	52.00	48.00	42.00	56.00	50.00	56.60	46.60	50.00	54.00	56.00	58.80	46.60	
10	58.00	52.80	50.00	59.60	53.00	58.00	50.00	54.00	58.00	58.00	61.60	50.00	
15	60.00	59.20	54.00	60.40	58.00	58.00	60.00	60.00	60.00	60.00	64.00	60.00	
25	62.00	64.00	60.00	68.00	62.00	62.00	62.00	62.00	65.00	60.50	68.00	62.00	
50	70.00	70.00	70.00	70.00	71.00	70.00	68.00	70.00	72.00	70.00	72.00	68.00	
75	76.00	78.00	76.00	78.00	80.00	79.00	75.00	76.00	80.00	79.50	80.00	75.00	
90	80.00	83.20	82.40	84.00	84.00	80.00	80.00	80.00	84.00	82.60	86.80	80.00	
95	88.00	85.60	88.20	88.00	90.00	81.40	82.00	81.20	90.00	88.30	93.60	82.00	

SBP: Systolic blood pressure, DBP: Diastolic blood pressure

to higher BP levels might be the possible reason illuminating the association.^[14] More frequent junk food consumption seen in our study population tend to elevate their BP levels. This is contradictory with findings of from other study^[15] that found no association. Consumption of fruits regularly significantly decreased BP elevation. Accordance with this is evidence from Ostrowska-Nawarycz and Nawarycz, and Sundar^[16,15] consistent to findings from other researches, our study has significant association of increased screen time and physical inactivity with high BP.^[15,17-20] Being physically inactive, there is dysregulation of body weight, insulin use and indirectly blood lipids, glucose and clotting factors gets deranged, altering the blood vessels and thereby the BP alteration.^[21]

Knowledge of BP among adolescents is the new aspect in our study. The children had very poor understanding which might be due to greater dearth in proficiency about the perplexity by their parents and teachers as well. This underlines the fact that elder generation is less health conscious and they incorporate the same to their progenies. School teachers contribute to only less than fourth in preaching about healthy lifestyle enhancing practices. This reveals that the present education system aids in blinding of the health security of the future generation.

The limitations in our study are: (i) The average of the BP measurement was taken only once, which may affect the validity of the results. (ii) The assessment of food habits was based on frequency of consumption and responses from the child's memory which may subject to recall bias. (iii) PA was recorded as told by the children; no observation was done which all adds to constraints of this study. However, relatively large sample size and measurements taken using validated instruments add strength to the study as the results can be generalized. Measures were taken to minimize "white-coat effect" which also adds strength to the study.

CONCLUSIONS

Health education intended to parents and school teachers whose doctrine has an extensive perpetuation in advancing the attitude of young children toward primordial prevention will be the pick to control this epidemic. In addition, new legislations that ensure adequate PA both in schools and homes along with banning of high-calorie dense foods have to be framed. As there is limited evidence evaluating effectiveness of these strategies in the low-income settings, alternate strategies betokening these factors have to be framed.

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Conflicts of interest

There are no conflicts of interest.

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