 DOI: 10.18231/2394-2738.2017.0004

Systemic Hypertension and Pre-hypertension among school going adolescents: A cross-sectional study

Sonal R. Deshpande[1], Pragati G. Rathod[2,*], Sharad Mankar[3], Uday Narlawar[4], Suresh Ughade[5]

[1,2,5]Assistant Professor, [4]Professor & HOD, Dept. of Community Medicine, Govt. Medical College, Nagpur, Maharashtra, [3]Assistant Professor, Dept. of Physiology, SVNGMC, Yavatmal, Maharashtra

***Corresponding Author:**
Email: pragati.rathod05@gmail.com

Abstract

Introduction: Essential hypertension in adults has its onset in childhood. Early detection of hypertension is important to initiate appropriate measures. Present study was planned to estimate the prevalence of systemic hypertension and pre-hypertension amongst school going adolescents and to study some epidemiological factors.

Methods: A cross-sectional study was carried at a school in Nagpur among 871 adolescents aged 10 to 18 years during September 2014 to March 2015. Demographic information, family history of hypertension, dietary history and history of physical activity were collected using pre-designed proforma. Height, weight and BP measurements were taken using standard techniques. BMI was calculated.

Results: Out of 871 adolescents, 462 (53.05%) were males. Mean age was 13.86±2.2 (10–18) years. Prevalence of pre-hypertension and hypertension was 10.10% and 8.27% respectively. Prevalence of pre-hypertension and hypertension increased with increasing age. Overweight and obesity was found to be the most important factor related with pre-hypertension & hypertension. Other factors which were significantly related with pre-hypertension and hypertension were family history of hypertension, junk food consumption more than three times a week, inadequate physical activity & higher socioeconomic status. Significant difference was not found with respect to factors like gender, added salt consumption and inadequate consumption of fruit and vegetable.

Conclusion: High prevalence of pre-hypertension and hypertension is found amongst school going adolescents. Prevalence increased with increasing age. Overweight and obesity, inadequate physical activity, higher socio-economic status, consumption of junk food and family history of hypertension are found to be significantly related with pre-hypertension and hypertension.

Keywords: Systemic Hypertension, Pre-Hypertension, Adolescent

Introduction

Systemic hypertension though common in adults, is not so rare in children and adolescents. In infants and younger children, systemic hypertension when present, is usually indicative of an underlying disease process (secondary hypertension) but adolescents may acquire primary or essential hypertension.(1) Studies have demonstrated that hypertension begins to develop in first two decades of life. Thus, hypertension in adults has its onset in childhood. Blood pressure has been found to track from childhood but with stronger tracking seen in older ages of childhood and in adolescence.(2) Furthermore, children have a 10% higher risk of developing hypertension in adulthood for each 1 to 2 mmHg increment of systolic blood pressure. Therefore, blood pressure at early age is an important predictor of adult hypertension.(3)

Though Hypertension has its origin in childhood, it goes undetected unless specifically looked for. Thus, primary hypertension in young people is largely undiagnosed and untreated. Therefore early detection of hypertension and its precipitating or aggravating factors is important to initiate appropriate measures so that complications of hypertension can be averted.

With the above reason, present study was planned to estimate the prevalence of systemic hypertension and pre-hypertension amongst school going adolescents and to study some epidemiological factors.

Methodology

Present cross-sectional study was carried at Secondary and Higher Secondary School in Nagpur among adolescents aged 10 to 18 years during September 2014 to March 2015. Approval from institutional ethics committee was sought. The school was purposively selected for feasibility reasons. Permission from school Principal was sought after appraising her about nature and purpose of the study.

Assuming the prevalence of Hypertension amongst adolescents to be 10% (Rao S et al(4) 2007), α=5%, β=20%, by using formula $N = Z_{(1-\alpha)}^2\ p\ (1-p)/\ d^2$ sample size was calculated to be 864.There were in all 2627 students in the school from standard 5th to 12th. There were six divisions in each standard with around 55 to 60 students in each division. Two divisions were randomly selected from each standard by lottery method. All the students present at the first visit in the selected division were included in the study. Thus, the final sample size for study was 871.

Demographic information, family history of hypertension, dietary history and history of physical activity were collected using pre-designed proforma based on Global School-based Student Health Survey.(5)

History of past one week was taken for assessment of dietary habits and physical activity.

Height was measured to nearest 0.1cm using Seca Stadiometer. Weight was measured with 100gm accuracy using electronic weighing machine.

Inadequate consumption of fruit and vegetables was defined as consuming less than five total servings (400 grams) of fruit and vegetables per day; while Insufficient physical activity in adolescents defined as less than 60 minutes of moderate to vigorous intensity activity daily.[6,7] Body Mass Index Percentile Charts (WHO Charts for boys and girls) were used to classify the nutritional status of the adolescents.[8] Overweight was defined as 85th to 95th Percentile of BMI while Obese as >95th Percentile of BMI.[9]

Blood pressure was measured by using mercury sphygmomanometer. Percentiles for systolic and diastolic blood pressure were obtained by using Fourth task force report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents. Adolescents were classified as normotensive (< 90th percentile of both SBP and DBP), pre-hypertensive ($\geq$90th to 95th percentile of either or both SBP and DBP) and hypertensive ($\geq$95th percentile of either or both SBP and DBP). BP levels greater than or equal to 120/80 mmHg were considered pre-hypertensive irrespective of the percentile.[10]

Data was entered in excel and analyzed using statistical software Epi Info 7.

Descriptive statistics (percentage, mean, standard deviation, range) were used to summarize baseline characteristics of the study subjects.

Association between two categorical variables was analyzed by using Chi -square test, odds ratio along with 95% confidence interval (CI); whereas correlation co-efficient was calculated for association between two continuous variables.

P value < 0.05 was considered to be statistically significant.

Results

Among 871 adolescents 462 (53.05%) were male. Mean age $\pm$ SD of study participants was 13.86 $\pm$ 2.21 years. Majority of them were Hindu by religion (80.71%). Most of them (84.96%) belonged to upper middle and lower middle class (II & III) by socio-economic status.

Prevalence of pre-hypertension was 10.10% and hypertension was 8.27%. Overall 18.37% study subjects had elevated blood pressure. Out of 871 study subjects, 12 (1.38%) had systolic pre-hypertension, 31 (3.56%) had diastolic pre-hypertension and 45 (5.17%) had both systolic and diastolic blood pressure in pre-hypertension range. Similarly, 7 (0.80%) study subjects had systolic hypertension, 31 (3.56%) had diastolic hypertension and 34 (3.90%) had both systolic and diastolic hypertension.[Table 1]

The combined prevalence of pre-hypertension and hypertension significantly increased with increasing age from 10 to 17 years (P=0.017). [Table 2]

Mean blood pressure was seen to increase with increasing age. Significant positive linear correlation was found between age and mean systolic and diastolic blood pressure in both males and females. [Fig. 1 and Fig. 2]

Overweight and obesity (OR 12.32, 95% CI 7.37 – 20.60), Family history of hypertension (OR 2.15, 95% CI 1.52- 3.04), Junk food consumption more than three times a week (OR 1.98, 95% CI 1.37 – 2.87), Physical inactivity (OR 1.56, 95% CI 1.09 – 2.23), and higher Socioeconomic status i.e. Upper &Upper middle (OR 1.43, 95% CI 1.01 – 2.02) were significantly related to pre-hypertension and hypertension. Whereas gender, fruits and vegetable consumption and added salt consumption were not significantly related to pre-hypertension and hypertension. [Table 3]

Table 1: Prevalence of pre-hypertension and hypertension (n=871)

Type	Pre-hypertension		Hypertension	
	Number	Percentage	Number	Percentage
Systolic	12	1.38	7	0.80
Diastolic	31	3.56	31	3.56
Both systolic and diastolic	45	5.17	34	3.90
Total	88	10.10	72	8.27

Table 2: Age wise Prevalence of Pre-hypertension and Hypertension

Age (years)	Study Subjects				
	Total Number	Pre-hypertension		Hypertension	
		Number	Percentage	Number	Percentage
10	115	8	6.96	8	6.96
11	100	7	7.00	7	7.00
12	100	9	9.00	7	7.00
13	127	7	5.51	15	11.81
14	125	14	11.20	11	8.80
15	94	14	14.89	6	6.38
16	133	20	15.04	13	9.77
17	74	9	12.16	5	6.76
18	3	0	0.00	0	0.00
Total	871	88	10.10	72	8.27

Chi Square for linear trend = 5.71, df = 7, P=0.017
(Considered upto age 17 years as there were only three study subjects aged 18 years and none was pre-hypertensive or hypertensive)

Table 3: Some epidemiological factors for pre-hypertension and hypertension (n=871)

Factors		Total	Pre-hypertensive & Hypertensive n(%)	P value*	OR(95% CI)
Gender	Male	462	92 (19.91)	0.21	1.24 (0.88 – 1.76)
	Female	409	68 (16.62)		
Socioeconomic Status#	Upper & Upper middle	421	89 (21.14)	0.04	1.43 (1.01 – 2.02)
	Lower middle & Upper Lower	450	71 (15.77)		
Fruit and vegetable consumption	Inadequate	782	140 (17.90)	0.29	1.24 (0.88 – 1.76)
	Adequate	89	20 (22.47)		
Junk food	> 3 times a week	212	57 (26.88)	<0.001	1.98 (1.37 – 2.87)
	≤3 times a week	659	103 (15.62)		
Added salt consumption	Yes	413	77 (18.64)	0.84	0.75 (0.44 – 1.30)
	No	458	81 (17.68)		
Physical activity	Not active	478	102 (21.33)	0.012	1.56 (1.09 – 2.23)
	Active	393	58 (14.75)		
Family history of Hypertension	Present	330	85 (25.75)	<0.001	2.15 (1.52- 3.04)
	Absent	541	75 (13.86)		
Nutritional status	Overweight & Obese	77	51 (66.23)	<0.001	12.32 (7.37 – 20.60)
	Normal & underweight	794	109 (13.72)		

*Chi square test, # By Kuppuswamy classification

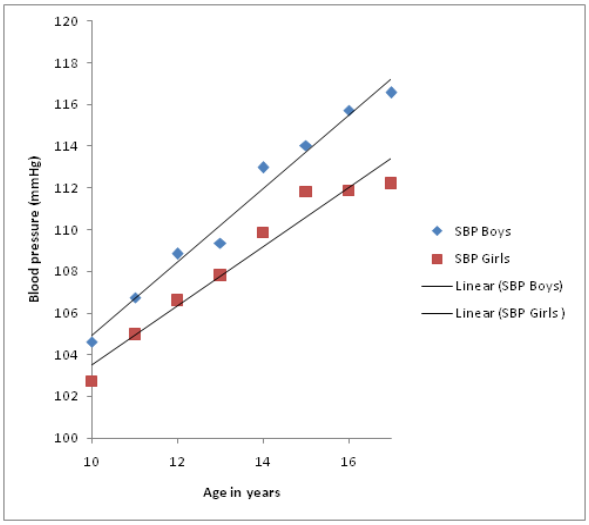

Fig. 1: Mean Systolic Blood Pressure of boys and girls by age

Boys: Systolic- r= 0.51, P<0.001, Girls: Systolic- r= 0.42, P<0.001

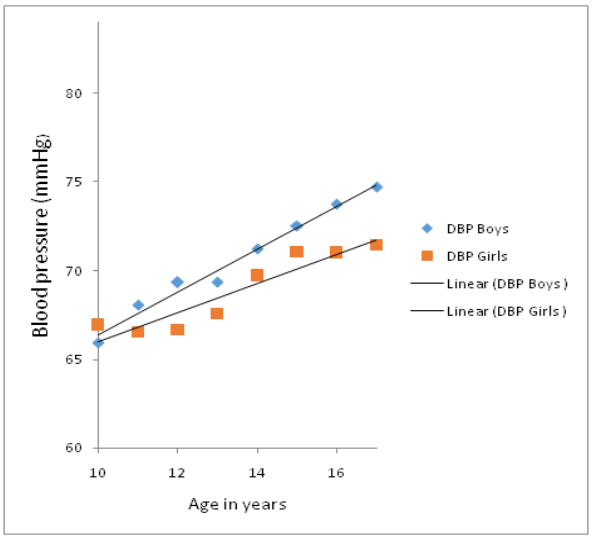

Fig. 2: Mean Diastolic Blood Pressure of boys and girls by age

Boys: Diastolic- r=0.41, P<0.001, Girls: Diastolic- r=0.30, P<0.001

Discussion

Present analytical cross sectional study was conducted among school going adolescents in Nagpur to estimate the prevalence of pre-hypertension and hypertension and to study some epidemiological factors related to it. Prevalence of pre-hypertension and hypertension was found to be 10.10% and 8.27% respectively. Thus, total 18.37% of the study subjects had elevated blood pressure.

In the present study, overall prevalence of hypertension (systolic and/or diastolic) was 8.27%, which was less than that found by Verma V et al[11](9.2%), Shah SS et al[12] (20.09%) but more than that found in the similar studies by Anand NK et al[13](0.46%), Anjana et al[14] (7.5%), Savitha MR[15] et al (6.16%). Very low prevalence of hypertension in the study by Anand NK et al may due to different criteria used to classify hypertension and it was done in year 1995. While relatively recent study done by Anjana et al[14] in 2005 in the same city of Amritsar found the higher prevalence of hypertension (7.5%).

Prevalence of pre-hypertension was found to be 10.10% in the present study. The prevalence found in other studies is Sharma A et al[16] (12.3%), Verma V et al[11] (10.8%), Deshpande AV[17] (15.9%).

The diversity in prevalence of pre-hypertension and hypertension may be due to the varying age groups included in the study, differences in the geographic, dietary and cultural factors.

The prevalence of pre-hypertension was higher than the hypertension in the present study, and all the many of the studies support this finding.[11,16,17]

In the present study it was found that mean blood pressure increased with increasing age. Significant positive linear correlation was found between age and mean systolic as well as diastolic blood pressure in both males and females. This finding is supported by many studies.[11,14,18,19,20,21] While present study found almost uniform rise in the blood pressure levels by age, spurt in systolic blood pressure was observed with the onset of puberty in the study done by Durrani AM et al.[18]

Prevalence of pre-hypertension and hypertension was found to increase with increasing age in our study (Chi square for linear trend=5.71, P=0.017). This finding is consistent in most of the studies.[11,14,18,22,23]

In the present study, prevalence of pre-hypertension and hypertension was higher in males (19.91%) as compared to females (16.63%), but this difference was not statistically significant. This finding is seen in many other studies.[11,14,16,17,18] However study done by Shah SS et al,[12] Dinc G et al[24] found higher prevalence in females. In early life there is little evidence of a difference in blood pressure between the sexes. However, at adolescence, men display a higher average level.[25]

In the present study, prevalence of pre-hypertension and hypertension was significantly higher among upper socioeconomic class. In study by Soudarssanane MB et al[26] they found that systolic blood pressure was significantly related to higher socio-economic status.

In the present study there was no significant difference in prevalence of pre-hypertension and hypertension with respect to fruit and vegetable consumption. While epidemiological data support the association between high intake of vegetables and fruits and low risk of chronic disease.[2]

In our study we found that the prevalence of pre-hypertension and hypertension was significantly higher among those who consumed junk food more than three times in a week. It is in contrast to the finding of study done by Savitha MR et al.[15]

Present study found no significant difference between added salt consumption and prevalence of pre-hypertension and hypertension. Study done by Singh AK et al[27] showed that, adding extra salt was significantly associated with systolic hypertension but not with diastolic hypertension.

Prevalence of pre-hypertension and hypertension was significantly higher among those who were not physically active in the present study. Insufficient physical activity in adolescents is defined as less than 60 minutes of moderate to vigorous intensity activity daily.[6,7] Physical activity improves the level of high density lipoprotein cholesterol, improves control of blood glucose in overweight people, even without significant weight loss and reduces blood pressure.[10]

In our study prevalence of pre-hypertension and hypertension was significantly higher among those having family history of hypertension. Similar finding is seen in various study by Sharma A et al.[16] Persistent elevation of blood pressure is found among children with family history of hypertension.[28]

Our study found highly significant association between prevalence of pre-hypertension and hypertension with overweight and obesity. This finding is consistent with other studies.[16,18,19,27] The root cause of high blood pressure in obese individuals is primarily due to a combination of factors that raise systemic vascular resistance.[29]

Conclusion

High prevalence of pre-hypertension and hypertension is found amongst school going adolescents. Prevalence increased with increasing age. Overweight and obesity, inadequate physical activity, higher socio-economic status, consumption of junk food and family history of hypertension are found to be significantly related with pre-hypertension and hypertension.

Limitations

Being a cross-sectional study prevalence odds ratio could be calculated. Though World Health Organization defines Adolescents between age 10 to 19 years, students only upto 18 years were available in the school. As the school was purposively selected for feasibility reasons, study has limited generalization.

Funding: None

Conflict of interest: None

References

1. Kleigman R, Behrman R, Jenson H, Staton B(ed). Nelson Textbook of Pediatrics, 19th edition. Philadelphia, Elsevier Thompson press, 2011;1639-47.
2. WHO Technical Report Series no. 916. Diet, nutrition and the prevention of chronic diseases. World Health Organisation. Geneva 2002 [cited 2013 April 12]; Available from: http://www.who.int/dietphysicalactivity/ publications/ trs916/en/.
3. Prasad DS, Kabir Z, Dash AK, Das BC "Childhood cardiovascular risk factors in South Asians: A cause of concern for adult cardiovascular disease epidemic" Ann Pediatr Cardiol (2011) 4(2),166–71.
4. Rao S, Kanade A, Kelkar R, "Blood pressure among overweight adolescents from urban school children in Pune, India" European Journal of Clinical Nutrition (2007) 61, 633–41.
5. Global School-based Student Health Survey (CBSC). India Factsheet. [Internet]. Geneva: World Health Organisation;2007 [cited 2014 August 12]; Available from: http://www.who.int/chp/gshs/2007_India_CBSE_fact_sheet.pdf.
6. WHO Technical Report Series no. 916. Diet, nutrition and the prevention of chronic diseases. [Internet]. Geneva: World Health Organisation; 2002 [cited 2013 April 12]; Available from: http://www.who.int/dietphysicalactivity/publications/trs916/en/.
7. Draft comprehensive global monitoring framework and targets for the prevention and control of noncommunicable diseases. Sixty-sixth world health assembly a66/8. Provisional agenda item 13.1. [Internet]. Geneva: World Health Organization;2013 [cited 2014 January 14]; Available from: http://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_8-en.pdf.
8. BMI-for-age (5-19 years) Growth Charts [Internet]. Geneva: World Health Organisation;2007 [cited 2012 December 24]. Available from: http://www.who.int/growthref/who2007_bmi_for_age/en/ .
9. Nutritional status categories as per BMI: NHANES III. [Internet]. Atlanta: CDC;2007 [updated 2015 May 15; cited 2016 May 29] Available from:http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html.
10. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The Fourth Report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents. Pediatrics (2004) 114, 555-75.
11. Verma V, Singh SK "Prevalence of hypertension in Gujarati school going children and adolescents in Anand district" National Journal of Community Medicine (2012) 3(3), 452-7.
12. Shah SS, Dave BR, Sharma AA, Desai AR "Prevalence of Hypertension and Association of Obesity with Hypertension in School going Children of Surat City, Western India" Online J Health Allied Scs (2013) 12(2), 5.
13. Anand NK, Tandon L "Prevalence of hypertension in school going children" Indian pediatrics (1996) 33, 377-81.
14. Anjana, Prabhjot, Kaur N, Kanta Kumari, Sidhu S "Variation in Blood Pressure among School Children of Amritsar (Punjab)" Anthropologist (2005) 7(3), 201-204.
15. Savitha MR, Krishnamurthy B, Fatthepur SSR, Yashwanth Kumar AM, Khan MA "Essential Hypertension in Early and Mid-Adolescence" Indian J Pediatr (2007) 74(11), 1007-11.
16. Sharma A, Grover N, Kaushik S, Bhardwaj R Sankhyan N "Prevalence of Hypertension among Schoolchildren in Shimla" Indian Pediatrics (2010) 47, 873-6.

17. Deshpande AV "Study of prevalence of Hypertension in adolescent in Central India" International Journal of Basic Medicine and Clinical Research (2014) 1(3), 66-71.
18. Durrani AM, Wasim F "Determinants of blood pressure distribution in school children; European Journal of Public Health (2012) 22 (3), 369-373.
19. Patil RR, Garg BS "Prevalence of hypertension and variation in blood pressure among school children in rural area of Wardha" Indian Journal of Public Health (2014) 58(2), 79-83.
20. Mujumdar VG, Indupalli A S, Changty S, Batool A, Fatima "Blood pressure profile of school children of Gulbarga city" Journal of Evolution of Medical and Dental Sciences (2012) 1(6), 1227- 33.
21. Krishna P, Bajaj S, K Thennarasu, Desai N, KM Prasanna Kumar "Regional Differences in the Reference Blood Pressure in Young Indians" Indian Pediatrics (2007) 44, 921-3.
22. Chakraborty P, Dey S, Pal R, Kar S, Zaman FA, Pal S "Obesity in Kolkata children: Magnitude in relationship to hypertension "J Nat Sci Biol Med (2011) 2(1), 101–6.
23. Buch N, Goyal JP, Kumar N, Parmar I, Shah VB, Charan J "Prevalence of hypertension in school going children of Surat city, Western India" J Cardiovasc Dis Res (2011) 2, 228-32.
24. Dinc G, Saatli G, Baydur H, Ozcan C "Hypertension and overweight among Turkish adolescents in a city in Aegean region of Turkey: a strong relationship in a population with a relatively low prevalence of overweight" Ana do lu Kar di yol Derg (2009) 9, 450-6.
25. WHO Technical Report Series no. 862. Hypertension Control; 1996. Available from: http://whqlibdoc.who.int/trs/ WHO_TRS_862.pdf.
26. Soudarssanane MB, Karthigeyan M, Stephen S, Sahai A "Key Predictors of High Blood Pressure and Hypertension among Adolescents: A Simple Prescription for Prevention" Indian Journal of Community Medicine (2006) 31(3), 164-9.
27. Singh AK, Maheshwari A, Sharma N, K. Anand "Lifestyle Associated Risk Factors in Adolescents" Indian J Pediatr (2006) 73(10), 901-6.
28. Bose AS, Marimuthu P, Chakraborty AK "Mean blood pressure values of 3-17 year old children in an urban area" Health and Population-Perspectives and Issues (2000) 23(1), 28-36.
29. Torrance B, McGuire KA, Lewanczuk R, McGavock J "Overweight, physical activity and high blood pressure in children: a review of the literature" Vascular Health and Risk Management (2007) 3(1), 139–49.