

## ORIGINAL ARTICLE

# Prevalence of Hypertension among Overweight and Obese Children of 10–18 Years in Urban Areas of Miraj

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## ABSTRACT

**Background:** Hypertension (HTN) in children and adolescents is also a major health problem that is overlooked by physicians. It is well-established that overweight and childhood obesity are in strong correlation with primary HTN in children. Hence, history and physical examination on regular bases is needed for all children with HTN with or without obesity to rule out underlying secondary causes. **Objective:** The objective of the study was to estimate the prevalence of HTN among obese and overweight children aged 10–18 years. **Methodology:** A cross-sectional comparative study was done in ten schools of Miraj city by Systematic sampling among overweight and obese children aged 10–18 years for a period of 1 year. Overweight is defined as body mass index (BMI) >85<sup>th</sup> percentile, and obese (BMI >95<sup>th</sup> percentile) children. Children with congenital heart diseases, k/c/o cardiac disease, and taking medications which affect cardiac function were excluded from the study. A total sample size of 180 subjects was included and was evaluated for HTN. **Results:** In our study, 66.7% were overweight and 33.3% were obese. The prevalence of HTN in overweight and obese children is 7.8%. Among 14 subjects with HTN, 14.3% were overweight and 85.7% were obese. In our study, among those with overweight, 1.7% had HTN and among obese subjects, 20% had HTN. There was significant difference in the prevalence of HTN between overweight and obese subjects. In our study, among hypertensive children, 85.7% were females and 14.3% were males. Among normotensive subjects, 54.2% were females and 45.8% were males. **Conclusion:** From our study, it can be concluded that overweight and obesity are important risk factors for HTN among children aged b/w 10–18 years. With increase in weight, prevalence of HTN was also increased among children. Females had higher prevalence of obesity and HTN in the present study.

**Key words:** Body mass index, hypertension, obese, overweight, school

## INTRODUCTION

The prevalence of overweight children as well as obese children is increasing globally. Of late, complications of obesity among adult population are well studied.<sup>[1]</sup> Occasionally, obesity in adult population dates back to childhood and adolescence in its origin. By probing into some early clinical variables of obese children can help us in early diagnosis of upcoming complications in adulthood.<sup>[2]</sup> Investigating obese children with or without hypertension (HTN) may disclose some unknown facts of obesity, which helps in preventing unfavorable outcomes in

the near future. For cardiovascular, mortality and morbidity obesity is strong risk factor. In addition, obesity is also a strong risk for many of metabolic abnormalities such as dyslipidemia, insulin resistance, hyperglycemia, and HTN. Very less is known about the reversibility of preclinical cardiac abnormalities in obese children after weight reduction by exercise and diet.<sup>[3,4]</sup>

HTN in children and adolescents is also a major health problem that is overlooked by physicians. It is well established that overweight and childhood obesity are in strong correlation

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with primary HTN in children. Hence, history and physical examination on regular bases is needed for all children with HTN with or without obesity to rule out underlying secondary causes. Children as well as adolescents with HTN should also be checked for other risk factors for cardiovascular diseases, such as dyslipidemia and diabetes mellitus.

### Need for the Study

Childhood obesity is usually associated various cardiovascular structure and function abnormalities, HTN is the most common cardiovascular morbidity, and can be detected far before the symptoms appear, if this HTN is associated with overweight or obesity these people may develop significant increase in the cardiovascular sequelae soon. Hence, this study was conducted with the aim to determine prevalence of HTN among obese and overweight children.

### Objectives

The objectives are as follows:

1. To estimate prevalence of HTN among obese and overweight children aged 10–18 year
2. To find association of HTN with overweight and obese children
3. To find the association of gender with HTN.

### MATERIALS AND METHODS

A cross-sectional comparative study was done in ten schools of Miraj city by Systematic sampling among overweight and obese children aged 10–18 years for a period of 1 year. Overweight is defined as body mass index (BMI) >85<sup>th</sup> percentile, and obese (BMI >95<sup>th</sup> percentile) children. Children with congenital heart diseases, k/c/o cardiac disease, and taking medications which affect cardiac function were excluded from the study. Sample size was estimated using the prevalence of overweight among children in the age group of 10–16 years as 11.9% from the study by Adinatesh and Prashant.<sup>[5]</sup> Using the formula  $n = Z^2 p (1-p)/d^2$ ,  $p = 11.9$ ,  $q = 88.1$ ,  $d = 5\%$ . Using the above values at 95% confidence level, a sample size of 162 obese and overweight school children was obtained, considering 10% nonresponse rate total sample size of 180 subjects was included and was evaluated for HTN.

### Data Collection Technique and Tools

Ethical clearance was obtained by the Institutional Ethical Committee before starting our study. Written informed assent was taken from all the children and informed consent from parents before starting study. Study was done in schools of Miraj city, ten schools were selected by systematic sampling. Questionnaire was given to children to collect the data. Anthropometric measurements such as height and weight

were measured by standard methods. Standing height was measured using Stadiometer. Electronic weighing scale was used to measure weight. BMI was estimated as weight (in kilograms) divided by height (in meters) squared ( $\text{kg}/\text{m}^2$ ).

Classification of overweight and obesity by BMI among children

BMI-for-age weight status categories and the corresponding percentiles	
Weight status category	Percentile range
Underweight	Less than the 5 <sup>th</sup> percentile
Normal or healthy weight	5 <sup>th</sup> percentile to less than the 85 <sup>th</sup> percentile
Overweight	85 <sup>th</sup> to less than the 95 <sup>th</sup> percentile
Obese	95 <sup>th</sup> percentile or greater

### Blood Pressure (BP)<sup>[6]</sup>

Systolic BP (SBP) and diastolic BP (DBP) using a mercury sphygmomanometer with standard cuff size. Standard cuff: 12 cm width (for Mid Arm Circumference (MAC) <32 cm). The Korotkoff technique is used to measure BP. Done by brachial artery being occluded by cuff that is placed around the upper arm and cuff is inflated above systolic pressure. The beginning of Phase I correspond to systolic pressure, the disappearance of the sound (i.e., Phase V) corresponds to diastolic pressure.

### Statistical Analysis<sup>[7-10]</sup>

Data were entered into Microsoft Excel data sheet and were analyzed using SPSS 22 version software. Categorical data were represented in a form of frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data were represented as mean and standard deviation. Independent *t*-test/Mann–Whitney U-test was used as test of significance to identify mean difference between two quantitative variables.  $P < 0.05$  was considered as statistically significant after assuming all the rules of statistical tests.

### RESULTS

In our study, 66.7% were overweight and 33.3% were obese. The prevalence of HTN in overweight and obese children is 7.8%. Among 14 subjects with HTN, 14.3% were overweight and 85.7% were obese [Table 1].

In our study, among those with overweight, 1.7% had HTN and among obese subjects, 20% had HTN. There was significant difference in the prevalence of HTN between overweight and obese subjects [Table 2].

In our study, there was no significant difference in mean age, heart rate (HR), DBP between overweight and obese subjects. Mean SBP among overweight children was  $124.64 \pm 5.64$  mmhg and among obese children was  $128.2 \pm 6.3$ . There was

significant difference in mean SBP between overweight and obese children [Table 3].

In our study, there was significant difference in mean height, weight, BMI, DBP, and SBP between hypertensive and normotensive children. There was no significant difference in mean age and HR between hypertensive and normotensive children [Table 4].

In our study, among hypertensive children, 85.7% were females and 14.3% were males. Among normotensive subjects, 54.2% were females and 45.8% were males. There was significant association between gender and HTN [Table 5].

**DISCUSSION**

Overweight or obesity has now become highly prevalent at developed countries and it is rapidly reaching its epidemic proportions in the developing countries as well. Obesity related disorders, such as diabetes and HTN, are also increasing at alarming rate in developing countries. From the study done by Whitaker *et al.*, obese children below 3 years of age group without the obese parents are at lower risk for obesity among adulthood, but among older children, childhood obesity is an important predictor of the adult obesity, and regardless of whether parents these children are obese or not.<sup>[11]</sup>

In the present study, the prevalence of HTN in overweight and obese children is 7.8%. Among 14 subjects with HTN, 14.3% were overweight and 85.7% were obese. Yadav *et al.*<sup>[12]</sup> observed that the prevalence of HTN among overweight and obese children was 12.5% and 42.85%, respectively, similarly Menghetti *et al.*<sup>[13]</sup> observed the prevalence of HTN among overweight and obese children was 21.9% and 42.3%, respectively. The analysis of data from NHANES surveys between 1999 and 2008 demonstrated that 14% of adolescents aged 12–19 years had either prehypertension or HTN.<sup>[14]</sup> A study conducted among schools at United States, the prevalence of HTN increased significantly as the BMI increased from ≤5<sup>th</sup> percentile (2%) to ≥95<sup>th</sup> percentile (11%).<sup>[15]</sup> Seven hundred and sixty-one school children were studied at Oklahoma, United States, in that, almost 28% were having childhood obesity and 18% had their BPs >90<sup>th</sup> percentile on their first test and among those 2.8% had persistently elevated BP after three subsequent tests. BMI ≥85<sup>th</sup> percentile (i.e., overweight) was significantly associated with HTN compared to normal weight children.<sup>[16]</sup> This trend is also observed in other parts of world. The incidence of HTN was almost 25% and pre-hypertension 34.7% among obese children at one endocrinology referral center in India.<sup>[17]</sup> Menghetti *et al.*<sup>[13]</sup> in 2015, at a pediatric primary healthcare in Italy noted about 35% of children to be overweight or obese and also incidence of prehypertension and HTN was 7.1% in normal weight, 21.9% in overweight, and 42.3% in obese. Among Chinese adolescents, higher incidence of HTN was associated among higher BMI percentiles. Non-obese adolescents had <5% incidence of HTN whereas among those with BMI >95<sup>th</sup> percentile.<sup>[18]</sup>

In the present study, among hypertensive children 85.7% were females and 14.3% were males, Study conducted by Yadav *et al.*,<sup>[12]</sup> among hypertensive 55.5% were males and 44.4% were females. Similar results were obtained among Chinese adolescents by Dong *et al.*, approximately 20% males and 12% females had HTN.<sup>[19]</sup>

In the present study, among overweight children 58.3% were females and 41.7% were males and among obese 53.3% were females and 46.7% were males. Similar results were obtained

**Table 1: Prevalence of HTN among overweight and obese children**

Category of children	Count (n=180)	%
<b>Group</b>		
Overweight	120	66.7
Obese	60	33.3
<b>BP</b>		
HTN	14	7.8
Normotensive	166	92.2
<b>HTN</b>		
Overweight with HTN	2	14.3
Obesity with HTN	12	85.7

BP: Blood pressure, HTN: Hypertension

**Table 2: Association between overweight, obesity with gender and HTN**

Gender and Hypertension	Group						χ <sup>2</sup> , df, P-value
	Overweight (n=120)		Obese (n=60)		Total (n=180)		
	Count	%	Count	%	Count	%	
<b>Gender</b>							
Female	70	58.3	32	53.3	102	56.7	
Male	50	41.7	28	46.7	78	43.3	
<b>HTN group</b>							
HTN	2	1.7	12	20	14	7.8	18.74, 1, <0.001*
Normotensive	118	98.3	48	80	166	92.2	

HTN: Hypertension

**Table 3:** Comparison of profile of children with respect to overweight and obese children

Profile of children	Group				P-value
	Overweight		Obese		
	Mean	SD	Mean	SD	
Age	13.5	2.96	13.3	2.78	0.662
HR	87.90	5.83	87.36	5.63	0.554
DBP	75.46	4.68	74.78	4.56	0.355
SBP	124.64	5.64	128.2	6.3	0.001*

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HR: Heart rate

**Table 4:** Comparison of profile of children with respect to hypertensives and normotensive children

Profile of children	HTN group				P-value
	HTN (n=14)		Normotensive (n=166)		
	Mean	SD	Mean	SD	
Age	14.68	2.32	13.62	2.78	0.167
Height	157.00	5.62	147.88	9.21	<0.001*
Weight	65.38	5.14	50.89	9.02	<0.001*
BMI	26.49	0.87	23.07	1.86	<0.001*
HR	77.38	4.95	77.72	4.75	0.674
DBP	88.4	2.72	76.8	3.76	<0.001*
SBP	132.46	2.86	118.42	4.56	<0.001*

BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HR: Heart rate, HTN: Hypertension

**Table 5:** Association between gender and HTN among children

Sex	HTN			
	HTN		Normotensive	
	Count	%	Count	%
Female	12	85.7	90	54.2
Male	2	14.3	76	45.8
Total	14	100	166	100

 $\chi^2=5.216$ ,  $df=1$ ,  $P=0.022^*$ . HTN: Hypertension

by study done by Lemamsha *et al.* (2019), which showed incidence of overweight and obesity is more in females than males.<sup>[20]</sup> Whereas in study conducted by Kalpana and Lakshmi, in their study done in Coimbatore city observed that incidence of overweight among males of 10–12 years was 28% and the percentage of obesity was 31.9%. The percentage of overweight and obesity was 23.2 and 24.8, respectively, among females of 10–12 years. The findings revealed that incidence of overweight as well as obesity was higher among males than females.<sup>[21]</sup>

In the present study, the prevalence of HTN among overweight was 1.7% and among obese children was 20% which was statistically significant. A study conducted by Yadav *et al.* showed that 12.5% of overweight were hypertensive and 42.85% of obese were hypertensive.<sup>[12]</sup> Children with obesity

are more at risk for the cardiovascular disease (CVD) and they have higher BP and are at greater risk of dyslipidemia as well as insulin resistance.<sup>[22]</sup> In fact, 70% of childhood obesity have at least 1 of CVD risk factor, and 39% of these have two or more CVD risk factors.<sup>[23]</sup> The CVD risk factors, along with childhood obesity, are not only associated along cardiac diseases in childhood (such as atherosclerosis and left ventricular hypertrophy) but are also associated with an increased incidence of CVD risk factors in adulthood resulting in increased morbidity and mortality among these children.<sup>[24-28]</sup>

## CONCLUSION

From the study, it can be concluded that overweight and obesity are important risk factors for HTN among children aged b/w 10–18 years. With increase in weight, prevalence of HTN was also increased among children. Females had higher prevalence of obesity and HTN in the present study.

## Recommendations

1. Study recommends for screening of overweight and obese children for HTN for habitual basis
2. Study also recommends for prevention of overweight and obesity among children by regular physical exercise, increased outdoor sports activities, avoiding junk foods, and others preventive aspects.

## Limitations

1. Sampling errors cannot be ruled out, during the sampling, students who were absent were not included in the study, which may have led to selection bias
2. Errors of measuring weight, height, and BP cannot be ruled as it carries, instrumental errors, observer variations, and other factors such as anxiety among children
3. In our study, normal BMI children were not included; hence, the results obtained are exclusively for children who are overweight and obese.

## REFERENCES

1. Zeybek C, Celebi A, Aktuglu-Zeybek C, Onal H, Yalcin Y, Erdem A, *et al.* The effect of low-carbohydrate diet on left ventricular diastolic function in obese children. *Pediatr Int* 2010;52:218-23.
2. Gnani R, Spagnoli TD, Galotto C, Pugliese E, Carta A, Cesari L, *et al.* Socioeconomic status, overweight and obesity in prepubertal children: A study in an area of Northern Italy. *Eur J Epidemiol* 2000;16:797-803.
3. Hennekens CH, Schneider WR, Barice EJ. Obesity in childhood: Introduction and general considerations. *Pediatr Res* 2007;61:634-5.
4. Aggoun Y. Obesity, metabolic syndrome, and cardiovascular disease. *Pediatr Res* 2007;61:653-9.



5. Adinatesh KV, Prashant RK. A study of prevalence of childhood obesity among school children in Karimnagar town. *MRIMS J Health Sci* 2013;1:8-11.
6. Low PA, Opfer-Gehrking TL, McPhee BR, Fealey RD, Benarroch EE, Willner CL, *et al.* Prospective evaluation of clinical characteristics of orthostatic hypotension. *Mayo Clin Proc* 1995;70:617-22.
7. Gaddis ML, Gaddis GM. Introduction to biostatistics: Part 4, statistical inference techniques in hypothesis testing. *Ann Emerg Med* 1990;19:820-5.
8. Patra P. Sample size in clinical research, the number we need. *Int J Med Sci Public Health* 2012;1:5-9.
9. Sunder Rao PS, Richard J. An introduction to biostatistics. In: *A Manual for Students in Health Sciences*. 4<sup>th</sup> ed. New Delhi: Prentice Hall of India; 2006. p. 86-160.
10. Elenbaas RM, Elenbaas JK, Cuddy PG. Evaluating the medical literature, Part II: Statistical analysis. *Ann Emerg Med* 1983;12:610-20.
11. Lu X, Shi P, Luo CY, Zhou YF, Yu HT, Guo CY, *et al.* Prevalence of hypertension in overweight and obese children from a large school-based population in Shanghai, China. *BMC Public Health* 2013;13:24.
12. Yadav PKS, Yadav MB, Yadav C. Prevalence of overweight, obesity and hypertension among school going children in District Kanpur, Uttar Pradesh, India: A longitudinal study. *Int J Contemp Pediatr* 2019;6:159-62.
13. Menghetti E, Strisciuglio P, Spagnolo A, Carletti M, Paciotti G, Muzzi G, *et al.* Hypertension and obesity in Italian school children: The role of diet, lifestyle and family history. *Nutr Metab Cardiovasc Dis* 2015;25:602-7.
14. May AL, Kuklina EV, Yoon PW. Prevalence of cardiovascular disease risk factors among US adolescents, 1999-2008. *Pediatrics* 2012;129:1035-41.
15. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ. Overweight, ethnicity, and the prevalence of hypertension in school-aged children. *Pediatrics* 2004;113:475-82.
16. Moore WE, Stephens A, Wilson T, Wilson W, Eichner JE. Body mass index and blood pressure screening in a rural public school system: The healthy kids project. *Prev Chronic Dis* 2006;3:A114.
17. Phatale P, Phatale H. Prevalence of pre-diabetes, diabetes, pre-hypertension, and hypertension in children weighing more than normal. *Indian J Endocrinol Metab* 2012;16:S483-5.
18. Cao ZQ, Zhu L, Zhang T, Wu L, Wang Y. Blood pressure and obesity among adolescents: A school-based population study in China. *Am J Hypertens* 2012;25:576-82.
19. Dong Y, Jan C, Zou Z, Dong B, Wang Z, Yang Z, *et al.* Effect of overweight and obesity on high blood pressure in Chinese children and adolescents. *Obesity (Silver Spring)* 2019;27:1503-12.
20. Lemamsha H, Randhawa G, Papadopoulos C. Prevalence of overweight and obesity among Libyan men and women. *BioMed Res Int* 2019;2019:16.
21. Kalpana CA, Lakshmi UK. Prevalence of overweight/obesity among school children in Coimbatore city, Tamil Nadu. *Int J Curr Res* 2011;3:12-6.
22. Friedemann C, Heneghan C, Mahtani K, Thompson M, Perera R, Ward AM. Cardiovascular disease risk in healthy children and its association with body mass index: Systematic review and meta-analysis. *BMJ* 2012;345:e4759.
23. Freedman DS, Mei Z, Srinivasan SR, Berenson GS, Dietz WH. Cardiovascular risk factors and excess adiposity among overweight children and adolescents: The Bogalusa heart study. *J Pediatr* 2007;150:12-7.
24. Berenson GS, Srinivasan SR, Bao W, Newman WP III, Tracy RE, Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. The Bogalusa heart study. *N Engl J Med* 1998;338:1650-6.
25. Morrison JA, Friedman LA, Gray-McGuire C. Metabolic syndrome in childhood predicts adult cardiovascular disease 25 years later: The Princeton lipid research clinics follow-up study. *Pediatrics* 2007;120:340-5.
26. Strong JP, Malcom GT, McMahan CA, Tracy RE, Newman WP III, Herderick EE, *et al.* Prevalence and extent of atherosclerosis in adolescents and young adults: Implications for prevention from the pathobiological determinants of atherosclerosis in youth study. *JAMA* 1999;281:727-35.
27. Brady TM, Fivush B, Flynn JT, Parekh R. Ability of blood pressure to predict left ventricular hypertrophy in children with primary hypertension. *J Pediatr* 2008;152:73-8.
28. Brady TM, Appel LJ, Holmes KW, Fivush B, Miller ER III. Association between adiposity and left ventricular mass in children with hypertension. *J Clin Hypertens (Greenwich)* 2016;18:625-33.