Original Research Article

Epidemiological profile of hypertension and various risk factors in adolescents

Vikas Narayan Solunke[1], Yogita Gaekwad[2], Shivprasad Mundada[3*], Kiran Bhaisare[4] Shital Bhattad[5,] Satyakala Garad[6]

{[1,2,4]Associate Professor, [3]Professor And Head, [5]Assistant Professor, Department of Pediatrics} {[6]Medical officer, Department of Ophthalmology} Government Medical College, Latur, Maharashtra, INDIA.
Email: drvikassolunke@gmail.com

Abstract

Background: Primary hypertension has been now shown to be most common among adolescents, and usually presents as stage I hypertension along with a positive family history. Secondary hypertension has various systemic causes. **Objectives:** To see epidemiological profile of hypertension and various risk factors in early adolescent school children. **Material and Methods:** This cross-sectional study was planned to assess the prevalence of overweight, obesity in school children in early and mid adolescence in different schools in a city in Maharashtra, India was carried out during August 2015 to July 2017. Five districts were selected randomly in Maharashtra. After applying formula 1646 adolescents sample was arrived but since it is an epidemiological study, it was decided to include maximum number of adolescents from the 5 selected schools in 7th, 8th and 9th standard. At the end of data collection, the final sample size was 2496. Descriptive statistics were expressed in Mean+SD, frequencies and percentages, correlation was studied using Pearson's product moment correlation for data with normal distribution. **Results:** Among the students, 37.9% were of 13 years, 57.8% were males while 42.2% were females. significant association was found between systolic BP and sex, vegetable intake, salt intake frequency, oil intake, physical activity, parental hypertension and BMI. While diastolic hypertension was found significance with salt intake, oil consumption, physical activity, parental hypertension and BMI. **Conclusions:** Adolescent hypertension also may also show ice berg phenomenon like adult hypertension so we should be very careful with unhealthy lifestyle of our adolescent population so as to avoid development of hypertension in adult life.
Key Word: Early adolescent, systolic hypertension, diastolic hypertension,

***Address for Correspondence:**
Dr. Shivprasad Mundada, Associate Professor, Department of Pediatrics, Government Medical College, Latur, Maharashtra, INDIA.
Email: drvikassolunke@gmail.com
Received Date: 18/02/2019 Revised Date: 30/03/2019 Accepted Date: 12/05/2019
DOI: https://doi.org/10.26611/1061031

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 01 June 2019

INTRODUCTION

Like obesity, hypertension is also a potential risk factor for occurrence of cardiovascular diseases in adulthood. Hence, detection of hypertension in children and adolescents may is an initial step in prevention of cardiovascular diseases in adulthood. For this, it is important to study the pattern of variation of hypertension in the local community. According to the report of National High Blood Pressure Education Program (NHBPEP),'all children above 3 years of age, seen in medical care should have their blood pressure measured routinely.' Number of factors like family history of hypertension[1-4]and obesity in childhood[5-7] have been established risk factors for essential hypertension in adulthood. Early detection of hypertension and modification of risk factors helps in prevention. Though the prevalence of hypertension is known to be lower in adolescents, evidence shows that hypertension develops in initial 2 decades of life.[2]

Trends in blood pressure over the period from childhood to adolescence are important predictors in the trends of hypertension in adulthood.[8] This was noted by Luepker *et al*[9] who noted that children/ adolescents with higher blood pressure than their peers maintain this relative

How to cite this article: Vikas Narayan Solunke *et al*. Epidemiological profile of obesity in mid school children. *MedPulse International Journal of Pediatrics*. June 2019; 10(3): 69-75. http://medpulse.in/Pediatrics/index.php

position of higher blood pressure in adulthood. Evidence has shown the susceptibility of asymptomatic adolescents with mild elevated blood pressure to target organ damage.[10] In India, considerable work has been done by number of researchers to study the normal blood pressure variation in different age groups.[2,3,11-14] However, such data in reference to blood pressure in adolescents in certain regions of Maharashtra in recent times is not available. Hence, this study was planned to report the prevalence of hypertension among school children in early adolescence. The present study was planned with an aim to observe the epidemiology of hypertension in the early adolescence in a district place in Maharashtra, India, to study the various associated factors.

MATERIAL AND METHODS

The present cross-sectional study was planned to assess the prevalence of hypertension in school children in early and mid adolescence in different schools in a city in Maharashtra, India was carried out during August 2015 to July 2017. Written approval from ethical committee, at the institute level was obtained. Five districts were selected randomly in Maharashtra. Since, it is an epidemiological study, it was decided to include maximum number of adolescents from the 5 selected schools in 7th, 8th and 9th standard. At the end of data collection, the final sample size was 2496. Students of either sex in the 7th, 8th and 9th standards in school, aged >11 years but < 15 years and those students who gave informed assent, and whose parents or teachers gave informed consent were included and all those with any systemic diseases were excluded from the study. Teachers, students and their parents were informed about the study, in a language which could be easily understood by them. Informed consent from the teachers and parents, and from students. Height, weight, BMI and blood pressure was calculated using predefined and standard procedures. As per WHO percentile charts for age, sex and blood pressure, students were grouped as,[16]Procedure was fully explained to students before measurement of blood pressure. They were allowed to sit quietly for 5 minutes. Blood pressure was recorded by auscultation method using a standard mercury sphygmomanometer, in a sitting position, on right arm with level of cubital fossa at that of the heart. Cuff size was selected appropriately such that, bladder width was 40% of arm circumference at midway point between the olecranon and acromion processes. The bladder covered at least 80-100% of circumference of arm. Normal blood pressure: SBP and DBP < 90th percentile Prehypertension: SBP or DBP 90-95th percentile, Stage 1 hypertension: SBP and/or DBP 95-99th percentile plus 5 mmHg Stage 2 hypertension: SBP and/or DBP > 99th percentile plus 5 mmHg The data was analyzed using SPSS version 21 software. Descriptive statistics were expressed in Mean+SD, frequencies and percentages, correlation was studied using Pearson's product moment correlation for data with normal distribution. The level of significance in the study was 0.05 ($p<0.05$).

RESULTS

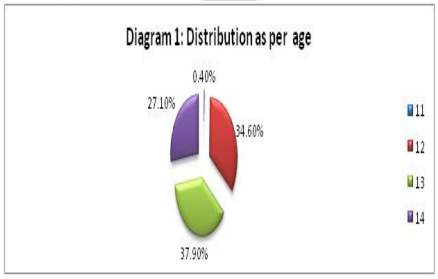

Figure 1: Distribution as per age

Among the students, 37.9% were of 13 years, 34.6% were of 12 years, 27.1%were of 14 years, while 0.4% were of 11 years. Among the students, 57.8% were males while42.2% were females. On comparing the presence of systolic hypertension with sex of students using Chi square test, a statistical significant association was found between the presence of systolic hypertension and sex of students [$\chi 2$ (1) = 12.3, p=0.001].

Table 1: Association with vegetable intake

		Count	Frequency of vegetable intake			Total
			Daily	>1/week	≤ 1week	
Systolic Hypertension	No	N	1428	663	234	**2325**
		%	94	92.5	90	**93.1**
	yes	N	91	54	26	**171**

		%	6	7.5	10	**6.9**
	No	**N**	166	682	246	**2394**
Diastolic Hypertension		%	96.5	95.1	94.6	**95.9**
	Yes	**N**	53	35	14	**102**
		%	3.5	4.9	5.4	**4.1**

On comparing the presence of systolic hypertension with vegetable intake in students using Chi square test, a statistical significant association was found between the presence of systolic hypertension and vegetable in take in students [$\chi 2$ (2) = 6.322, p=0.042]. On comparing the presence of diastolic hypertension with vegetable intake in students using Chi square test, no association was found between the presence of diastolic hypertension and vegetable intake in students [$\chi 2$ (2)= 3.657, p=0.161].

Table 2: Association with intake of junk food

		Count	Frequency of intake of junk food				Total
			Daily	Occasionally > 1/week	Occasionally 1/week	Never	
Systolic Hyper tension	**No**	**N**	354	595	822	554	**2325**
		%	91.2	93.1	93.6	93.7	**93.1**
	Yes	**N**	34	44	56	37	**171**
		%	8.8	6.9	6.4	6.3	**6.9**
Diastolic hypertension	**No**	**N**	370	615	844	565	**2394**
		%	95.4	96.2	96.1	95.6	**95.9**
	Yes	**N**	18	24	34	26	**102**

On comparing the presence of systolic hypertension with intake of junk food in students using Chi square test, no association was found between the presence of systolic hypertension and intake of junk food in students [$\chi 2$ (3) = 2.854, p=0.415]. On comparing the presence of diastolic hypertension with intake of junk food in students using Chi square test, no association was found between the presence of diastolic hypertension and intake of junk food in students [$\chi 2$ (3) = 0.731, p=0.866].

Table 3: Association with salt intake

		Count	Frequency of salt intake			Total
			Low	Medium	High	
Systolic Hypertension	**No**	**N**	156	1917	252	**2325**
		%	96.3	94.3	93.4	**93.1**
	Yes	**N**	6	115	50	**171**
		%	3.7	5.7	16.6	**6.9**
Diastolic hypertension	**No**	**N**	158	1963	273	**2394**
		%	97.5	96.6	90.4	**95.9**
	Yes	**N**	4	69	29	**102**
		%	2.5	3.4	9.6	**4.1**

On comparing the presence of systolic hypertension with salt intake in students using Chi square test, a statistical significant association was found between the presence of systolic hypertension and salt intake in students [$\chi 2$ (2) = 51.611, p<0.001]. On comparing the presence of diastolic hypertension with salt intake in students using Chi square test, a statistical significant association was found between the presence of diastolic hypertension and salt intake in students [$\chi 2$ (2) = 27, p<0.001].

Table 4: Association with oilintake

		Count	Frequency of oil intake			Total
			Low	Medium	High	
Systolic Hypertension	**No**	**N**	91	2001	243	**2325**
		%	97.6	94.2	84.1	**93.1**
	Yes	**N**	2	123	46	**171**
		%	2.4	5.8	15.9	**6.9**
Diastolic hypertension	**No**	**N**	82	2052	260	**2394**
		%	98.8	96.6	90	**95.9**
	Yes	**N**	1	72	29	**102**
		%	1.2	3.4	10	**4.1**

On comparing the presence of systolic hypertension with oil intake in students using Chi square test, a statistical

significant association was found between the presence of systolic hypertension and oil intake in students [$\chi 2$ (2) = 43.527, p<0.001]. On comparing the presence of diastolic hypertension with oil intake in students using Chi square test, a statistical significant association was found between the presence of diastolic hypertension and oil intake in students [$\chi 2$ (2) = 30.475, p<0.001].

Table 5: Association with physical/sports activity

		Count	Frequency of physical/sports activity					Total
			Daily > 1hr	Daily ≤ 1hr	Occasionally > 1/week	Occasionally ≤ 1/week	Never	
Systolic Hypertension	No	N	605	940	129	442	209	**2325**
		%	95.6	95	86	90.6	88.6	**93.1**
	Yes	N	28	49	21	46	27	**171**
		%	4.4	5	14	9.4	11.4	**6.9**
Diastolic Hypertension	No	N	616	956	142	464	216	**2394**
		%	97.3	96.7	94.7	95.1	91.5	**95.9**
	Yes	N	17	33	8	21	20	**102**
		%	2.7	3.3	5.3	4.9	8.5	**4.1**

On comparing the presence of systolic hypertension with physical/sports activity of students using Chi square test, a statistical significant association was found between the presence of systolic hypertension and physical/sports activity of students [$\chi 2$ (4) = 36.294, p<0.001]. On comparing the presence of diastolic hypertension with physical/ sports activity of students using Chi square test, a statistical significant association was found between the presence of diastolic hypertension and physical/ sports activity of students [$\chi 2$ (4) = 17.637, p=0.001].

Table 6: Association with parental history of hypertension

		Count	Parental history of hypertension		Total
			No	Yes	
Systolic Hypertension	No	N	2260	65	**2325**
		%	93.6	79.3	**93.1**
	Yes	N	154	17	**171**
		%	6.4	20.7	**6.9**
Diastolic hypertension	No	N	2321	73	**2394**
		%	96.1	89	**95.9**
	Yes	N	93	9	**102**
		%	3.9	11	**4.1**

On comparing the presence of systolic hypertension with parental history of hypertension in students using Chi square test, a statistical significant association was found between the presence of systolic hypertension and parental history of hypertension in students [$\chi 2$ (1) = 25.599,p=0.001]. On comparing the presence of diastolic hypertension with parental history of hypertension in students using Chi square test, a statistical significant association was found between the presence of diastolichy pertension and parental history of hypertension in students [$\chi 2$ (1) = 10.266, p=0.005].

Table 7: Comparison of waistcircumference

Waist circumference [Mean ±SD] in cm				Statistical test	P value
No systolic hypertension (n=2325)	Systolic hypertension (n=171)	No diastolic hypertension (n=2394)	Diastolic hypertension (n=102)		
71.3±8.64	75.91±10.09	71.4±8.71	76.7±9.79	Unpaired t test	<0.001

The mean waist circumference in those with normal blood pressure was 71.3+8.64 cm while that in children with systolic hypertension was 75.91+10.09 cm. On comparing using unpaired t test, the mean waist circumference was statistically significantly higher (p<0.001) in children with systolic hypertension compared to those with normal systolic blood pressure. The mean waist circumference in those with normal blood pressure was 71.4+8.71 cm while that in children with diastolic hypertension was 76.7+9.79 cm. On comparing using unpaired t test, the mean waist circumference was statistically significantly higher (p<0.001) in children with diastolic hypertension compared to those with normal diastolic blood pressure

DISCUSSION

Adolescent hypertension is associated with increased risk of persistence in adulthood. In India, there is a lack of studies which demonstrate the correlation between the adolescent hypertension and various contributing factors. Hence, this study was planned with the objectives to evaluate the factors associated with prevalence of hypertension in adolescents, and to assess, if any, correlation between the two. The present study was conducted in a city in Maharashtra, India in early adolescents from 6 schools. Prevalence of systolic and diastolic hypertension was 6.9% and 4.1%, respectively. There was an association between the presence of overweight or obesity and presence of systolic as well as diastolic hypertension in the students. Common factors associated with presence of systolic hypertension were consumption of vegetables, salt, oil, physical/sports activities, duration of daily sleep, mode of delivery, parental history of hypertension, and waist circumference. Additional factors associated particularly with presence of systolic hypertension were gender. While diastolic hypertension was associated with consumption of salt and oil, physical and sports activity, mode of delivery and parental history of hypertension. In the current study, the prevalence of systolic and diastolic hypertension was 6.9% and 4.1%, respectively. Kilcoyne MM *et al*[17] reported the same prevalence to be 5.4% and 7.8% respectively. IrgilE *et al*[18] systolic and/or diastolic hypertension in 7.2% adolescents in the age group of 13-18 years in Turkey. In Houston, McNiece KL *et al*[19], reported presence of hypertension in 3.2% adolescents in the age group of 11-17 years. The prevalence of hypertension in students attending 6th grade was 2.2%, of which 81% had isolated systolichypertension in a study by Chiolero A *et al*.[20] In Nepal, systolic hypertension was prevalent in 2.8% and diastolic hypertension was prevalent in 3.4% in adolescents aged 10-16 years.[21] A high prevalence of hypertension of 21.2% was reported in adolescents aged 13-17 years in a study by Nkeh-Chungag *et al* in South Africa.[22] In a systematic review of studies in Brazilian adolescents, the overall prevalence of hypertension was calculated to be 8%.[23] Among the Indian studies, Prabhajot *et al*[8] reported prevalence of hypertension as 7.5% in Punjab students in age group of 6-14 years, SavithaM *et al*[24] reported 6.16% in Karnataka students of 10-16 years, Taksande *et al*[25] reported 3.25% systolic and 2.49% diastolic hypertension in Wardha-Maharashtra in 6-17 years age group, BahlD *et al*[26] reported 16.6% in 12-15 years age group in New Delhi, AmmaD *et al*[27] reported 0.6% in 8th-10th standard adolescents in Kerala, Kumar R *et al*[28] reported 2.2% in adolescent girls in Moradabad-Uttar Pradesh, YogendraprasadR *et al*[29] reported 4.69% in Bengaluru in 6-15 years age group, and MakwanaM *et al*[30] reported 4.86% in Rajasthan in 5-16 years age group, with higher prevalence in age group of 10- 16 years contributing to 84% of hypertensive cases. Gender variation in blood pressure of adolescents was reported by Kilcoyne MM *et al*[17], with higher systolic and diastolic pressures and significantly higher prevalence of systolic and diastolic pressures in males than females. Increased prevalence of high blood pressure in males than females was reported by Din-Dzietham R *et al*[31] in children and adolescents in 8-17 years age. In current study in early adolescents, systolic hypertension was more prevalent in females than males, while no gender variation was observed with respect to diastolic hypertension. Reasons for this finding cannot be ascertained to a particular cause. Thus, studies show variation regarding this finding and further Indian studies are required in this aspect to confirm these findings of the study. In the present study, factors associated with systolic and diastolic hypertension were evaluated separately, in contrast to many studies where both systolic and diastolic hypertension are considered as one. As observed from the socioeconomic status, the prevalence of systolic hypertension was much higher in the upper status compared to the other classes. Among the lifestyle habits, systolic hypertension was frequent in those with less vegetable intake, while more salt and oil intake, and reduced physical/sports activity, is associated with both systolic and diastolic hypertension. Relation between salt intake and hypertension is a well-documented fact in number of clinical trials.[32] Another finding associated with presence of hypertension was parental history of hypertension, which emphasizes the fact that children of hypertensive parents may be hypertensive. This has been earlier demonstrated in a study by KazimSF *et al*.[33] Those with hypertension had higher waist circumference than normotensive adolescents. Choy CS *et al*[34] noted that waist circumference is associated with increased risk of elevated blood pressure in children and also, represents metabolic risk in them. ChioleroA *et al*[20], AmmaD *et al*[27] had similar factors associated with hypertension as with our study.MakwanaM *et al*[30] noted association of presence of hypertension with family history of chronic diseases such as diabetes mellitus or hypertension. Association between blood pressure and BMI was noted by Rafraf *et al* in Iranian adolescent girls.[135] Systolic and diastolic blood pressures were positively correlated with in Indian studies by BahlD *et al*[26] and Kumar *et al*.[28] In the present study, a positive correlation was found between the BMI and systolic blood pressure in the adolescents. Lone *et al* demonstrated a significant correlation between the anthropometric measurements such as height, weight and BMI with presence of

hypertension in adolescents.[111]Dietary habits and physical and sports activities are modifiable risk factors for hypertension in adolescents, and hence, good dietary habits should be inculcated amongst the youngsters. By controlling these risk factors, the occurrence of hypertension can be prevented or managed. Though adolescents are young, they are mature enough to understand the risks of the diseases under consideration. Educating them properly about these disorders will not only be helpful to prevent adolescent hypertension, but will also encourage to live a healthy lifestyle which will benefit him/ her as an adult. It is also important to educate the parents regarding these disease in their children. Many may consider hypertension as a disease of the elderly and may not be considerate of prevalence of hypertension in adolescents. It is also important to communicate to the parents, that presence of hypertension in them will increase the risk of their adolescent children becoming obese and hypertensive.

CONCLUSION

The prevalence S1 stage systolic hypertension was 4.3% and S2 stage systolic hypertension was 2.6%. The prevalence of S2 stage diastolic hypertension was 3.6% and S2 stage diastolic hypertension was 0.5%. There was strong association between the presence of overweight or obesity and presence of systolic as well as diastolic hypertension. Associated factors with increased prevalence of systolic and diastolic hypertension were high salt and oil intake, reduced physical and sports activity, parental history of hypertension and increased waist circumference. Factors particularly associated with systolic hypertension, in addition, were female gender, upper socioeconomic status, less vegetable intake. There was a medium positive correlation between BMI and systolic blood pressure and weak positive correlation between BMI and diastolic blood pressure.

REFERENCES

1. Munger RG, Prineas RJ, Gomez-Marin O. Persistent elevation of blood pressure among children with a family history of hypertension: the Minneapolis Children's Blood Pressure Study. J Hypertens. 1988; 6(8):647-653. http://www.ncbi.nlm.nih.gov/pubmed/3263416. Accessed May 21, 2017.
2. Chadha SL, Tandon R, Shekhawat S, Gopinath N. An epidemiological study of blood pressure in school children (5-14 years) in Delhi. Indian Heart J. 51(2):178-182. http://www.ncbi.nlm.nih.gov/pubmed/10407546. Accessed May 21, 2017.
3. Gupta AK. Influence of family history of morbid cardiovascular events on blood pressure levels of school children. Indian Pediatr. 1991; 28(2):131-139. http://www.ncbi.nlm.nih.gov/pubmed/2055627. Accessed May 21, 2017.
4. Burke V, Gracey MP, Beilin LJ, Milligan RA. Family history as a predictor of blood pressure in a longitudinal study of Australian children. J Hypertens. 1998; 16(3):269-276. http://www.ncbi.nlm.nih.gov/pubmed/9557919. Accessed May 21, 2017.
5. Verma M, Chhatwal J, George SM. Biophysical profile of blood pressure in school children. Indian Pediatr. 1995; 32(7):749-754. http://www.ncbi.nlm.nih.gov/pubmed/8617550. Accessed May 21, 2017.
6. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ. Overweight, ethnicity, and the prevalence of hypertension in school-aged children. Pediatrics. 2004; 113(3 Pt 1):475-482. http://www.ncbi.nlm.nih.gov/pubmed/14993537. Accessed May 21, 2017.
7. Falkner B, Gidding SS, Ramirez-Garnica G, Wiltrout SA, West D, Rappaport EB. The relationship of body mass index and blood pressure in primary care pediatric patients. J Pediatr. 2006; 148(2):195-200. doi:10.1016/j.jpeds.2005.10.030.
8. Prabhajot A, Kaur N, Kumari K, Sidhu S. Variation in Blood Pressure Among School Children of Amritsar (Punjab). Anthropologist. 2005; 7(3):201-204.
9. Luepker R V, Jacobs DR, Prineas RJ, Sinaiko AR. Secular trends of blood pressure and body size in a multi-ethnic adolescent population: 1986 to 1996. J Pediatr. 1999; 134(6):668-674. http://www.ncbi.nlm.nih.gov/pubmed/10356132. Accessed May 21, 2017.
10. Brener ND, Eaton DK, Lowry R, McManus T. The Association between Weight Perception and BMI among High School Students. Obes Res. 2004; 12(11):1866-1874. doi:10.1038/oby.2004.232.
11. Agarwal R, Mandowara SL, Bhandari B, Garg OP. Prevalence of hypertension in apparently healthy school children. Indian Pediatr. 1982; 19(9):779-784. http://www.ncbi.nlm.nih.gov/pubmed/7160905. Accessed May 21, 2017.
12. Agarwal VK, Sharan R, Srivastava AK, Kumar P, Pandey CM. Blood pressure profile in children of age 3-15 years. Indian Pediatr. 1983; 20(12):921-925. http://www.ncbi.nlm.nih.gov/pubmed/6676304. Accessed May 21, 2017.
13. Anand NK, Tandon L. Prevalence of hypertension in schoolgoing children. Indian Pediatr. 1996; 33(5):377-381. http://www.ncbi.nlm.nih.gov/pubmed/9005224. Accessed May 21, 2017.
14. Gupta AK, Ahmad AJ. Normal blood pressures and the evaluation of sustained blood pressure elevation in childhood. Indian Pediatr. 1990; 27(1):33-42. http://www.ncbi.nlm.nih.gov/pubmed/2361741. Accessed May 21, 2017.
15. Bharati DR, Deshmukh PR, Garg BS. Correlates of overweight andamp; obesity among school going children of Wardha city, Central India. Indian J Med Res. 2008; 127(6):539-543. http://www.ncbi.nlm.nih.gov/pubmed/18765871. Accessed May 26, 2017.

16. Lande MB. Systemic Hypertension. In: Marcdante KJ, Kliegman RM, eds. Nelson Essentials of Pediatrics. 1st ed. South Asian: Elsevier; 2016:2249.
17. Kilcoyne MM. Adolescent hypertension. Am J Med. 1975; 58(6):735-739. doi:10.1016/0002-9343(75)90629-4.
18. Irgil E, Erkenci Y, Aytekin N, Aytekin H. Prevalence of hypertension among school children aged 13-18 years in Gemlik, Turkey. Eur J Pub Heal. 1998; 8(2):13-15. doi:10.1093/eurpub/8.2.176.
19. McNiece KL, Poffenbarger TS, Turner JL, Franco KD, Sorof JM, Portman RJ. Prevalence of Hypertension and Pre-Hypertension among Adolescents. J Pediatr. 2007; 150(6):640-644.e1. doi:10.1016/j.jpeds.2007.01.052.
20. Chiolero A, Cachat F, Burnier M, Paccaud F, Bovet P. Prevalence of hypertension in schoolchildren based on repeated measurements and association with overweight. J Hypertens. 2007;25(11):2209-2217. doi:10.1097/HJH.0b013e3282ef48b2.
21. Kafle R, Shrestha S. Prevalence of essential hypertension in school going early and mid adolescent children of Kathmandu Valley. J UniversColl Med Sci. 2013;1(2):24-29.
22. Nkeh-chungag BN, Sekokotla AM, Sewani-rusike C, Namugowa A, Iputo JE. Prevalence of Hypertension and Pre- Hypertension in 13 – 17 Year Old Adolescents Living in Mthatha – South Africa□: a Cross- Sectional Study. Cent Eur J Public Heal. 2015; 23(1):59-64. doi:10.21101/cejph.a3922.
23. Gonçalves VSS, Galvão TF, de Andrade KRC, Dutra ES, Bertolin MNT, de Carvalho KMB, *et al*. Prevalence of hypertension among adolescents: systematic review and meta-analysis. Rev SaudePublica. 2016; 50: 27. doi:10.1590/S1518-8787.2016050006236.
24. Savitha M., Krishnamurty B, Fatthepur SSR, Kumar A.M Y, Khan MA. Essential Hypertension in Early and Mid-Adolescene. Indian J Pediatr. 2007;74(11).
25. Taksande A, Chaturvedi P, Vilhekar K, Jain M. Distribution of blood pressure in school going children in rural area of Wardha district, Maharashatra, India. Ann PediatrCardiol. 2008; 1(2):101-106. doi:10.4103/0974-2069.43874.
26. Bahl D, Singh K, Sabharwal M. Screening and Identifying Delhi school going adolescents (12-15 yrs) with Pre Hypertension and hypertension. Int J Sci Res Publ. 2015; 5(10):1-7.
27. Amma D, Vasudevan D, Akshayakumar D. Prevalence and Determinants of PreHypertension and Hypertension among Adolescents□: A School based Study in a Rural area of Kerala, India. Int J Res Med Sci. 2015; 3(1):1. doi:10.5455/2320-6012.ijrms20150111.
28. Kumar R, Sharma M, Srivastava A. A cross sectional study of hypertension in adolescent girls of district Moradabad, Uttar Pradesh, India. Int J Community Public Heal. 2016;3(6):1388-1392. http://www.ijcmph.com/index.php/ijcmph/article/view/402.
29. Yogendraprasad R, Chandrakala P, Goutham AS. Study of blood pressure profile in school children in Bangolre city. Int J Gen Pediatr Med. 2017; 2(1):1-6.
30. Makwana M, Bhati R, Mourya H, Dabi J, P SJ, Sharma P. A study to find out prevalence of hypertension in school going children of age group 5 to 16 years in Western Rajasthan. J Evid based Med Healthc. 2017;4(16):916-920.
31. Din-Dzietham R, Liu Y, Bielo M V, Shamsa F. High blood pressure trends i children and adolescents in national surveys, 1963 to 2002. Circulation. 2007; 116(13):1488-1496.
32. Ha SK. Dietary salt intake and hypertension. Electrolyte Blood Press. 2014;12(1):7-18. doi:10.5049/EBP.2014.12.1.7.
33. Kazim SF, Salman MB, Zubairi AJ, Afzal A, Ahmad U. Offsprings of hypertensive parents have higher blood pressure and BMI. J Coll Physicians Surg Pakistan. 2008; 18(1):64-65.
http://ecommons.aku.edu/pakistan_fhs_mc_bbs. Accessed July 20, 2017.
34. Choy CS, Chan W-Y, Chen T-L, Shih C-C, Wu L-C, Liao C-C. Waist circumference and risk of elevated blood pressure in children: a cross- sectional study. BMC Public Health. 2011; 11: 613. doi:10.1186/1471- 2458-11-613.

Source of Support: None Declared
Conflict of Interest: None Declared