European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 02, 2022

A study on prevalence of elevated blood pressure and hypertension among healthy school children at an altitude of 4000-5000 feet

[1]Dr. Divyabh Gehlot, [2]Dr. Neelam Grover, [3]Dr. Hemant Gupta, [4]Dr. Rajeev Vinayak, [5]Dr. Amudeep Singh

[1]PG Resident (3rd Year), Department of Pediatrics, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan, Himachal Pradesh, India
[2]Professor & Head of Department of Pediatrics, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan, Himachal Pradesh, India
[3]Associate Professor, Department of Pediatrics, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan, Himachal Pradesh, India
[4]Professor, Department of Pediatrics, Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan, Himachal Pradesh, India
[5]Ph.D. Scholar, Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research, Chandigarh, India

Corresponding Author:
Dr. Hemant Gupta (hemant.solan@gmail.com)

Abstract

Introduction: Early diagnosis of hypertension is an important strategy in its control which is usually missed in OPD practice. Kumarhatti, Solan, was selected as the place of study based on the new AAP 2017 criteria to find the prevalence of elevated blood pressure and hypertension at an altitude of 4000-5000 feet.

Objective: To measure blood pressure of school going children and to classify BP measurements into normal BP, Elevated BP and Hypertension.

Methods: 600 children between 10 to 17 years of age were selected from urban and rural schools. The final diagnosis of HTN was made if a child or adolescent had auscultatory confirmed BP readings ≥95thpercentile on 3 different visits. Data collected was analyzed using SPSS20.

Results: Prevalence of EBP, stage 1 and stage 2 hypertension was found to be 15, 8%, 4.5% and 1% respectively in the study. Prevalence of EBP and stage 1 hypertension was higher in urban population (17.2% and 5.3% respectively) whereas stage 2 hypertension was almost equal in both population (P<0.05). Prevalence of EBP, stage 1 and stage 2 hypertension was maximum in obese category as 38.6%, 13.63%, 6.8% followed by overweight 24%, 11.25%, 2.5% respectively (P<0.05). The prevalence of positive family history among study subjects was 15% (N=90) with P value<0.05.

Conclusion: Prevalence of hypertension was 5.5% in the study subjects. Prevalence of EBP and stage 1 hypertension was higher in urban population. Our study revealed that prevalence of elevated blood pressure and hypertension was significantly more in overweight and obese children and with positive family history compared to normal children proving obesity and positive family history as an important risk factor for hypertension in children.

Keywords: Hypertension, school children, elevated blood pressure, obesity, family history

ISSN 2515-8260 Volume 09, Issue 02, 2022

Introduction

Blood pressure measurements for adults have proven to be crucial in the assessment of cardiovascular health, and since Stephen Hales' experiments in the eighteenth century, have become a routine part of physical examination [1]. However, it wasn't until 1977 that proper assessment of hypertension in children was carried out in united nation by the Task Force on control of BP [2].

Morbidity among school-going children adversely affects their normal growth and development and hence it is a major public health concern [3]. In developed countries preponderance of systemic hypertension is 1-2% [4]. The average systolic blood pressure at birth is approximately 70 mmHg which increases to 85 mmHg by one month of age [5]. Children with secondary hypertension have a specific, potentially correctable, abnormality responsible for their high blood pressure while those with primary or essential hypertension do not [6].

In obese pediatric patients primary HTN is showing an increasing trend. Life style changes like low potassium food, high sodium intake, use of alcohol beverages and caffeinated drinks, smoking, mental stress, sleep deprivation, high calories intake, decrease physical activity are other causes for increase preponderance of HTN. Cause of secondary hypertension is more in children than adults with reno vascular disease followed by endocrinal diseases [7]. A familial influence on blood pressure can be identified early in life. History of familial hypertension tends to have higher BP than of normotensive families [8].

Previous studies estimated prevalence of confirmed hypertensive children ranging2-4%. [9, 10, 11] New Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents were published by the AAP in the year 2017 for updating the criteria for hypertension diagnosis in children [12].

Due to lack of BP measurement among pediatricians in outpatient practice, enough data is not available regarding prevalence of hypertension at an altitude of 4000-5000 feet. So, we selected Kumarhatti, Solan, Himachal Pradesh as the place to find the prevalence of hypertension and elevated blood pressure at an altitude of 4000-5000 feet.

Materials and Methods

A cross sectional study was done to find the prevalence of elevated blood pressure and hypertension among healthy school going children over a period of 18months.

Urban area defined as all places with a municipality, corporation, cantonment board or notified town area committee, etc. and area which are not categorized as urban area was considered as rural area. Socioeconomic status of child was assessed by modified Kuppuswamy Scale.

Number of subjects and study population: Study included 600 healthy school going children between 10 to 17 years of age were selected from urban and rural schools over 18 months.

Inclusion criteria

1. 600 were included in the study after an informed consent from guardians/attendants from rural and urban school.
2. School going children of both sexes aged between 10 years to 17 years were included.

Exclusion criteria

All school absentees, children with any chronic illness, children taking any prolonged medication were not included in the study.

Written, informed and valid consent were taken and Parent Teachers Association (PTA) and school authorities were well-informed prior to the study and approval was obtained.
Weight, height were taken according to standard guidelines. BMI were taken and was compared with IAP-BMI Charts 2015. BMI >23rd adult equivalent line refers as overweight and more than 27th adult equivalent line refers as obesity. Less than 3rd adult equivalent line refers as underweight and 3th to 23rd adult equivalent line refers as normal weight.
Blood pressure was measured by using updated definitions of BP Categories and stages (as per AAP 2017 GUIDELINES).

For children aged 1 to 13 years	For children aged 13 years
Normal BP:< 90th percentile	Normal BP:<120/<80mmHg
Elevated BP: ≥ 90th percentile to < 95th percentile or 120/80mmHg to <95th percentile (whichever is lower)	Elevated BP: 120/<80 to 129/<80mmHg
Stage 1 HTN: ≥ 95th percentile to <95TH Percentile + 12mmHg or 130/80 to 139/89 mmHg. (whichever is lower)	Stage 1 HTN: 130/80 mmHg to 130/89 mmHg
Stage 2 HTN: ≥ 95th percentile + 12mmHg or ≥ 140/90mmHg.(Whichever is lower)	Stage 2 HTN: ≥ 140/90mmHg

All children were examined in a comfortable position. BP measurement was carried out using sphygmomanometer in right arm in sitting position. The cuff is deflated at the rate of 2-3 mm Hg/second. The first phase I Korotkoff and last phase V Korotkoff audible sounds were taken as SBP and DBP respectively. If the Korotkoff sounds are heard to 0 mm Hg, the point at which the sound is muffled phase IV Korotkoff was taken as the DBP, or the measurement repeated with less pressure applied over the brachial artery. The measurement was read to the nearest 2 mmHg. BP was measured in each child three times at a minimum interval of at least 5 min in between successive measurements and average reading was taken and was plotted on the BP tables provided by the latest 2017 AAP. If child had Stage 1 hypertension, a second reading was taken after 1-2 weeks and 3rd reading was taken after 3 months and if child had stage 2 hypertension he/she was immediately referred to the MMMC&H, Solan for further evaluation. Final diagnosis of HTN was made if a child or adolescent had auscultatory confirmed BP readings ≥95th percentile on 3 different visits.

Statistical analysis

Chi-square test and Fisher Exact Test were used. Data analysis was performed using SPSS20 VERSION. In our study, P<0.05 is considered to be statistically significant.

Results

There was preponderance of males in our study [Males =343(57.2%); females = 257 (42.8%)]. Subjects were equally distributed in urban and rural area with 302 (50.3%) and 298 (49.7%) respectively.

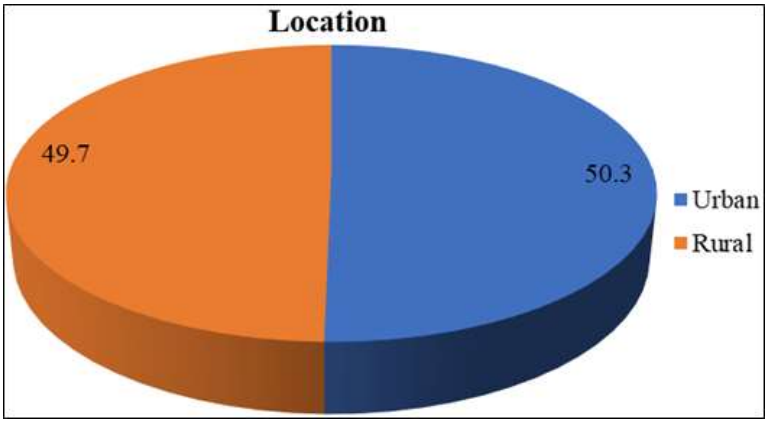

Fig 1: Location distribution

Prevalence of elevated blood pressure, stage 1 and stage 2 hypertension was reported among 15.8%, 4.5% and 1% of the subjects respectively.

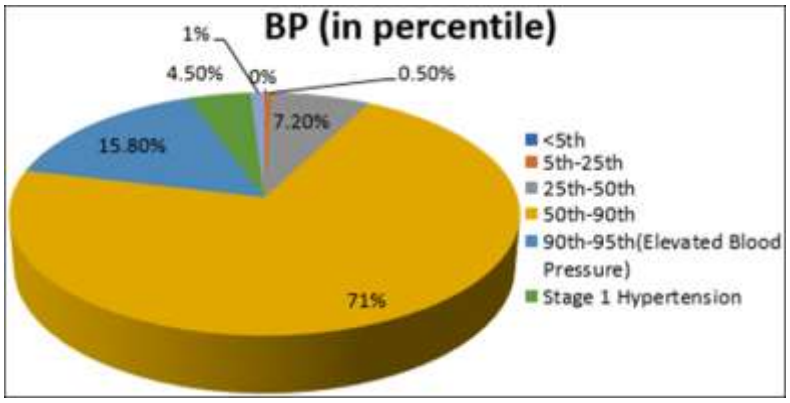

Fig 2: Prevalence of BP among the study subjects according to AAP guidelines, 2017

Prevalence of EBP and stage 1 hypertension was higher in urban population (17.2% and 5.3% respectively) as compared to rural population with statistically significant difference.

Table 1: Association of BP with location

BP (in percentile)	Location				N
	Rural		Urban		Total
	N	%	N	%	
5^{th}-25^{th}	0	0	3	0.99	3
25^{th}-50^{th}	22	7.38	21	6.95	43
50^{th}-90^{th}	219	73.49	207	68.54	426
90^{th}-95^{th} (Elevated Blood Pressure)	43	14.43	52	17.22	95
Stage 1 Hypertension	11	3.69	16	5.30	27
Stage 2 Hypertension	3	1.01	3	0.99	6
Total	298	100	302	100	600
Chi Square	9.17				
p value	0.028*				

The prevalence of EBP, stage 1 & 2 hypertension were maximum in children with history of familial hypertension which accounts for 35%, 21.7% and 3.3% of the subjects respectively with statistically significant difference as $p<0.05$.

Table 2: Association of BP with family history

BP (in percentile)	Family History							
	None		HTN		Diabetes Mellitus		HTN+DM	
	N	%	N	%	N	%	N	%
5^{th}-25^{th}	3	0.6	0	0	0	0	0	0
25^{th}-50^{th}	40	7.8	3	5	0	0	0	0
50^{th}-90^{th}	389	76.3	21	35	13	68.42	3	27.27
90^{th}-95^{th} (Elevated Blood Pressure)	68	13.3	21	35	4	21.05	2	18.18
Stage 1 Hypertension	8	1.6	13	21.7	2	10.53	4	36.36
Stage 2 Hypertension	2	0.4	2	3.3	0	0	2	18.18
Total	510	100	60	100	19	100	11	100
Fisher Exact Test	1.71							
p value	0.003*							

ISSN 2515-8260 Volume 09, Issue 02, 2022

The prevalence of EBP, stage 1 & 2 hypertension was least in children with history of familial diabetes mellitus which accounts for 21.05% and 10.53% of the subjects respectively. Mean weight, height and BMI was 48.43±13.03kgs, 158.01±10.62cms and 19.22±3.98kg/m^2 respectively.
Number of subjects in overweight and obese group were 80 (13.3 %) and 44 (7.3%) respectively. BMI categories shows significant association with hypertension in our study as $p<0.05$.

Table 3: Association of BP with BMI

BMI	N	Normotensive N	%	Elevated BP N	%	Stage I N	%	Stage II N	%	EBW+HTN N	%
Normal weight	476	409	85.9	54	11.3	12	2.5	1	0.21	67	14.07
Overweight	80	45	56.25	24	24	9	11.25	2	2.5	35	43.75
Obese	44	18	40.9	17	38.6	6	13.63	3	6.8	26	59.09
Total	600	472		95		27		6		128	
Chi Square		7.92									
p value		0.032*									

In this study, prevalence of EBP was found to be more among the males (N= 57 subjects with 16.6%) whereas prevalence of stage 1 and 2 of hypertension was found to be more among females (N= 19 subjects with 7.4% and N=4 subjects with 1.6% respectively). Maximum no. of subjects comes under upper lower class with 199 (33.2%) followed by lower middle with 169 (28.2%).
Subjects having age group of 10-12, 13-15 and 16-17 years were 14%, 40.67% and 45.33% respectively in our study. In elevated blood pressure group the majority of subjects come under 16-17yr age group (45 subjects out of 95 subjects which accounts 16.54%). Statistically, no significant association was found between blood pressure and age groups in this study.

Discussion

In our study 20 subjects (3.3%) comes under <3rd percentile (underweight). 143 subjects were having 25th-50th percentile BMI (23.8%). Number of subjects in overweight and obese group were 80 (13.3 %) and 44 (7.3%) respectively. Nihaz K. Naha *et al*. conducted a study in Kerala, found prevalence of hypertension was 14.1% and pre-hypertension was 8.9% in overweight children and was 11.3% and 7.5% in obese children respectively. They observed that prevalence of hypertension was high in children with high BMI [13]. A similar study done in Shimla had observed high prevalence of hypertension in obese subjects as compared to non-obese-subjects (33% vs 11%) done by Sharma *et al*. [14] Bilal *et al*. done a study in Karachi, Pakistan which also present a strong relationship between hypertension and elevated BMI [15]. Which are similar to our study.
Prevalence of elevated blood pressure, stage 1 and stage 2 hypertension was reported among 15.8%, 4.5% and 1% of the subjects respectively. Majority of subjects 426 (71%) were with in 50th-90th percentile in normotensive group in this study.
The prevalence of hypertension in children is as high as 22% to as low as 0.6% shown by various studies done in all over the world [3]. Nirav Buch *et al*. in their study reported that prevalence of hypertension was 5.4% in government school while it was 8.24% in private school children [16]. Nihaz K. Naha *et al*. in their study found that total prevalence of hypertension was 4.5% and pre-hypertension was 5.8% [13].
The prevalence of hypertension, among the children going to municipal school of Delhi, was calculated to be 3.1% (63/2011 students) in Hakim IS study. Most of the students belong to poor socioeconomic background in their study because this study was restricted to only municipal schools of Delhi [17].
Another study done in Delhi by Chadha, *et al*. which shows prevalence of hypertension in school children, of Delhi was 11.7%. They studied the urban school children where unhealthy dietary habits, lack of physical activity and bad peer pressures could have contributed to such a high incidence [18]. A study done by Taksande *et al*. showed a reasonably high prevalence of 5.75% of HTN in rural India.

ISSN 2515-8260 Volume 09, Issue 02, 2022

Which contradict with the thought that prevalence of HTN was less in rural India as compared to urban India due to their life style. Interference of this type may be due to fast urbanization of rural areas in India which hampers the level of physical fitness, dietary culture and increases the social pressure of life [19].

Out of 600 subjects 343(57.2%) were males and 257 (42.8%) were females. Hence there was preponderance of males in our study. In this study, prevalence of EBP was found to be more among the males (N= 57 subjects with 16.6%) whereas prevalence of stage 1 and 2 of hypertension was found to be more among females (N= 19 subjects with 7.4% and N=4 subjects with 1.6% respectively). Nirav Buch *et al*. in their study reported that prevalence of hypertension in males was 6.74% and in females was 6.13% [16]. Hakim IS *et al*. in their study revealed similar findings that is the prevalence of HTN was found to be less among females than males about 3.3% in males and 2.9% in females [17]. Prabhajot *et al*. found the prevalence of hypertension to be8.3% in males and 6.52% in females in Amritsar, Punjab [20]. Male preponderance was seen in present study as well as in Nirav Buch *et al*., Hakim IS and Prabhajot *et al's* studies [16, 17, 20].

Subjects having age group of 10-12, 13-15 and 16-17 years were 14%, 40.67% and 45.33% respectively in our study. In elevated blood pressure group the majority of subjects come under 16-17yr age group (45 subjects with 16.54%). In stage 1 hypertension group, the majority of subjects come under 16-17yr age group (13 subjects with 4.78%). In stage 2 hypertension group, the majority of subjects come under 16-17yr age group, 3 subjects out of 6 subjects (1.10%). Therefore the chances of hypertension are more with increase in the age. Such increase in prevalence and mean BP due to increase in age may be due to increase in body mass. Similarly, Hakim IS *et al*. in their study found that the prevalence of hypertension increased with increasing age in females as well as males [17]. Nirav Buch *et al*. in their study reported that prevalence of hypertension increases with age [16]. Studies from Turkey by Irgil E *et al*. and Zambia by Lascaux-Lefebvre V *et al*. on school children showed rise of BP with age. Soundarssanane MB *et al*. from India also gives same opinion of increase in hypertension with increase in age [21, 22, 23].

Whereas in Bilal *et al*. study conducted in Karachi, Pakistan on children in outpatient department of a tertiary care hospital. Demonstrated that, those children between 4 to 7 years of age had a high prevalence of HTN (19.2%; 9.2% stage 1 and 10.0% stage 2) as compared to children aged between 8 to 12 years (14.5%; 8.0% stage 1 and 6.5% stage 2) [15].

Family history of hypertension was reported among 60(10%) subjects, family history of diabetes mellitus was 3.17% and history of both hypertension and diabetes mellitus was 1.83%. The prevalence of EBP, stage 1 & 2 hypertension was maximum in children with history of familial hypertension which accounts for 35%, 21.7% and 3.3% of the subjects respectively with statistically significant difference as $p<0.05$. The prevalence of EBP, stage 1 & 2 hypertension was least in children with history of familial diabetes mellitus out of all other studied risk factors which accounts for 21.05% and 10.53% of the subjects respectively.

Nirav Buch *et al*. in their study found that prevalence of hypertension in family members of pre hypertensives was 18.6% and in normotensive was 13.1% [16]. Nihaz K. Naha *et al*. in their study found that prevalence of hypertension in children with family history of hypertension was high and statistically significant [13]. Family history of hypertension was significant risk factor for HTN as evident in many studies like Zambian study done by Lascaux-Lefebvre V *et al*., which showed parental history before age of 60 years was related to offspring hypertension [22]. Studies from India and Pakistan like Verma *et al*., Soundarssanance *et al*., Gupta *et al*. and Bilal *et al*. have also reported similar observations [23, 24, 25].

Subjects were equally distributed in urban and rural area with 302 (50.3%) and 298 (49.7%) respectively, however maximum no. of males lies under rural and females under urban area with 207 subjects (60.35%) and 166 (64.59%) respectively. Prevalence of EBP and stage 1 hypertension was higher in urban population (17.2% and 5.3% respectively) as compared to rural population with statistically significant difference. Stage 2 hypertension was almost equal in both population in our study.

Naha NK *et al*. in their study revealed that prevalence of hypertension was 1.05% in rural school children while it was 7.52% in children from urban school. The prevalence of combined hypertension and pre-hypertension was 2.89% in rural area and 16.2% in urban area. This was highly statistically significant with p value<0.05. These findings are similar to our study [13].

Prevalence of EBP, stage 1 & 2 hypertension were maximum in obese category which accounts for

ISSN 2515-8260 Volume 09, Issue 02, 2022

38.6%, 13.63%, 6.8% followed by overweight 24%, 11.25%, 2.5% of the subjects respectively. BMI categories shows significant association with hypertension in our study as $p<0.05$.

Sandvik l *et al*. in Norwegian and Paffenbarger RS Jr, *et al*. in Taiwan demonstrated statistically significant association of high BMI with hypertension which showed same results [25, 26]. The Framingham study which was done by Dannenberg AL *et al*. also showed increased prevalence of obesity in subjects with hypertension as well increase in BP in established obesity [27].

Many studies from India had similar observations, like Sharma *et al*., observed that Elevated blood pressures were significantly higher among those with high BMI [14]. Similar observations were also reported by Torok E *et al*. in Hungary among adolescent population and Aullen JP *et al*. done a study in France which also stated that Half the cases of high blood pressure in children and adolescents improved on losing weight [28, 29]. Such similar association in early childhood with SBP was reported by Hardy *et al*. in British birth cohort [30].

Andriska *et al*. in Hungary found 41% of their hypertensive children were obese, so they concluded that obesity plays very important role in development of childhood hypertension [31]. Nirav Buch *et al*. in their study reported significant rise of hypertension with obesity in both sex groups, around 30% of obese children had hypertension [16].

Limitations of our study is that our study may not reveal the exact prevalence of hypertensive of the community. A large sample size could provide a better idea of prevalence of HTN in community. It is a single observer study. Factors like physical activity, dietary habits and salt intake were not observed in our study. These areas are further open for research.

Merits of our study is that no recent study has been conducted according to the new guidelines of American Academy Pediatrics 2017 on measurement of BP in pediatric population in India and very few studies has been conducted worldwide.

Conclusion

This study revealed that prevalence of hypertension and elevated blood pressure was found significantly high in obese and overweight children. Children with family history of hypertension and diabetes mellitus have high incidence of EBP and hypertension. Modification in lifestyle in urban areas like unhealthy dietary habits, decrease in physical activities, sedentary pursuits and technology dependency are the major culprits for increasing trend of hypertension in urban region.

References

1. Booth J. A short history of blood pressure measurement. Proc. Royal Soc. Med. 1977;70(11):793-9.
2. National Heart, Lung and Blood Institute's Task Force on Blood Pressure Control in Children. Report of the Task Force on Blood Pressure Control in Children. Pediatrics, 1977, 797-820.
3. Kulkarni MM, Varun N, Rathi P, Eshwari K, Ashok K, Kamath VG. Health status of school children in rural area of coastal Karnataka. Med J DY Patil Univ. 2016;9:31-5.
4. Munter P, He J, Cutler JA, Wildman RP, Whelton BK. Trends in blood pressure among children and adolescents. JAMA. 2004;291:2107-13.
5. Zinner SH, Rosner B, Oh W, Kass EH. Significance of blood pressure in infancy: familial aggregation and predictive effect on later blood pressure. Hypertension. 1985;7:411-6.
6. Sinaiko AR. Hypertension in children. N Engl. J Med. 1996;335(26):1968-73.
7. Patel N, Walker N. Clinical assessment of hypertension in children. Clinical hypertension. 2016;22(1):1-4.
8. 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; 6:647-53.
9. Din-Dzietham R, Liu Y, Bielo MV, Shamsa F. High blood pressure trends in children and adolescents in national surveys, 1963 to 2002. Circulation. 2007;116:1488-1496.
10. Hansen ML, Gunn PW, Kaelber DC. Under diagnosis of hypertension in children and adolescents.

JAMA. 2007;298:874-879.
11. Cheung EL, Bell CS, Samuel JP, Poffenbarger T, Redwine KM, Samuels JA. Race and obesity in adolescent hypertension. Pediatrics. 2017;139:e2016-1433.
12. Flynn JT, Kaelber DC, Baker-Smith CM, *et al*. Subcommittee on Screening and Management of High Blood Pressure in Children. Clinical practice guideline for screening and management of high blood pressure in children and adolescents. Pediatrics. 2017;140:e2017-1904.
13. Naha NK, John M, Cherian VJ. Prevalence of hypertension and risk factors among school children in Kerala, India. Int. J Contemp Pediatr. 2016;3:931-8.
14. Sharma A, Grover N, Kaushik S, Bhardwaj R, Sankhyan N. Prevalence of hypertension among schoolchildren in Shimla. Indian Pediatr. 2010;47(10):873-6.
15. Bilal M, Haseeb A, Saeed A, Saeed, A Ghaffar P. Prevalence and Risk Factors of Hypertension Among Children Attending Out Patient Department of a Tertiary Care Hospital in Karachi. Cureus 2020;12(5):e79-57.
16. 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.
17. Hakim IS, Vinod S, Ravi G, Lokesh CG, Virbhan B, Padmawati S, *et al*. Study of prevalence of hypertension in school going children in urban Delhi: A cross sectional study. Epidemol. Int. J 2018;2(1):1-6.
18. 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. 1999;51(2):178-182.
19. 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 Pediatr. Card. 2008;1(2):101-106.
20. Prabhjot A, Kaur N, Kumari K, Sidhu S. Variation in blood pressure among school children of Amritsar (Punjab). Anthropologist. 2005;7(3):201-204.
21. Irgil E, Erkenci Y, Ayetekin N, Ayetekin H. prevalence of hypertension in School children aged 13-18 yrs in Gemlike, Turkey. Euro J Public Health. 1998;40:176-8.
22. Lascaux-Lefebvre V, Ruidavets J, Arveiler D. Influence of parental history of hypertension on blood pressure. J Hum Hypertens. 1999;3:631-6.
23. Soudarssanane M, Mathanraj S, Sumanth M, Sahai A, Karthigeyan M. Tracking of blood pressure among adolescents and young adults in an urban Slum of Puducherry. Indian J Community Med. 2008;33:107-12.
24. Gupta-Malhotra M, Banker A, Shete S, Hashmi SS, Tyson JE, Barratt MS *et al*. Essential hypertension vs. secondary hypertension among children. Am J Hypertens. 2015;28(1):73-80.
25. Sandvik L, Erikssen J, Thaulow E, Erikssen G, Mundal R, Rodahl K. Physical fitness as predictor of mortality among healthy, middle-aged Norwegian men. N Engl. J Med. 1993;328:533-7.
26. Paffenbarger RS Jr, Hyde RT, Wing AL, Lee IM, Jung DL, Kampert JB. The association of physical activity level and other life style characteristics with mortality among men. N Engl. J Med 1993;328:538-45.
27. Dannenberg AL, Garrison RJ, Kennel WB. Incidence of hypertension in the Framingham study. Am J Public Health. 1998;78:676-9.
28. Torok E, Gyrafas I, Csukas M. Factors associated with stable high blood Pressure in adolescents. J Hypertens. 1985;3(3):389-90.
29. Aullen JP. Obesity, hypertension and their relationship in children and adolescents. An epidemiological study in schools (Authors transl). Sem Hop. 1978;54:637-43.
30. Hardy R, Wadsworth ME, Langenberg C, Kuh D. Birth weight, childhood growth and blood pressure at 43 yrs in a British birth cohort. Int. J Epidemiol. 2004;33:121-9.
31. Andriska J, Gombik M, Breyer H, Tarr A. Hypertension in children and adolescents. Results of a long term follow up study 1975-1985. Clin. Exp. Hypertens A. 1986;8:567-9.