Research Article

High blood pressure and its association with obesity among preuniversity college students of Udupi taluk

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Abstract

Background: There is an evidence of tracking of high blood pressure (BP) from childhood to adulthood. Hence detection, assessment, and management of high BP are important.

Objectives: To estimate the proportion of adolescents of Udupi taluk having high BP and to assess the association of high BP with overweight/obesity and other correlates.

Materials and Methods: A cross-sectional study was carried out among 838 adolescents studying in preuniversity colleges (PUCs) of Udupi taluk. Of the 49 PUCs of Udupi taluk, 15 PUCs were randomly chosen and one class from each was taken as a cluster. A pretested and structured questionnaire, based on World Health Organization Stepwise approach was used. Weight, height, and BP were measured using standardized tools. Data were analyzed using Statistical Package for the Social Sciences, version 15.00. Pearson's correlation and univariate and multiple logistic regressions were used to analyze the data.

Results: The prevalence of high BP and overweight/obesity was found to be 23.05% and 9.18%, respectively. High BP was positively correlated with overweight/obesity. Being a male, currently consuming alcohol, and being overweight/obese were the risk factors associated with high systolic BP and factor associated with high diastolic BP was overweight/obesity.

Conclusion: The proportion of respondents having high BP as well as overweight/obesity was found to be high. As high BP was found to be strongly associated with overweight/obesity in this study, we recommend screening of BP to be carried out both in children and adolescents and the inclusion of sports hours in their curriculum.

KEY WORDS: Adolescents, pre-university colleges, high blood pressure, overweight, obesity

Introduction

In recent years, it is seen that there is an increase in the cases of high blood pressure (BP) in children and adolescents, which is a major public-health concern.[1,2] This increase can be attributed to obesity,[1–3,4–6] change in eating patterns (i.e., calorie and salt intake),[7,2] reduced physical exercise, high stress,[2] high lipid levels,[1] family history of hypertension, and environmental factors.[7] High BP eventually leads to target organ damage and cardiovascular diseases (CVDs) in later years of life.[1,7,4,8,9] CVDs are one of the prime causes of mortality in low- and middle-income countries (LMICs).[3] As BP increases, the likelihood of acquiring hypertension-related diseases increases and life expectancy decreases.[10]

Evidence from studies conducted in LMICs shows that obesity enhances the probability of hypertension among children and adolescents. Overweight and obese children are 2.1 times and 7.2 times, respectively, more likely to develop hypertension.[3] In a study conducted in Texas in the year 2004 among school-going children, it was found that the burden of hypertension was 4.5%, which was strongly associated with obesity.[4] According to World Health Organization (WHO), each

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year about 7.5 million (12.8%) deaths are caused due to high BP and 57 million (3.7%) disability-adjusted life years are lost.[9]

In many studies conducted in Western world among children, the burden of hypertension is found to be between 7% and 19%.[1] A study conducted in Houston among 6790 adolescents of age 11–17 years reported the prevalence of high BP to be 9.4% at first screening.[11] A community survey conducted by Dyson et al.[3] among 12,730 adolescents of age 12–18 years reported the prevalence of hypertension as being 5.2%, 10.1%, and 14.1% and that of overweight/obesity as 16.6%, 4.1%, and 37.1% in China, India, and Mexico, respectively. The risk of hypertension among overweight children was 1.7–2.3 times and that of obesity was 3.5–5.5 times more than that of normal-weighing children.[3] As per China Health and Nutrition Survey conducted among individuals aged 6–17 years and a study conducted in Egypt among individuals in the 11–19 years age group, the prevalence of hypertension was found to be 13.8% and 4%, respectively.[3]

A study conducted in New Delhi among 12–18 years olds, reported the prevalence of systolic and diastolic hypertension as 7.84% and 2.15% and that of overweight/obesity as 18.6% and 16.5% for male and female, respectively.[12]

The actual burden of hypertension among children and adolescents is unknown globally,[3,13] particularly in LMICs. This can be attributed to many reasons: first, less than a quarter of hypertensive cases are diagnosed[4,6,8] by pediatricians and the cases that are identified are mostly of grown-ups, those having tall stature, and overweight/obese children.[4] Second, the way hypertension is defined from region to region, which reference for BP has been used, and the manner in which BP is recorded.[13] Lastly, until recently hypertension among children was rare and less number of studies were conducted on the same.[3]

To reduce the prevalence of hypertension among children and adolescents, early identification and treatment of high BP can act as strong pillars for control and prevention of its complications.[1,2,14] There is a strong evidence of tracking of high BP from childhood to adulthood.[7,6,15] Hence detection, assessment, and management of high BP among children and adolescents are gaining importance in recent years, in lieu of which the American Society for Hypertension has proposed to screen all children of ≥3 years of age.[3]

Therefore, this study was conducted with the objectives to find the proportion of adolescents studying in preuniversity colleges (PUCs) having high BP and to assess the association of high BP with overweight/obesity and other correlates.

Materials and Methods

A cross-sectional study was carried out among adolescents studying in PUCs of Udupi taluk. The study was conducted for a period of 6 months starting from January 2014. Sample size was calculated anticipating minimum prevalence of 20%, which was taken from a previous study conducted in Surat, India,[5] with 18% relative precision, 95% confidence interval (CI), 1.5 design effect, and 15% nonresponse rate. The final sample size calculated was 838. A multi-stage sampling technique was used to recruit the respondents. In the first stage, 49 PUCs were stratified as per their type as follows: 19 (39 %) government, 18 (37%) private, and 12 (24%) aided, of which 15 PUCs were randomly selected using proportional allocation method. At a later stage, using lottery method, one class was chosen as a cluster from each of the selected PUC. Respondents having any chronic disease for more than 6 months and those absent on the day of data collection were excluded.

The ethical approval for conducting the study was obtained from the institutional ethical committee (IEC18/2014) of Kasturba Medical College, Manipal. Permission was taken from block education office, Udupi taluk and also from the principal or the head of the selected PUCs. The written informed consent was obtained from the parents of the respondents before data collection.

Using a pretested and structured questionnaire, based on WHO Stepwise approach (steps 1 and 2),[16] data were collated from the respondents. Data on background variables and modifiable noncommunicable disease (NCD) risk factors (smoking, tobacco, and alcohol consumption, physical inactivity, junk food, addition of extra salt to diet, meat consumption, and family history of hypertension) were gathered. Questionnaire was administered in both English and Kannada (local) languages.

Before the study, pretesting of the questionnaire was done involving 10 students of 15–19 years of age, different from the students who took part in the study, following which required modifications were undertaken.

Weight was measured using digital weighing scale with an error to the nearest ±500 g and height was measured with the help of a standardized anthropometric rod with an error to the nearest ±0.5 cm. The weighing scale was regularly checked with recognized standard weights. Body mass index (BMI) was calculated based on height and weight readings. BP was measured using an Omron digital instrument. Two readings of BP were taken from the left arm making adolescent sit on a chair. When a difference of >10mm Hg between two readings (either systolic or diastolic BP) was observed, another measurement was taken after a break of 5 min. While measuring the BP for the first time, it was noticed that most of the respondents were anxious, hence only the last reading was taken into consideration while analyzing the data.

Definitions Used

High BP was defined as per the guidelines given in the *Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents* (as per age, gender, and height percentile in each age group).[15,17] BP <90th percentile was classified as normal; BP between 90th and 95th percentile as well as equal to or exceeding 120/80 mm Hg was classified as above normal BP; and BP >95th percentile was classified as high BP. If BP lied between 95th percentile and 99th percentile plus 5 mm Hg

Table 1: Distribution of respondents by age and gender according to BP percentile

Age (years)	Blood pressure percentiles			
	<90th Male/Female (frequency)	90th Male/Female (frequency)	95th Male/Female (frequency)	99th Male/Female (frequency)
Systolic blood pressure				
15	2/13	10/11	0/2	0/2
16	40/114	94/100	33/26	16/15
17	34/67	87/47	38/14	15/17
18	3/14	6/10	1/2	0/0
19	0/2	2/0	1/0	0/0
Diastolic blood pressure				
15	11/25	1/0	0/2	0/1
16	158/219	17/24	5/6	3/6
17	153/128	9/9	10/2	2/6
18	10/23	0/0	0/2	0/1
19	3/2	0/0	0/0	0/0

was classified as stage I, and BP >99th percentile plus 5 mm Hg was classified as stage II high BP.

On the basis of WHO's Asia-Pacific classification,[18] respondents were categorized into four groups as per their BMI, which were as follows: underweight (<18.5 kg/m^2), normal (18.5–22.9 kg/m^2), overweight (23–24.9 kg/m^2), and obese (≥25 kg/m^2).

Current smoker was defined as "one who had smoked at least once in the last 30 days".[12,19,20] Current smokeless tobacco usage was defined as "using smokeless tobacco at least once in 30 days".[20] Getting exposed to passive smoking at least once in last 7 days was considered as at risk.[21] Current alcoholic was "the one who had consumed at least one dose (30 ml) of any of the alcoholic beverage in the last 30 days".[19,20] A measurement cup of 100 ml with marking on it was shown to the respondents to aid in approximately calculating and reporting the intake of alcohol.[19]

One serving of vegetable was equal to one cup (100 g) of raw green leafy vegetables, ½ cup of other vegetables (cooked or chopped raw), or ½ cup of vegetable juice.[12,20,21] One serving of fruit was about one medium sized piece of apple, banana, orange, or other fruits, ½ cup of chopped, cooked, or ½ cup of fruit juice, not artificially flavored. A standard 100 g bowl was shown to the respondents.[12,20,21] Respondents consuming less than one serving/day <4 times/week of fruits as well as vegetables were considered as at risk.[12,20,21]

Physical inactivity was defined as "not performing vigorous physical activity" for at least 60 min/day for three times in a week[12,19,20] or not performing moderate physical activity for ≥5 times/week for ≥30 min/day.[12,19] Physical activity was assessed by inquiring on any type of physical activity for the last 7 days and during a typical week. Information on playing of outdoor sports and the time spent at home in sedentary activities such as watching television and playing video/mobile games was gathered. Family history of hypertension in parents or grandparents was considered as a risk.[19] Eating junk food (chips, samosa, vada, pizza) three or more times/week[19,21] was considered as a risk factor. Addition of extra salt to curd/vegetables/fruits was considered as a risk.[12] Consumption of fish and meat including chicken three or more times/week was asked.

Statistics

Data analysis was performed by using SPSS (Statistical Package for the Social Sciences), version 15.00. The results were arranged in tables (by frequencies) and figures (by proportions). Pearson's correlation was performed to find out the relationship between systolic BP (SBP) and diastolic BP (DBP) with BMI. Univariate analysis was performed to find out the strength of association between high SBP and other variables; crude odds ratio (cOR) with 95% confidence interval (CI) was used; the same analysis was performed for DBP. Multiple logistic regression was performed on those variables that were statistically and clinically significant in univariate analysis. Adjusted odds ratio (aOR) with 95% CI has been used. For analysis purpose, BP was classified as normal (clubbing normal and above normal BP) and high (clubbing stages I and II of high BP), and BMI was classified as normal (BMI <23 kg/m^2) and overweight/obesity (BMI ≥23 kg/m^2).

Results

A total of 838 respondents in the age group of 15–19 years participated in the study. More than half (54.42%) of the respondents were females. Of the total respondents, 46.5%, 34%, and 19.5% were from the government, unaided, and aided PUCs, respectively. The proportion of respondents following Hinduism, Islam, and Christianity religions were 79.6%, 14.9% and 5.5%, respectively. Majority of the respondents were from a nuclear family (73.5%) and the rest belonged to joint family (26.5%). As per the place of residence, 67.1% of the respondents were residing in rural areas and the remaining 32.9% in urban areas.

The mean height and weight of the male respondents was 191 (7.62 SD) cm and 54.04 (11.52 SD) kg, respectively, the

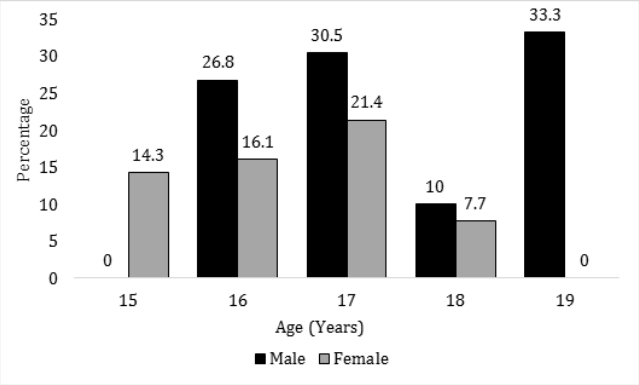

Figure 1: Distribution of high systolic blood pressure as per age and gender.

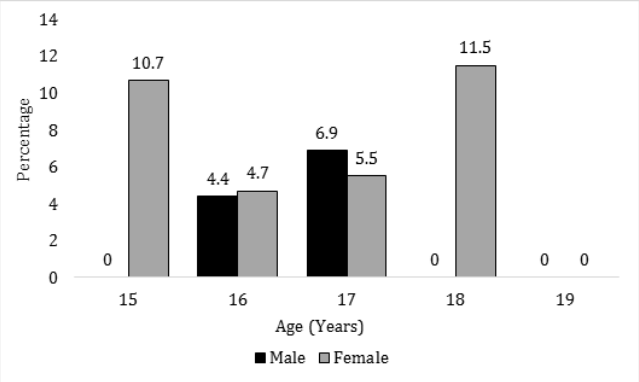

Figure 2: Distribution of high diastolic blood pressure as per age and gender.

same for female respondents being 157 (6.11 SD) cm and 45.6 (8.36 SD) kg, respectively. The mean BMI was found to be 18.8±3.28 and 18.52±3 kg/m^2 in males and females singly. The mean SBP and DBP for males was 128.79 (14.22 SD) mm Hg and 67.76 (11.42 SD) mm Hg, respectively; and for females it was found to be 118.62 (14.86 SD) mm Hg and 67.93 (11.92 SD) mm Hg correspondingly.

The distribution of respondents by age and gender according to BP percentile is depicted in Table 1. Age- and gender-wise distribution of respondents according to high SBP and DBP is shown in Figures 1 and 2, respectively. The Pearson's coefficient for SBP and BMI was 0.205 and DBP and BMI was 0.16. Though relation was positively correlated, the strength of association was low.

Among the total male respondents, 4.7% were having both high SBP and DBP. The same occurrence was noticed among 3.5% of the female respondents. The percentage of male and female respondents who had either of their BP (SBP or DBP) high was 22.5% and 15.4% respectively. Hence the total prevalence of high BP was found to be 23.05%.

Table 2: Multiple logistic regression of systolic blood pressure with covariates

Variable	SBP		cOR*	aOR*
	Normal	High	(95% CI)	(95% CI)
Gender				
Male	378	78	1	
Female**	278	104	1.81 (1.3–2.53)	1.48 (1.02–2.16)
Religion				
Hindu**	536	141		
Muslim	81	25	1.17 (.72–1.91)	
Christian	39	16	1.56 (0.85–2.87)	
Smoking				
No**	646	178		
Current	10	4	1.45 (0.45–4.7)	0.52 (0.12–2.35)
Passive smoking				
No**	545	151		
Exposed	111	31	0.97 (0.65–1.56)	0.92 (0.56–1.5)
Smokeless tobacco				
No**	652	180		
Current	4	2	1.81 (0.33–9.97)	1.9 (0.31–11.85)
Alcohol				
No**	644	173		
Current	9	9	3.7 (1.46–9.52)	3.2 (1.02–10.04)
Junk food				
<3 times**	148	40		
3 or more	426	111	0.96 (0.64–1.45)	0.98 (0.64–1.5)
Fish				
≥3**	223	63		
1 – 2	182	41	1.03 (0.69–1.55)	
No	192	56	0.79 (0.51–1.24)	
Meat				
No**	565	150		
1–2	72	24	1.26 (0.76–2.1)	
≥3	5	3	2.2 (0.5–9.56)	
Addition of extra salt				
No**	441	123		
Yes	210	58	0.99 (0.7–1.41)	0.85 (0.57–1.27)
Physical activity				
Active**	53	15		
Not active	589	164	0.98 (0.54–1.79)	
F/H of HTN#				
No**	606	172		
Yes	50	10	0.7 (0.35–1.42)	0.69 (0.33–1.47)
BMI				
Normal**	609	152		
Overweight/ Obese	47	30	2.56 (1.56–4.18)	2.89 (1.69–4.94)

*cOR, crude odds ratio; aOR, adjusted odds ratio, BMI, body mass index, SBP, systolic blood pressure; HTN, hypertension.
**Taken as reference in each independent variable.
#Family history of hypertension.

The proportion of overweight was 4.53% and that of obesity was 4.65%, which was not associated with gender. The proportion of overweight/obese adolescents who had high SBP was 38.96%, and high DBP was 10.39%.

Table 3: Multiple logistic regression of diastolic blood pressure with covariates

Variables	DBP		cOR*	aOR*
	Normal	High	(95% CI)	(95% CI)
Gender				
Female**	430	26		
Male	362	20	0.91 (0.5–1.66)	
Religion				
Hindu**	642	35		
Muslim	98	8	1.5 (0.67–3.32)	
Christian	52	3	1.06 (0.31–3.56)	
Residence				
Rural**	487	22		
Urban	305	24	1.74 (0.96–3.16)	
Family				
Joint	208	9		
Nuclear	584	37	1.46 (0.69–3.09)	
Smoking				
No**	778	46		
Current	14	0		
Smokeless tobacco				
No**	787	45		
Current	5	1	3.5 (0.4–30.57)	2.1 (0.18,24.11)
Passive smoking				
No**	661	35		
Exposed	131	11	1.59 (0.78–3.2)	1.97 (0.9,4.31)
Alcohol				
No**	773	44		
Current	16	2	2.2 (0.49–9.85)	2.14 (0.41,11.29)
Junk food				
<3 times**	179	9		
3 or more	508	29	1.13 (0.53–2.44)	1.04 (0.46,2.34)
Fish				
≥3**	269	17		
1–2	212	11	0.95 (0.46–1.96)	
No	234	14	0.82 (0.38–1.8)	
Meat				
No**	679	36		
1–2	87	9	1.95 (0.91–4.19)	
≥3	7	1	2.7 (0.32–22.5)	
Addition of extra salt				
No**	530	34		
Yes	258	10	0.6 (0.29–1.24)	0.45 (0.19,1.1)
Physical activity				
Active**	66	2		
Not active	709	44	2.05 (0.49–8.64)	
F/H of HTN#				
No**	736	42		
Yes	56	4	1.25 (0.43–3.62)	1.4 (0.44,4.41)
BMI				
Normal**	723	38		
Overweight/ Obese	69	8	2.21 (1–4.92)	2.39 (1–5.82)

*cOR, crude odds ratio; aOR, adjusted odds ratio, DBP, diastolic blood pressure.
**Taken as reference in each independent variable.
#Family history of hypertension.

Respondents having high DBP were 15.93 (7.73, 32.8) times more likely to have high SBP. After adjusting for the variables that were statistically and clinically significant, being a male respondent, currently consuming alcohol, and being overweight/obese were the risk factors for high SBP [Table 2] and that for high DBP was overweight/obesity [Table 3]. There was no difference in the prevalence of high BP among different strata of PUCs as well as with type of curriculum. High BP was not significantly associated with any sociodemographic variable.

Discussion

The prevalence of high BP and overweight/obesity was found to be 23.05% and 9.18%, respectively. High BP was positively correlated with overweight/obesity. Being a male, currently consuming alcohol, and being overweight/obese were the risk factors for high SBP and that for high DBP was overweight/obesity.

Normally, BP in childhood and adolescence fluctuates with age, height,[22,23] gender, and weight.[23] BP is also affected by other factors such as time of the day, fasting state of the person, surrounding environment, and psychological factors,[22,24] which could not be taken care of in our study. One of the reasons for high prevalence of elevated BP found in our study was probably because the data were collected either immediately before or after board examination, wherein they might have been facing exam-related stress. It was also seen that most of the respondents were anxious while their BP was being measured as they were experiencing it for the first time.

High BP in overweight/obese adolescents might be caused due to excess action of the sympathetic nervous system, insulin resistance, and abnormality in structure and functioning of blood vessels.[7]

In this study, the prevalence of high BP was found to be comparatively higher than the studies conducted previously in India[12,14] including Karnataka[23,24] and abroad.[1,3,7] The prevalence of high BP was found to be more in males than females in the studies conducted in India,[12,14,24] which was in agreement with the findings of the present study, while it was contradictory to the findings of the study conducted in Udupi taluk.[23] In the present study, SBP and DBP were not related to increasing age whereas in studies conducted in Karnataka[23,24] and elsewhere[25] it was seen that BP was directly proportional to increasing age.

In this study, the prevalence of obesity was found to be almost similar to that in the study conducted in Surat.[2] It was high as compared to the study conducted in Udupi,[23] whereas it was low in comparison to the international studies.[1,7] As compared to present study, Dyson et al.[3] found high prevalence of overweight/obesity in China and Mexico, whereas it was low for India.

In our study, both high SBP and DBP increased with increasing BMI (although the correlation was weak), and the

studies conducted previously[7,12,23] also provide evidence to this finding.

Overweight/obesity was associated with high SBP and DBP in this study as well as in the studies conducted in India and elsewhere.[1,3,7.12,14,23,26] Adding extra salt to diet and smoking were significant risk factors in the study conducted in New Delhi,[12] whereas these were not significant in our study; alcohol consumption was significant in this study whereas it was not so in the former one,[12] and family history of hypertension was not associated with high BP in both the studies. Family history of hypertension was significantly associated with high BP in studies conducted by Abolfotouh et al.[1] and Sunder et al.[14] Stream of curriculum and physical inactivity was not found to be associated with high BP in the study conducted by Sunder et al.[14] as well as in our study. In our study, DBP was related to SBP, which indicates that both ascend together; similar findings were reported in a study by Singh et al.[12]

Limitation

As per the *Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents*,[17] hypertension is diagnosed after verifying the average SBP and/or DBP on more than three distinct occasions, which is greater or equal to the pressure level corresponding to the 95th percentile (considering gender, age, and height percentile) of the reference population. In the present study only two measurements of BP were taken and the last reading was considered as being the final one for analysis.

Conclusion

The proportion of respondents having high SBP and DBP as well as overweight/obesity was found to be high. In terms of the relationship between high BP and BMI, although it was positively correlated, the strength of association was low. As high BP was found to be strongly associated with overweight/obesity in this study, we recommend screening of BP should be carried out in children and adolescents. During the study it was noticed that there was no time devoted for sports in the PUCs; hence we recommend the inclusion of sports hours in their curriculum. Early intervention strategies for prevention and control of high BP and obesity as well as other risk factors for NCDs should be carried out in the early years of life to prevent the increasing burden of NCDs. We give emphasis to further research among adolescents by using all three steps of WHO Stepwise approach and to measure overweight/obesity by using BMI along with other anthropometric methods such as waist circumference.

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References

1. Abolfotouh MA, Sallam SA, Mohammed MS, Loutfy AA, Hasab AA. Prevalence of elevated blood pressure and association with obesity in Egyptian school adolescents. Int J Hypertens 2011; 2011:952537.
2. 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 Sci 2013;12(2):5.
3. Dyson PA, Anthony D, Fenton B, Matthes DR, Stevens DE. Community Interventions for Health Collaboration. High rates of child hypertension associated with obesity: a community survey in China, India, and Mexico. Paediatr Int Child Health 2013;34(1):43–9.
4. Patel NH, Romero SK, Kaelber DC. Evaluation and management of pediatric hypertensive crises: hypertensive urgency and hypertensive emergencies. Open Access Emerg Med 2012;4:85–92.
5. Chen X, Youfa Wang. Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. Circulation 2008;117:3171–80.
6. Hansen ML, Gunn PW, Kaelber DC. Underdiagnosis of hypertension in children and adolescents. JAMA 2007; 298(8):874–9.
7. Souza MCBD, Rivera IR, Silva MAMD, Carlos A, Carvalho C. Relationship of obesity with high blood pressure in children and adolescents. Arq Bras Cardiol 2010;94(6):714–9
8. Kaelber DC, Pickett F. Simple table to identify children and adolescents needing further evaluation of blood pressure. Pediatrics 2009;123(6):e972–4.
9. WHO. *Global Status Report on Noncommunicable Diseases 2010*. Geneva: World Health Organization, 2011.
10. Soudarssanane MB, Karthigeyan MS, Stephen S, Sahai A. Key predictors of high blood pressure and hypertension among adolescents: a simple prescription for prevention. Indian J Commun Med 2006;73(10):164–9.
11. McNiece KL, Poffenbarger TS, Turner JL, Franco KD, Sorof JM, Portman RJ. Prevalence of hypertension and prehypertension among adolescents. J Pediatr 2007;150(6): 640–4, 644.e1.
12. Singh Ak, Maheshwari A, Sharma N, Anand K. Lifestyle associated risk factors in adolescents. Indian J Pediatr 2006; 73(10):901–6.
13. Falkner B. Hypertension in children and adolescents: epidemiology and natural history. Pediatr Nephrol 2010;25: 1219–24.
14. Sunder JS, Adaikalam JMS, Parameswari S, Valarmarthi S, Kalpana S, Shantharam D. Prevalence and determinants of hypertension among urban school children in the age group of 13–17 years in, Chennai, Tamil Nadu. Epidemiology 2013;3:130.
15. Lurbe E, Cifkova R, Cruickshank JK, Dillon MJ, Ferreira I, Invitti C, et al. Management of high blood pressure in children and adolescents: recommendations of the European Society of Hypertension. J Hypertens 2009;27(9):1719–42.

16. WHO. *STEPS Instrument (Core and Expanded)*. Geneva: World Health Organization.
17. National Institute of Health. *The Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents*. Bethesda, MD: National Institute of Health, 2005.
18. Swamy S, Subramanian M, Chitambaram NS, Jayan M. Prevalence and determinants of overweight and obesity in school children. J Evol Med Dental Sci 2013;2(39):7392–7.
19. Jain A, Dhanavat J, Kotian MS, Angeline R. Assessment of risk factors of non-communicable diseases among high school students in Mangalore, India. Int J Health Allied Sci 2012;1: 249–54.
20. Anand A, Shah B, Yadav K, Singh R, Mathur P, Paul E, Kapoor SK. Are the urban poor vulnerable to non-communicable diseases? A survey of risk factors for non-communicable diseases in urban slums of Faridabad. Natl Med J India 2007;20(3):115–20.
21. Gujjarlapudi C, Kasyapa VB, Ravinder A. Risk factors for non communicable diseases (NCD) among high school students in an urban setting. Int J Recent Trends Sci Technol 2013; 7(2):82–5.
22. Krishna P, Prasanna Kumar KM, Desai N, Thennarasu K. Blood pressure reference tables for children and adolescents of Karnataka. Indian Pediatr 2006;43(6):491–501.
23. Kamath VG, Parthage PM, Pattanshetty S, Kamath A, Balakrishnan A, Mishra T, et al. Prevalence of hypertension in the paediatric population in Coastal South India. AMJ 2010;3(11):695–8.
24. Bardol RV, Ranagol A, Patil SV. Hypertension as an emerging health problem amongst school children and adolescents. Int J Med Res Health Sci 2013;2(4):941–8.
25. Yan W, Liu F, Wu L, Zhang Y, Cheng Y, Zhou W, et al. Blood pressure percentiles by age and height for non-overweight Chinese children and adolescents: analysis of the China Health and Nutrition Surveys 1991–2009. BMC Pediatr 2013;13:195.
26. Veetus S, Shivaprakash NC. The study of blood pressure profile and body mass index among children in a rural setting. Int J Biomed Res 2014;5(4):244–6.

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