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BLOOD PRESSURE PROFILE AND ITS RELATION TO AGE AND ANTHROPOMETRIC MEASUREMENTS (WEIGHT, HEIGHT, BODY MASS INDEX) IN SCHOOL GOING ADOLESCENTS.

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ABSTRACT

Background: The prevalence of non-communicable diseases such as obesity, hypertension, cardiovascular diseases and diabetes is increasing at alarming rate. Early identification of overweight/obesity and high blood pressure is effective strategy for institution of preventive measures. **Aims & Objective:** The objectives of this study were to assess blood pressure profile and its relation to age and anthropometric parameters in school going adolescents. **Materials and Methods:** This is a cross sectional study involving 507 school children aged between 10-17 years. Anthropometric parameters were assessed and a blood pressurewasmeasured using a standardized mercury sphygmomanometer. Elevated blood pressure (pre-hypertension) and Hyper-tension was defined by age, gender and height specific blood pressure charts. **Results:** A positive correlation was found with rise in mean systolic blood pressure (mSBP)/mean diastolic blood pressure (mDBP) with increase inweight and height. There was no correlation between age and Body Mass Index (BMI) with rise in (mSBP) and (mDBP). Higher mSBP and mDBP was observed in adolescents with BMI > 95%. Totally there were 123 subjects (24.26 %); who had elevated blood pressure/hypertension. **Conclusion:** The study points out the need for at least annual measurements of Body weight, Height, BMI and periodic screening for high blood pressure in school going children.

KEYWORDS: Hypertension, Obesity, Overweight, Pre-hypertension.

INTRODUCTION

Adolescent Elevated blood pressure (pre-hypertension)/Hypertension are an emerging health problem in developed anddeveloping countries as well.Changes in life style, food habits and lack of awareness have contributed for heavier children not only in urban area or from affluent class but in peri-urban/rural area or low-income population. This has led to an increase in prevalence of elevated blood pressure and hypertension.

Althoughblood pressure normally increases with growth anddevelopment, the children with higher levels of bloodpressure tend either to maintain that position as theymature or track into higher levels of blood pressure inadulthood.[1] Obesity is identified as the most important risk factor affecting blood pressure (BP) distribution in children.[2,3]

As the symptoms of childhood hypertension are largely nonspecific, most children with essential hypertension are likely to be asymptomatic and may hence go unnoticed.Adverse effects of even mild elevations in childhood BP on adult cardiovascular outcomesare now well recognized.[4]

Recognition of blood pressure correlateserves to identify groups within a population who areat increased risk of hypertension.Even the anthropometric measurements such as weight, height and BMI can be taken as surrogate marker of prevalence of hypertension. Therefore, the earlydetection of hypertension and its causative factors areimportant to evolve measures to prevent the hypertensionand its complications.[5]

The present study was taken up to know the blood pressure profile in apparently healthy school adolescents and to determine the correlation of blood pressure with age, gender and anthropometric parameters in school going children/adolescents.

MATERIALS AND METHODS

A cross-sectional study was carried out among school children from class 5 to 9 studying in a Government and a private school located in peri-urban area of Pune, Maharashtra.

All the students who were present on the day of assessment and willing to participate were included. The study was carried out after obtaining ethical clearance from Institutional Ethical Committee.Permission from

school authorities was also sought after explaining the objectives as well as the method of study and they were also told that it did not include any invasive procedures.Age of the child was confirmed from the school records.

Total 507 children were examined. 209 from a government run school and 298 from a Private school from same locality. After taking a verbal consent, anthropometric assessment was done by a trained undergraduate student, under the supervision of a faculty from the department of Pediatric medicine.

The subjectswere weighed using electronic weight machine; with minimum clothing and without shoes, standing upright motionless.Their weights were recorded to the nearest 0.1kg.

Height was measured by the use of stadiometer with the subject standing without foot-ware in erect posture to the nearest 0.1cm.

BMI was calculated using the formula BMI= weight (kg)/ (height in meter)^2 and the study population was then classified as underweight (Thin), normal, overweight andObese.[6]

- **Underweight:** BMI was less than or equal to 3rd percentile for that age and sex.
- **Normal:** BMI was more than 3rd percentile but less than 85th percentile for that age and sex.
- **Overweight:** BMI exceeded 85 th percentile for that age and sex.
- **Obese:** BMI exceeded 95 th percentile for that age and sex.

After giving rest for 5-10 minutes blood pressure was recorded using mercury sphygmo-manometer and appropriate sizedcuffin sitting position.

Systolic blood pressure was determined as appearance of 1st Korotkoff sounds and diastolic blood pressure was taken at the point of muffling of heart sounds (4th Korotkoff sounds).Blood pressure recordings were expressed to the nearest 2 mm Hg. Two blood pressure recordings were taken from each child at 0 and 10 minutes using auscultatory method. Average of two consecutive readings was taken. All blood pressure recordings were taken on the same time of the day.

Children were classified into three groups as follows.[7]

- Normal (N) Blood pressure - BP < 90th percentile for that age, sex and height.
- Elevated blood pressure - BP = 90-95th percentilefor that age, sex and height.
- Hypertension (HTN) I - BP > 95th percentilefor that age, sex and height.
- Hypertension (HTN) II - BP > 95th percentile + 12 mm of Hg.

The collected datawas entered into the computer using software program MS Excel.Subsequentanalysis was done by inferential statistical methods.Mean and standard deviation of the parameters were calculated.Pearson's Correlationcoefficient was calculated to see correlationbetween age, weight, height, BMI and mSBP/mDBP.

RESULTS

In the present study, total 507 students in age group between 10 to 17 years studying in class 5th to 9th were included. Out of which 281 (55.42%) were boys and 226 (44.58%) were girls. Of the total 507 students, 209 (41.2%) and 298 (58.7%) were from government and private schools, respectively. Mean with standard deviation of anthropometric parameters have been shown in Table-1.

Table 1: Age and Anthropometric indices (Mean ± SD) of study subjects.

PARAMETER	GOVT. SCHOOL (n=209)			PRIVATE SCHOOL (n=298)		
	Mean ± SD	Min.	Max.	Mean ± SD	Min.	Max.
Age(Years)	13.42 ± 1.82	10	17	11.02 ± 0.92	10	14
Weight (Kgs.)	37.07 ± 9.72	19	63	32.88 ± 8.3	17	60
Height (cms.)	146.3 ± 10.89	121	171	139.57 ± 9.8	120	162
BMI	17.06 ± 3.01	11.14	25.80	16.73 ± 3.21	10.97	28.08

Variation with age

Study subjects were divided into six groups, with a difference of 1 year between each group. The mean SBP and DBP were corelated. There were variable changes in mSBP and mDBPwith increase in age.

Table 2: Mean, standard deviation, and increments in systolic blood pressure and diastolic blood pressure among boys and girls at different ages in the ascending order.

Age (Years)	Gender (n)	SBP (Mean ± SD)	Increment	DBP (Mean ± SD)	Increment
10	M (65)	103.3 ± 10.02	--	74.03 ± 7.62	--
	F(54)	107.6 ± 7.33	--	73.96 ± 8.08	--
11	M (70)	107.37 ± 9.48	+ 4.07	74.62 ± 7.53	+ 0.59
	F(54)	107.44 ± 9.46	- 0.14	75.44 ± 8.22	+ 1.48
12	M (65)	109.07 ± 9.10	+ 1.70	75.34 ± 7.44	+ 0.72
	F(53)	108.53 ± 7.98	+ 1.09	75.77 ± 7.68	+ 0.33
13	M (29)	107.86 ±8.89	- 1.21	76.07 ± 7.47	+ 0.73
	F(20)	109.1 ± 7.99	+ 0.47	75.7 ± 7.40	- 0.07
14	M (24)	111.42 ± 9.42	+ 3.56	77.75 ± 9.08	+ 1.63
	F(23)	107. 91 ± 9.79	- 1.19	74.09 ± 8.40	- 1.69
> 15	M(28)	118 ± 12.99	+ 6.58	80.71 ± 9.03	+ 2.96
	F(22)	106 ± 13.26	- 1.91	71.90 ± 8.89	- 2.19

Variation with weight

The weight of students was divided into five groups, independent of age and height of the children with a difference of 10 kg between each group. The mean SBP and DBP were corelated. It was observed that the mSBP and mDBP increased gradually from < 20 kg. to> 51 kg. weight groups (**Table-3**).

Table 3: Distribution of blood pressure according to body weight.

Body Weight (Kgs.) group	n	SBP (Mean + SD)	DBP (Mean + SD)
< 20	17	100.47 + 11.06	70.47 + 6.42
21-30	199	105.64 + 8.64	74.29 + 7.33
31-40	161	107.56 + 8.14	74.77 + 7.86
41-50	109	112.44 + 10.84	77.39 + 8.99
> 51	21	118.19 + 12.15	80.67 + 7.33
Overall	507	108.05 + 9.88	75.24 + 8.04

Variation with height

Based on height of the individual student, five groups were made independent of age and weight with a difference of 10 cm between the groups. It was observed that there was gradual increase in mSBP and mDBP in all height groups with maximum rise above 160 cm of height (Table-4).

Table 4: Distribution of blood pressure according to height.

Height (cms.)	n	SBP (Mean + SD)	DBP (Mean + SD)
< 129	60	103.33 + 9.22	71.97 + 7.70
130-139	147	106.78 + 9.69	74.50 + 6.62
140-149	153	108.38 + 8.25	75.95 + 7.75
150-159	123	110.13 + 10.42	75.90 + 8.17
> 160	24	115.08 + 12.85	80.08 + 9.40

Distribution with bmi category

The BMI of students was divided into four groups. The mean SBP and DBP were calculated. It was observed that as BMI increased, both SBP and DBP increased gradually. (**Table-5**).

Table 5: Distribution of blood pressure according to BMI.

BMI	n	SBP (Mean + SD)	DBP (Mean + SD)
< 3	40	105.15 + 10.06	73.65 + 7.88
3 - 85	363	107.54 + 9.88	75.02 + 7.89
Overweight	71	110.23 + 9.07	75.69 + 8.58
Obese	33	112.49 + 11.27	78.60 + 8.62

Table6: Prevalence of Elevated BP and hypertension by BMI Category.

Nutritional status by BMI	N	N (%)		
		Normal BP	Elevated BP	Hypertension
Underweight	40	30	04(10.0%)	06 (15.0%)
Normal	363	294	41 (11.3%)	28 (7.7%)
Overweight	71	45	11 (15.5%)	15 (21.1%)
Obese	33	15	07 (21.2%)	11 (33.3%)
			63	60

A total of 63 (12.43%) children with elevated blood pressure and 60 (11.83%) children with hypertension were detected in the present study, of which 41 (15 elevated blood pressure + 26 hypertension) were studying in Government school and 82 (48 elevated blood pressure + 34 hypertension) were in private schools. Out of 41 hypertensive students in Government schools, 22 were males and 19 were females. Out of 82 hypertensive students in private schools, 47 were males and 35 were females.

DISCUSSION

It is important to measure blood pressure regularly in children/adolescents to identify them before or in the stage of elevated blood pressure. Itwould help in taking early steps to prevent the persistent state of elevated blood pressure and possibly prevention of later morbidity and mortality.

In the present study, meansystolicblood pressure(mSBP) and mean diastolic blood pressure (mDBP) was 108.05 mmHg and 75.24 mmHg, respectively. The mSBP and mDBP observed in the present study are lower than reported earlier.[8] However,The mSBP and mDBP was higher than reported by Kishorekumar C et.al.[9] This difference suggests that the factorslike dietary habits, physical activities, geographical locality may be playing a role in the determination of blood pressure.

Higher mSBP and mDBP was recorded in boys than girls, however it did not show statistically significant difference between the two sexes. Similar observations have been reported.[10]

The variable statistically non-significant changes in mSBP and DBP wereobserved in the present study between 10 -16 years inboth sexes. In boys, mean SBP increased with age except at 13 years, wherein there was a marginal decline in mean SBP (-1.21), and mean DBP has persistently increased with age. In girls, mSBP and mDBP also increased during early adolescence; but after 14 years of age, there was a fall in mSBP as well as mDBP. This variability is probably related to certain biological and psychological factors. A trend of variable increase in SBP and DBP with age in the present study was observed in both sexes. Similar observation has been reported.[11,12]

In boys the systolic and diastolicblood pressure spurts observed after 14 years can be accounted by the onset of puberty, which results in increase ofbody weight and height, as a result of increase in muscular tissue.In boys the mSBP was 103.3 mm Hg at the age of 10 years and 118 mm Hgat the age above 15 years, showed an increase of 14.7 mmHg increase in the systolic blood pressure. Similarly, theincrease of mDBP was observed as 6.41 mm Hg for the same age group. So, the age effect was foundto be more for systolic blood pressure in the present study.

The mSBP and mDBP increased steadily with weight.However,there was weaklypositive correlation between increase in body weight and rise in SBP / DBP.In contrast the Bogalusa heart study reported a close(linear) relationship between the log of the body weight and bloodpressure.[13]

In our study, there was an increase in 5 mm of Hg in mSBP in weight group up to 30 kg and above 40kg. Rise of 3 mm of Hg in mDBP in similar weight groups.

The mSBP and mDBPwere found to increase with increase in the height in both sexes. However, there was weaklypositive correlation between increase in height and rise in SBP / DBP. Similar finding has been reported byAgarwal VK*et al*.[14]

In our study, the mSBP and mDBP increased by2-3of Hg for every 10 cm increase in height, independent of age, and weight. It was also observed thatBP increment was more pronounced (4–5mm of Hg) in students whose height was more than 160 cm. This probably could be explained as blood pressure does not have a simple linear correlation with height as it is thought to be or other factors like hormonal, emotional factors can be attributed for this observation.[15]

In the present study the mean BMI of study subjects was found to be 16.87 ± 3.13, while mean BMI of boys was 17 ± 3.24 and that of girls was 16.69 ± 3. mSBP in thin (BMI < 3rd centile) childrenwas 105.15 ± 10.06 mmHg, which gradually increased to 112.49 ± 9.88 mmHg in obese children. Similarly, overall mDBP in group of thin children was 73.65 ± 7.88mmHg, which gradually increased to 78.60 ± 8.62 mmHg in obese children.It can be observed that mean SBP was significantly higher for overweight/obesechildren than the children with normal BMI.

Though, in the present study there was no correlation between BMI and rise in mSBP and mDBP;the highest mean blood pressures were observed in adolescents with BMI more than 95%. In contrast positive relationship between blood pressure and BMI has been expressed in several studies.[11,12]

In the present study the prevalence of hypertension was found to be 11.83% (95th percentile for age and sex was cut-off point) and an additional 12.43 % had elevated blood pressure (pre-hypertension).Higher prevalence of elevated blood pressure and hypertension in studied children may be due to single blood pressure measurement.

Other researchersacross India also found varied prevalence of hypertension amongadolescents. Taksande*et al*.[11] reported 5.75% in rural Wardha,Khan *et al*.[17] reported 9.78% prevalence in Ahmedabad, Mane*et al*.[18] found 4% prevalence in Western India. These variations in the prevalence of pre-hypertension and hypertension may be attributed to the difference in geographical location, socio-economic backgrounds, and different criteria adopted for defining hypertension.

Obesity and hypertension

The combined prevalence of overweight/obesity was 20.5% in study subjects. The prevalence of overweight/obesity was significantly higher in boys (24.9%) than in girls (15.04%).

Amongst obese/overweight subjects 42.3% were pre-hypertensive/ hypertensive whereas only 19% normal weight subjects were hypertensive. The difference was found statistically significant.A similar finding has also been reported in India; Chakrabortyet *al*.[19] found prevalence of overweight to be17.12% and prevalence of obesity 2.45%among adolescents and statistically significant association betweenpresence of hypertension and overweight/ obesity.Shah*et al*.[20] reported 8.94% prevalence of obesity and 20.9% prevalenceof hypertension among adolescents of Surat city and higher prevalence of hypertension in obese adolescents when compared to normal weightadolescents. The possible mechanisms to relate obesity and elevated blood pressure include increased cardiac output, increased blood volume, sodium retention, and sympathetic nervous system/ renin-angiotensin-aldosterone system activation.[21]

Interestingly, our study showed a high prevalence of hypertension and elevated blood pressure among underweight students.This observation suggests that the factors other than anthropometric parameters may be determining the level of blood pressure. Genovesi S, in their study documented a high prevalence of HT among normal and underweight children.[22]

Limitations

Allmeasurements were made by a single observer, which may be a source of bias. A third or fourthmeasurement of blood pressure could have possiblylowered the number of hypertensive children.As blood pressure was measured in the school, an element of anxiety and apprehension might have affected a subset of children. Findings of the present studysuggest a need for larger population-based studies toaccurately estimate the prevalence hypertensionamong children/adolescents.

CONCLUSION

The patterns of increase in mSBP and mDBP values were different in boys and girls and among the different age groups. Increasing height, weight had weakly positive correlation with rise in mean SBP and DBP. There was no correlation between age and BMI with rise inmean SBP. Higher prevalence of elevated blood pressure/hypertension was observed in over-weight/obese adolescents when compared to normal weightadolescents. The overall prevalence of elevated blood pressure/hypertension was found to be higher as compared to some of the previous reports from rural/semi-urban areas. It is therefore necessary to measure weight, height and BMI and to check the BP regularly to find out the overweight/obesity and hidden cases of elevated blood pressure and hypertension in adolescent children.

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REFERENCES

1. Luepker RV, Jacobs DR, Prineas RJ, Sinaiko AR. Secular trends of blood pressure and body size in a multiethnic adolescent population: J Pediatr, 1999; 134: 668-74.
2. Falkner B. Children and adolescents with obesity-associated high blood pressure. J Am SocHypertens, 2008; 2: 267-74.
3. Ho TF. Cardiovascular risks associated with obesity in children and adolescents. Ann Acad Med Singapore, 2009; 38: 48-9.
4. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. Pediatrics, 1999; 103: 1175–82.
5. Bagga A, Jain R, Vijaykumar M, Kanitkar M, Ali. Evaluation and management of hypertension.Indian Pediatric, 2007; 44: 103-21.
6. Indian Academy of Pediatrics Growth Charts Committee, Khadilkar V, Yadav S, Agrawal KK, Tamboli S, Banerjee M, *et al.* Revised IAP growth charts for height, weight and body mass index for 5 to 18-year-old Indian children. Indian Pediatr, 2015; 52: 47-55.
7. Flynn JT, Kaelber DC, Baker-Smith CM, et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. *Pediatrics,* 2017; 140(3): 20171904.
8. Singh N,Patel S,Pal DK,Priya A.Prevalence of Hypertension and Associated Risk Factors among UrbanSchool Adolescents in Lady Bhore Catchment Area of Bhopal City. National Journal of Community Medicine, 2017; 8(6): 315-19.
9. Kishorekumar C, Christy A, Ganesh Kumar P, Vijayakumar R, Srikumar R, Venkatesh Gobi V Prevalence of Hypertension among School Children in Puducherry. Int. J. of Innovative Res. & Development, 2014; 3(4): 290-95.
10. Taleb MA, Ahmed MM, Sharmin KN, Islam D. Blood pressure and its associated factors: a comparative study among rural and urban adolescents in Bangladesh. Int J Res Med Sci, 2016; 4: 4778-87.
11. Taksande A, Chaturvedi P, Vilhekar K, Jain M. Distribution of blood pressure in school going children in rural area of Wardha district, Maharashtra, India. Ann PediatrCardiol, 2008; 1: 101-6.
12. Bhuvaneswari M, Ramaprasad GS. Biophysical profile of blood pressure in urban healthyschool children- a cross sectional study. J. Evid. Based Med. Healthc, 2018; 5(9): 749-752.

13. Foster TA, Voors AW, Webber LS, Frerichs RR, Berenson GS. Anthropometric and maturation measure-ments of children, ages 5 to 14 years, in a biracial community--the Bogalusa Heart Study. Am J ClinNutr, 1977; 30(4): 582-91.
14. Agarwal VK, Sharan R, Srivastava AK, et al. Blood pressure profile in children of age 3-14 years. Indian Pediatr, 1983; 20(12): 921-925.
15. KrishnaP,PrasannaKumarKM,DesaiN,ThennarasuK. Bloodpressurereferencetablesforchildrenandadolescentsofkarnataka. *IndianPediatr*, 2006; 43(6): 491–501.
16. Mehta S, Gupta E, Singh S, Bilwal R. A Study Showing Correlation between BMI and Blood Pressure amongst Male Children of Age 6 To 14 Years.IOSR Journal of Dental and Medical Sciences, 2020; 19(2): 63-68.
17. Khan MI, Lala MK, Patil R, Mathur HN, Chauhan NT. A study of the riskfactors and theprevalence of hypertension in the adolescent school boysof Ahmedabad city. J ClinDiagn Res, 2010: 3348-54.
18. Mane SV, Agarkhedkar SR, Karwa DS, Pande V, Singhania SS, Karambelkar GR. Study of risk factors for lifestyle diseases among adolescents in Western India. Int J Pharm Biomed Sci, 2012; 3: 224-8.
19. Chakraborty P, Dey S, Pal R, Kar S, Zaman FA, Pal S. Obesity in Kolkatachildren: Magnitude in relationship to hypertension. J Nat SciBiol Med, 2011; 2: 101-6.
20. Shah SS, Dave BR, Sharma AA, Desai AR. Prevalence ofhypertension and association of obesity with hypertension in schoolgoing children of Surat city, Western India. Online J Health Allied Sci, 2013; 12: 5.
21. MuntnerP,HeJ,CutlerJA,WildmanRP,WheltonPK.Trendsinblood pressureamongchildrenandadolescents. *JAMA*, 2004; 291(17): 2107–13.
22. Genovesi S, Antolini L, Gallieni M, Aiello A, Mandal SK, Doneda A. High prevalence of hypertension in normal and underweight Indian children. J Hypertens, 2011; 29: 217–21.