



STUDY OF BLOOD PRESSURE IN SCHOOL GOING CHILDREN AGED 5 – 15 YEARS IN AHMEDABAD

Paediatrics

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ABSTRACT

BACKGROUND: There is increasing evidence that essential hypertension tracks into adulthood, resulting in considerable cardiovascular morbidity. Prevalence of hypertension is also increasing in children below 15 years of age due to various factors. Hence, early diagnosis of hypertension is an important strategy to be followed. **AIMS AND OBJECTIVES:** To study the distribution of blood pressure and determine the prevalence and risk factors of hypertension in children between 5-15 years of age in Ahmedabad, Gujarat. **METHODS AND MATERIALS:** This cross sectional study was carried out in children of a private school in the age group 5 to 15 years. This study was done by making measurements of height, BMI and blood pressure using standardized physical instruments following standard guidelines. The data was collected and analyzed using appropriate statistical tests. **RESULTS:** In our study total 1131 students aged 5-15 years were included. Prevalence of hypertension in our study was 15.91%. Total 441(38.99%) students had prehypertension and 180(15.91%) students had stage 1 hypertension. There were 599(52.96%) boys and 532(47.03%) girls (statistically significant). Most children were between 50th and 75th percentile (total 513;45.35% students) and 198 students were at 95th percentile according to BP centiles. 266 students were underweight, 102 students were overweight and 114 students were obese. Weight, height and BMI were found to have positive correlation with blood pressure. Obesity showed a significant association with hypertension. **CONCLUSION:** In the study, hypertension in students was found to be significantly associated with higher BMI and obesity, with male predisposition. Age, height and BMI were found to correlate positively with blood pressure levels.

KEYWORDS

Children, Hypertension, India, Risk Factors

INTRODUCTION:

Developing countries like India are undergoing a rapid epidemiological transition resulting in a dramatic change in lifestyle consisting of sedentary lifestyle, diet rich in fat, sugar and salt along with a high level of mental stress. This has led to increased incidence of noncommunicable diseases like hypertension, diabetes mellitus type 2, dyslipidemia, obesity and ischemic heart diseases.¹

Systemic hypertension is an important condition in childhood, with an estimated population prevalence of 1-2% in the developed countries.³ In infants and young children, systemic hypertension is uncommon, with a prevalence of <1%, but when present it is usually indicative of underlying disease process (secondary hypertension). In contrast, adolescents may develop primary or essential hypertension (with no underlying cause). Hypertension is classified as essential (primary) or secondary to underlying cause, like disease of renal parenchyma, renovascular or endocrine disorders.

The insidious and steady history of hypertension in adults indicates that essential hypertension in adults is a result of a process, that starts early in childhood and adolescent life, but probably goes unnoticed.⁴ The relationship between adolescent and adult BP is

demonstrated by the "tracking" phenomenon^[28] (Those children and adolescents whose BP were at the upper percentiles, would have their BP staying at the same range after their growth and development).

The landmark Global Burden of Disease Study showed that hypertension is leading the list of risk factors for death and disability worldwide^[12].

Obesity increases the risk for many chronic diseases including non-alcoholic fatty liver disease, which, further decreases the overall quality of life^[7-9]. Therefore, it is important to identify the individuals at risk at an early stage. Studies suggests that childhood obesity is a causative agent for early onset hypertension, increasing risk for adult coronary heart diseases, (CVD), type II diabetes and certain site-specific cancers including colorectal and breast cancer^[10,11,15,16].

AIMS AND OBJECTIVES:

1. To study the distribution of blood pressure among the school children aged 5-15 years.
2. To determine prevalence of hypertension in our study population
3. To study the association of factors like age, gender, body mass index(BMI) and obesity with hypertension.

MATERIALS AND METHODS:

This cross sectional study was carried out to determine the prevalence of hypertension in children between 5 to 15 years and to study the association between factors like age, gender, BMI and blood pressure. Permission was obtained from the Ethics committee of the Institute and informed consent was taken from the principal of the school.

For the study, 1131 children of a private school in the age group 5 to 15 years were selected. Children with chronic disease like renal, hepatic or endocrine disorders or taking treatment for the same were excluded.

Anthropometric measurements and blood pressure were recorded as per the standard WHO guidelines. The age was determined from date of birth of school registration records.

Weight was measured with the child standing motionless on the weighing scale. Height was measured with child being bare foot, standing in an erect position against a vertical scale of portable stadiometer in Frankfurt horizontal plane.

The BP was measured in left arm by auscultatory method using mercury sphygmomanometer with appropriate size cuff covering two third of the arm, the lower edge 2.5 cm above the antecubital fossa (as per WHO guidelines), child in a sitting position, with arm at the level of heart and after a five-minute rest.^[22] Three measurements were taken at an interval of 5 min each and mean of these readings were taken as average systolic blood pressure and average diastolic blood pressure.

Hypertension was diagnosed when the BP exceeded two standard deviations (i.e.95th percentile) above the mean blood pressure for the population. In our study, BP percentiles were identified by using height percentile table.¹⁸

BMI was used as a measure of obesity and it was derived by using the standard formula for it. CDC growth charts^[5] were used for anthropometric measurements.

Blood pressure values were compared to the values given by the update of 1987 task force report of the National high blood pressure Education Programme Co-ordinating Committee. Children were classified into three groups as follows (as per guidelines of the above committee):

- BP<90th percentile-Normal (N) Blood pressure
- BP=90-95th percentile-Pre-hypertension (PHTN)
- BP>95th percentile-Hypertension (HTN).

If the SBP and / or DBP were in higher range of blood pressure then two additional readings were obtained. The lowest of these readings was recorded. Those children who had recorded high blood pressure were advised for further evaluation.

BMI was calculated by the formula BMI=weight(kg)/height (m²).

BMI percentiles were calculated for each respective age group.

The BMI percentile between:

- 5th-85th percentile = normal,
- 85th-95th percentile = overweight,
- 95th percentile above = obese.

Chi-square test was used to find out any significant association between the risk factors and hypertension.

RESULTS AND DISCUSSION:

Prevalence of hypertension in the present study was 15.91%. It was higher compared to other studies by Nirav et al in Surat city, which had prevalence of hypertension 6.48%,^[34] and 4.4 % by Reddy et al in Maharashtra^[35].

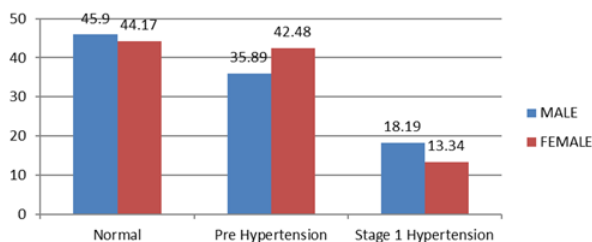
Total 441(38.99%) students had prehypertension and 180(15.91%) students had stage 1 hypertension.

We included 1131 students aged 5-15 years out of which 599(52.96%) were boys and 532(47.03%) were girls. There was male preponderance (statistically significant). [Table 1][Figure 1]

TABLE 1: ASSOCIATION OF GENDER WITH HTN

Gender	Total	Normal	Pre BP	Stage 1 BP	Chi square value	p value
Male	599 (52.96%)	275 (45.90%)	215 (35.89%)	109 (18.19%)	7.49	0.023

Female	532 (47.03%)	235 (44.17%)	226 (42.48%)	71 (13.34%)		
Total	1131 (100%)	510 (45.09%)	441 (38.99%)	180 (15.91%)		

Gender wise distribution of hypertensive status**FIGURE 1- Gender wise distribution of hypertensive status**

Most children were between 8-13 years of age. Mean age was 10 years. Most children were between 50th and 75th percentile (total 513;45.35% students) and 198 students were at 95th percentile according to BP centiles.

Increase in age was associated with increasing chance of hypertension.[Table 2] Similar results were found in a study conducted by Khan et al, at Ahmedabad in the year 2010.²⁹ Studies indicate that BP increases with age, which may be due to increase in body mass.^[23-26]

TABLE 2 : ASSOCIATION OF AGE WITH HTN

AGE	TOTAL	NORMAL	HYPERTENSION	p value
5 yrs	45	28	17	0.02
6 yrs	90	40	50	0.13
7 yrs	112	45	67	<0.0001
8 yrs	138	49	89	<0.0001
9 yrs	141	66	75	0.284
10 yrs	98	47	51	0.56
11 yrs	139	69	70	0.9
12 yrs	147	67	80	0.12
13 yrs	129	65	64	0.9
14 yrs	88	49	39	0.13
15 yrs	4	1	3	0.15
TOTAL	1131	526	605	

Present study shows that with increase in weight there was increase in hypertension which was also observed in a study conducted by Jagadesan et al in the year 2013 at Chennai.^[30] [Table 3]

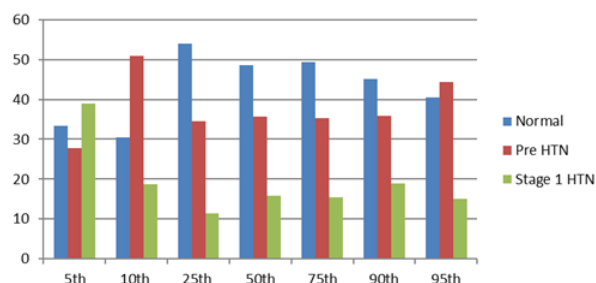
TABLE 3: ASSOCIATION OF WEIGHT WITH HTN

Weight	TOTAL	NORMAL	Pre HTN	Stage 1 HTN	p value
14-22	290(25.64 %)	137(47.24%)	128(44.13%)	25(8.62%)	0.185
22-30	284(25.11 %)	110(38.73%)	125(44.01%)	49(17.25 %)	<0.001
30-38	187(16.53 %)	84(44.91%)	64(34.22%)	39(20.85 %)	0.05
38-46	166(14.67 %)	72(43.37%)	64(38.55%)	30(18.07 %)	0.02
46-54	99(8.75%)	43(43.43%)	42(42.42%)	14(14.14 %)	0.06
54-62	44(3.89%)	21(47.72%)	19(43.18%)	4(9.09%)	0.66
62-70	42(3.71%)	15(35.71%)	12(28.57%)	15(35.71 %)	0.008
70-78	19(1.67%)	9(47.36%)	4(21.05%)	6(31.57%)	0.74
TOTAL	1131(100%)	491(43.41%)	458(40.49%)	182(16.09 %)	

Increase in height was associated with increase in hypertension. [Table 4][Figure 2] Similar results were also seen in studies conducted by Banker et al, at Bhavnagar, Gujarat in the year 2010³¹, and a study conducted by Ramya et al at Bangalore in the year 2018.^[32]

TABLE 4: ASSOCIATION OF HEIGHT WITH HTN

Height centile	Total	Normal	Pre HTN	Stage 1 HTN	p value
5th	18(1.59%)	6(33.33%)	5(27.77%)	7(38.88%)	<0.05
10th	59(5.21%)	18(30.50%)	30(50.84%)	11(18.64%)	<0.0001
25th	148(13.08%)	80(54.05%)	51(34.45%)	17(11.48%)	0.164
50th	272(24.04%)	132(48.52%)	97(35.66%)	43(15.08%)	0.49
75th	241(21.30%)	119(49.37%)	85(35.26%)	37(15.35%)	0.787
90th	195(17.24%)	88(45.12%)	70(35.89%)	37(18.97%)	0.05
95th	198(17.50%)	80(40.40%)	88(44.44%)	30(15.15%)	<0.0001
TOTAL	1131(100%)	523(46.24%)	426(37.66%)	182(16.09%)	

**FIGURE 2 - Association of height with HTN**

Out of 1131 students 266 students were underweight, 102 students were overweight and 114 students were obese. The results showed that lower the BMI, lesser the chances of hypertension. Obesity showed a significant association with hypertension which was also seen in other studies conducted by Ramya et al, at Bangalore in the year 2018³² and by Yadav et al, at Uttar Pradesh in the year 2019.³³

Hypertension in obese children could be due to increased cardiac output, increased blood volume, excessive sodium intake etc.^[29] The higher prevalence of hypertension in school going children reflects increase in cardiovascular diseases due to the changing lifestyles, dietary patterns, sedentary lifestyle etc. Preventive measures, early detection and modifying the risk factors can protect children from developing complications and thereby reducing the morbidity and mortality. Risk factor identification is an established strategy to apply primordial prevention to reduce the incidence of hypertension in the community.

There is increasing evidence that essential hypertension tracks into adulthood, resulting in considerable cardiovascular morbidity^[27]. Childhood hypertension is an established predictor of adult hypertension and organ damage, and it is an underestimated problem in developing countries. This may have major implications towards increasing prevalence of non-communicable disease (NCD) like obesity, diabetes, hypertension and cardiovascular disease in early adulthood^[20,21]. It also signifies the importance of screening adolescents for the detection of hypertension.

CONCLUSION:

Hypertension is a significant problem in the school going children of developing countries. Obesity and increased body mass index are significant anthropometric risk factors for hypertension. It suggests a need for targeted intervention to prevent adult noncommunicable diseases like hypertension, diabetes and stroke.

Using simple screening methods in younger ages itself helps to identify individuals at high risk at an early age and accordingly lifestyle modifications can be adopted to postpone the onset of the disease and reduce the burden on the community and the nation. Therefore, there is an urgent need for increasing awareness through education and motivation in school children and regular anthropometric and blood pressure monitoring at least once in a year in routine school health check-up.

REFERENCES:

- Mohan V. Why are Indians more prone to diabetes. *J Assoc Physic India*. 2004;52:468-74.
- World Health Organization. Obesity: preventing and managing the global epidemic. Technical Report Series No. 894, Geneva: WHO; 2000.
- Munter P, He J, Cutler JA, Wildman RP, Whelton BK. Trends in blood pressure among children and adolescents. *JAMA*. 2004;291:2107-13.
- Bhave S, Bavdekar A, Otiv M. IAP National Task force for childhood prevention of adult diseases : Childhood obesity. *Indian Paediatr* 2004;41:559-75.
- CDC Growth Charts: United States. Available from: <http://www.cdc.gov/growthcharts/background.htm>.
- Agarwal VK, Sharan R, Srivastava AK, Kumar P, Pandey CM. Blood pressure profile is children of age 3 to 15 Yrs. *Indian Paediatr*. 1983;20:291-5.
- Bose K, Bisai S, Mukhopadhyay A, et al. Overweight and obesity among affluent Bengalee school girls of Lake Town, Kolkata, India. *Matern Child Nutr* 2007; 3: 141-145.
- Berenson GS, Srinivasan SR, Wattigney WA, et al. Obesity and cardiovascular risk in children. *Ann NY Acad Sci* 1993; 699: 93-103.
- Berenson GS, Srinivasan SR, Bao W, et al. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. *The Bogalusa heart study*. *New Engl J Med* 1998; 338: 1650-1656.
- Mahoney LT, Burns TL, Stanford W. Coronary risk factors measured in childhood and young adult life are associated with coronary artery calcification in young adults: the Muscatine study. *J Am Coll Cardiol* 1996; 27: 277-284.
- Baker JL, Olsen LW, Sorensen TI. Childhood body-mass index and the risk of coronary heart disease in adulthood. *N Engl J Med* 2007; 357: 2329-2337.
- Bibbins-Domingo K, Coxson P, Pletcher MJ, et al. Adolescent overweight and future adult coronary heart disease. *N Engl J Med* 2007; 357: 2371-2379.
- K.D. Tripathi's text book of pharmacology, 7th edition year 2013 antihypertensive drug chapter page 558-574.
- Mitsnefes MM. Hypertension in children and adolescent. *Pediatr ClinNorthAm* 2006;53:493-512.
- Chouraki V, Wagner A, Ferrie's J, et al. Smoking habits, waist circumference and coronary artery disease risk relationship: the PRIME study. *Eur J Cardiovasc Prev Rehabil* 2008; 15: 625-630.
- Connolly BS, Barnett C, Vogt K, et al. A meta-analysis of published literature on waist-to-hip ratio and risk of breast cancer. *Nutr Cancer* 2002; 44: 127-138.
- Kaushik JS, Narang M, Parakh A. Fast food consumption in children. *Indian Paediatr*. 2011;48:97-101.
- The fourth Report on the diagnosis, Evaluation, and Treatment of high blood pressure in children and adolescent, 2004 American heart association, inc, Bonita Falkner ;Stephen R. Daniels.
- Chakraborty P, Dey S, Pal R, Kar S, Zaman FA, Pal S. Obesity in Kolkata children: Magnitude in relationship to hypertension. *J Natural Sci Bio Med*. 2012;2:101-6.
- Shah B, Anand K, Joshi P, Mahanta J, Mohan V, Thankappan K, et al. Report of the Surveillance of Risk Factors of Non-communicable Diseases (STEPS 1 and 2) From Five Centers in India - WHO India - ICMR initiative. New Delhi: http://www.whoindia.org/LinkFiles/NCD_Surveillance_NCD_RF_surveillance_report.pdf. 2004.
- Pickering et al. 2005, p 146. See blood pressure measurement method.
- Forfar and Arneil's text book of paediatric, 7 edition, cardiovascular disease chapter.
- Ganong's review of medical physiology, 23 edition section vi : cardiovascular physiology
- Ghai's textbook of pediatric, 7 edition, cardiovascular disease chapter
- Gupta AK, Ahmed AJ. Normal blood pressure and the evaluation of sustained blood pressure elevation in childhood. *Indian Paediatr* 1990;27:33-42
- Lane DA, Gill P. Ethnicity and tracking blood pressure in children. *J Human Hypertension* 2004; 18: 223-228.
- De'nes Pa'll M.D. Screening of adolescent Hypertension, and Evaluation of target organ damages; Debrecen Hypertension Study; 2002:23.
- Chadha SL, Tandon R, Shekhawat S, et al. An epidemiological study of blood pressure in school children (514 years) in Delhi. *Indian Heart J* 1999; 51: 178-182.
- Khan et al, A study of the risk factors and the prevalence of hypertension in the adolescent school boys of Ahmedabad city. *Journal of Clinical and Diagnostic Research* [serial online] 2010 December [cited: 2010 December 20]; 4:3348-3354.
- Jagadesan et al, Prevalence of overweight and obesity among school children and adolescents in Chennai. *Indian Paediatr*. 2014 Jul;51(7):544-9. doi: 10.1007/s13312-014-0444-6. PMID: 25031132.
- Banker et al. A Study of Prevalence of Hypertension in School Children, Gujarat medical journal / December-2013 Vol. 68 No. 2
- Ramya et al, Body mass index, waist hip ratio and body fat percentage as early predictors of pre-diabetes and pre-hypertension in adolescents. *Curr Pediatr Res* 2017; 21 (2): 327-334.
- Yadav et al, Prevalence of overweight, obesity and hypertension among school going children in District Kanpur, Uttar Pradesh, India: a longitudinal study. *Int J Contemp Pediatr* 2019;6:159-62.
- Nirav et al, Prevalence of hypertension in school going children of Surat city, Western India, *Journal of Cardiovascular Disease Research*. 2011 Oct-Dec; 2(4):228-232.
- Reddy D, Kushwaha AS, Kotwal A, Basannar DR, Mahen A. Study of blood pressure profile of school children 6-15 years in a rural setting of Maharashtra. *Med J Armed Forces India*. 2012 Jul;68(3):222-5. doi: 10.1016/j.mjafi.2012.03.004. Epub 2012 Jun 2. PMID: 24532872; PMCID: PMC3862704.