International Journal of Contemporary Pediatrics
Kamble MB et al. Int J Contemp Pediatr. 2018 Nov;5(6):2326-2332
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20184305

Original Research Article

A comparative study of hypertension and obesity with reference to risk factors in school children aged 6-12 years in urban and rural area

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Received: 02 September 2018
Accepted: 27 September 2018

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ABSTRACT

Background: Childhood obesity and hypertension are on the rise and limited data are available regarding the profile of childhood obesity and hypertension from India. We studied the prevalence of childhood obesity and hypertension in a representative sample of school children to find out the relationship between obesity and hypertension in study population.
Methods: This prospective, cross-sectional, observational study was conducted in Department of Pediatrics, Shri Vasantrao Naik Government Medical College, Yavatmal, Maharashtra, India and data were collected from urban and rural primary schools of Yavatmal from 1489 children between ages 6-12years, selected randomly. Anthropometric measurements were taken to calculate BMI and blood pressure was taken. Data was analyzed using CDC guidelines and statistically using contingency coefficient. Overweight and obesity were defined by body mass index for gender and age. Gender, age and height were considered for determining hypertension. The hypertensive children were followed up at 3 monthly intervals, 3 times, to look for persistent hypertension.
Results: Amongst the 1489 children, prevalence of hypertension was 4.49% and that of pre-hypertension was 1.47% and that of overweight was 1.74% and obese was 0.87%. In girls and boys both, increasing BMI was associated significantly ($p<0.0001$) with average SBP and average DBP in both pre-hypertension and hypertension groups in rural and urban areas. A higher prevalence of pre-hypertension and hypertension seen in the present study group compared to similar studies in the state. Children with higher BMI were associated with pre-hypertension or hypertension.
Conclusions: Prevalence of sustained hypertension overweight and obesity is on rise in children in this part of world. Possible related factors for this current trend may be the increasing sedentary life style, altered eating habits, and increased fat content of diet. The result suggests the need for more public awareness and prevention programs for childhood obesity and hypertension.

Keywords: Blood pressure, BMI, Hypertension, Obesity, School children, Urban/rural comparison

INTRODUCTION

The World Health Organization (WHO) defines obesity as a global epidemic.[1] It is evident that obesity in children is a risk factor for later coronary diseases. Childhood obesity and hypertension are not confined to industrialized countries, as high rates are already evident in some developing nations.[1] In reality, secondary hypertension resulting from renal disease which was thought earlier to be the most common cause of hypertension in children has become far less common than primary (i.e. essential) hypertension.Obesity has become an increasingly important medical problem in children and adolescents. Many of the outcomes associated with obesity that were previously thought of as diseases of adults are now affecting children as well. Obesity is also the most common nutritional problem among children in developed countries. This epidemic of paediatric obesity has resulted in great concern regarding the management of obesity and its complications as hypertension and obesity goes hand in hand.[2]

Even though there are many studies from developed countries and also from India, but there is scarcity of data from Central India. Hence, this study is taken up to evaluate the prevalence of hypertension, obesity and other related risk factors among school going children of Yavatmal district in Maharashtra which can lead to early detection, modifying the risk factors and preventing them from developing complications and thereby reducing the morbidity and mortality. This study will form a basic data which will help to design suitable school-based programme of physical activity and nutritional education in reducing obesity and hypertension.

Aims and objectives

- To find out the prevalence of hypertension in school children aged 6-12 years in Urban and Rural area.
- To find out the prevalence of obesity in school children aged 6-12 years in Urban and Rural area.
- To study the association between hypertension and obesity.
- To study other risk factors for hypertension and obesity.

METHODS

In this study, data regarding the list of Schools was collected from education office of the Yavatmal district. A mapping of different schools in the Tehsil was done. All village schools and urban schools in the Tehsil were visited. Permission regarding conduct of this study was taken from the District education officer and Principal of each school. Those schools who gave permission to conduct this study were selected. There were total of 10 such schools, 5 urban and 5 rural, who gave permission. From these selected schools, final samples were selected. A detailed history regarding age, sex, family history of obesity and hypertension, socio economic status was taken using pretested pro-forma.

A total of three visits were done in the same schools which are previously being selected, at interval of 3 months between the visits. Height and weight of each child was recorded by the principal investigator. Height was measured in centimetres by using stadio-meter with child standing upright barefoot on ground with heels, buttocks touching wall and head in Frankfurt plane. Height percentile for each child was calculated using the CDC growth charts. A calibrated and standardized mechanical weighing scale was used to measure weight in kilograms. BMI was calculated using the formula BMI=weight in kgs/(height in metres)^2. A child was classified according to NCHS guidelines as overweight with BMI for age between 85th and 95th percentiles and as obese with BMI for age at or above the 95th percentile.[3-6] Before recording the blood pressure, children in groups of 10 were taken to a separate room away from noise, and they were explained in detail, the procedure of blood pressure recording and they were reassured that the procedure is neither painful, nor harmful.

Blood pressure was recorded by the principal investigator as per recommendations of Fourth report by Task force on diagnosis, evaluation and treatment of high blood pressure in children and adolescents.[7-9]

Blood pressure was recorded using mercury sphygmomanometer and cuff size of approximately 40% of arm circumference tied midway between the olecranon and acromion process.[8,10]

After giving rest for 5-10 minutes blood pressure was recorded in sitting position with his/her back supported, feet on the floor and right arm supported with cubital fossa at heart level. Right arm was used for consistency and for comparison with standard tables and because of the possibility of coarctation of the aorta, which might lead to false (low) readings in the left arm. Blood pressure recordings were expressed to the nearest 2 mm Hg. Two blood pressure recordings were taken from each child at 0 and 30 minutes using auscultatory method. Efforts were made to eliminate factors which affect BP like anxiety, crying, exercise etc.

Average of three consecutive readings taken at 2 minutes interval was taken. All blood pressure recordings were taken on the same time of the day, i.e. during afternoon hours and recorded by the same person and by same instrument.

Systemic examination was done to exclude cardiovascular, renal and other diseases which could affect blood pressure Hypertension was diagnosed if average systolic and diastolic BP is > or = to 95th percentile for the age, sex and height. Pre-hypertension was diagnosed if average systolic and diaslolic BP is > or = to 90th and <95th percentile for age, sex, height.[8,10,11] Those found hypertensive and/or obese were investigated in the tertiary care hospital and evaluated further. The diagnosis of essential hypertension was made when the cause of hypertension is not found in a hypertensive child.

RESULTS

A total of 1489 school going children in the age group of 6-12 years were selected as study subjects from urban and rural schools. The prevalence of hypertension was 5.96% and that of obesity was 0.87% Table 1 shows the prevalence of hypertension in school going children was found to be 5.96% of which pre-hypertensive students were 1.47% and hypertensive were 4.49%.

Table 1: Prevalence of prehypertension and hypertension in school children.

N=1489	Sbp	Sbp %	Dbp	Dbp %	Total
Prehypertensive	7	0.47	15	1.00	1.47%
Hypertensive	46	3.08	21	1.41	4.49%
Total	53	3.55	36	2.41	5.96%

Prevalence of Systolic and diastolic hypertension is found to be 3.55% and 2.41% respectively. Table 2 shows that, maximum prevalence of systolic hypertension was found in rural females (4.95%), while it was found to be lowest in urban females (2.91%). Similarly, maximum prevalence of diastolic hypertension was found in rural females (3.49%).

Table 2: Sex and area wise prevalence of prehypertension and hypertension.

N=1489	Urban male, N=398		Urban female N=377		Rural male N=371		Rural female N=343	
	Sbp	**Dbp**	**Sbp**	**Dbp**	**Sbp**	**Dbp**	**Sbp**	**Dbp**
Prehypertensive	1 (0.25%)	4 (1.00%)	2 (0.53%)	4 (1.06%)	2 (0.53%)	2 (0.53%)	2 (0.58%)	5 (1.45%)
Hypertensive	12 (3.01%)	6 (1.50%)	9 (2.38%)	4 (1.06%)	10 (2.69%)	4 (1.07%)	15 (4.37%)	7 (2.04%)
Total	13 (3.26%)	10 (2.50%)	11 (2.91%)	8 (2.12%)	12 (3.22%)	6 (1.60%)	17 (4.95%)	12 (3.49%)

Table 3: Overweight and obesity in school children.

N=1489	Urban male N=398	Urban female N=377	Rural male N=371	Rural female N=343	Total N=1489
Overweight	9	9	6	2	26
Total (%)	2.26	2.38	1.61	0.58	1.74
Obese	5	2	4	2	13
Total (%)	1.25	0.53	1.07	0.58	0.87

Table 4: Prevalence of hypertension and obesity in urban and rural school children.

N=1489	Urban N=775	Rural N=714
Hypertension (total)	24	29
Percent	3.09%	4.0%
Obesity (total)	7	6
Percent	0.90%	0.84%

Table 5: Risk factors with hypertension and obesity in the school children.

Risk factors n=1489	Urban		Rural		Total	P value	
	Male (398)	**Female (377)**	**Male (371)**	**Female (343)**		**HTN**	
						SBP	**DBP**
Family history							
Hypertension	4 (1.0%)	5 (1.32%)	5 (1.34%)	2 (0.58%)	16 (1.07%)	P=0.111	P=0.267
Diabetes mellitus	5 (1.25%)	3 (0.79%)	1 (0.26%)	2 (0.58%)	11 (0.73%)	P=0.815	P=0.868
Diet							
Vegeterian	377 (25.31%)	349 (23.43%)	354 (23.77%)	331 (22.22%)	1411 (94.76%)		
Mixed (veg+non-veg)	21 (1.41%)	28 (1.88%)	16 (1.07%)	12 (0.80%)	77 (5.17%)	P=0	P=0
Physical inactivity	5 (1.25%)	7 (1.85%)	6 (1.61%)	4 (1.16%)	22 (1.47%)		
LBW/IUGR	4 (1%)	0	0	1 (0.29%)	5 (0.033%)	P=0.912	P=0.938
Socioeconomic status						P=0.598	P=0.969
Medium	394	363	344	298	1399 (93.95%)		
Low	4 (1%)	14 (3.71%)	27 (7.27%)	45 (13.11%)	90 (6.04%)		
High	00	00	00	00	00		
Seasonal variation	00	00	00	00	00		
Sleep disorders	00	00	00	00	00		

Table 3 shows that in the study population, overweight and obese constituted 2.61%, out of which 1.74% were overweight and 0.87% were obese as per Body Mass Index calculations. It was further noticed that, obesity was maximum in males in urban area while that of overweight is maximum in females in urban area.

Table 4 depicts that the prevalence of hypertension is more in rural children, while obesity is almost the same in rural and urban children.

Table 6: Investigations and hypertension.

N=1489	Urban		Rural		Total
Investigations	Male	Female	Male	Female	
Urea	1	3	1	2	7
Creat	2	3	3	3	11
Cholesterol	0	0	2	0	2
Rbsl	0	0	0	0	0
CXR	0	0	0	0	0
ECG	0	0	0	0	0
Urine r/m	2	1	0	0	3

On analysis of the risk factors associated with hypertension, it was seen that the children consuming mixed diet have high chances of developing hypertension (Table 5). The p value = 0.00 is statistically significant. Similarly, the children who were physically inactive were found to develop hypertension. The p value =0.00 is statistically significant. Other risk factors associated with hypertension and obesity were family history of hypertension, family history of Diabetes mellitus, Low birth weight/Intrauterine growth restriction, socioeconomic status were also important but were not statistically significant. As per the observations from Table 6, the cause for hypertension was found to be renal in 21 cases, hypercholesterolemia in 2 cases, while in other 30 cases, no cause of hypertension was detected which probably were essential hypertension.

DISCUSSION

Hypertension

The prevalence of hypertension in present study was 5.96%. This is almost similar to that reported by Savitha et al (6.1%) and Sharma et al (5%).[12,13] The overall reported prevalence in the present study is equal to that by Taksande et al (5.75%), but they had studied only rural children whereas in the present study both urban and rural children were included.[14]But this figure of 5.96% is far lower than that by Sunder et al (21.5%) and Chandrashekhar et al (13.4%), probably because in these studies only urban population was considered as study subjects.[15,16]

Sex and hypertension

In the present study, the prevalence of hypertension amongst male was 3.25% and that amongst female was 3.88% (Table 2). In a study by Anjana et al, the prevalence of hypertension was 7.50% and 6.52% in males and females respectively, which is higher than the present study. These figures are higher as compared to the present study probably because they have taken children of affluent class of the state of Punjab.[17]

In the present study, hypertension was more in females (3.88%) as compared to males. In a study by Raj et al, girls showed higher values of blood pressure than boys. This preponderance is due to the fact that with the onset of sexual maturation there is increase in systolic and diastolic blood pressure.[18,19] The timing of sexual maturity is different for boys and girls, with the girls attaining it relatively earlier, hence in the study population of 6-12 years this sex difference might have occurred. In the present study, the prevalence of both systolic and diastolic hypertension was more in rural females which was 4.95% and 3.49% respectively. This is in correlation with the results by Raj et al, Kerala, which shows higher values of blood pressure in girls.[18]

Area and hypertension

The prevalence of hypertension amongst the rural and urban area was 4.0% and 3.09% respectively (Table 2). In a study done by Lakshmanudu et al, the mean SBP and DBP were elevated in rural children as compared to that of urban children.[20] Previously, it was thought that the prevalence of hypertension in children in rural India would be less due to their life style. However, the present study showed reasonably high prevalence of 4.0% in rural area. Taksande et al had found prevalence of hypertension in rural area to be 5.75% which is similar to this study.[14] According to Taksande et al, this is probably due to rapid urbanization of rural India which has altered the dietary habits, level of physical activity, and social pressures of life.

Systolic and diastolic hypertension

The prevalence of systolic and diastolic hypertension was found to be 3.55% and 2.41% respectively in this study. This correlates exactly with the study by Taksande et al who showed systolic and diastolic hypertension in 3.25% and 2.49% children respectively, except for the fact that he considered only rural population.[14]

Obesity

The overall prevalence of obesity was 0.87% in this study, which was much lower than that reported by, Dhingra et al (25%), Monga et al (8.2%).[21] This is probably because both of these studies were conducted in Metro cities and no children in rural area were considered. Preetam et al showed that 2.1% of the children in their study were obese, amongst them girls (2.29%) were more in number than boys (1.97%), they conclude that it is due to the inherent hormonal differences among the genders.[21,22] In this study, the prevalence of obesity in boys was 2.32% and that in girls was 1.11%.The prevalence of obesity was found to be maximum in urban males (1.25%). This is probably due to the sedentary urban lifestyle, food fads, increased fat content of the diet, decreased physical activity, watching television and playing computer games, lack of outdoor activities.

Association between hypertension and obesity

The correlation between obesity and hypertension was statistically significant (p<0.01) as found in the present study. Verma et al was of the opinion that obesity in childhood has a significant association with hypertension.[11] Study done by Sharma et al shows that rates of elevated blood pressure were significantly higher (46.55 vs 17%) among those with high BMI (overweight and obese) compared to those with normal BMI, which is similar to the present study.[13]

Age and hypertension

Age wise, hypertension was maximum in children at 11 years of age, followed by 10 years, with more prevalence in girls than boys. Chadha et al in a study on children in 5-14 years of age group concludes that the values of systolic and diastolic blood pressure increase with age in both sexes with maximum prevalence found amongst 10-12 years of age. The gradual increase in the blood pressure along with increase in age can be explained by the fact that, the body mass also increases, which is one of the determinants of blood pressure, along with age. The systolic spurt observed in the present study can be accounted for the onset of puberty.[23] While study done by Anjana et al, did not find such correlation.[17]

As per this study age wise, obesity is found to be maximum in children of 10 and 12 years of age. This might be due to physical inactivity and unhealthy food habits in them. In the present study, it is seen that the prevalence of obesity is more in urban children as compared to rural children. Mohan et al observed that, overweight population was significantly higher in urban area.[24]

Risk factors associated with hypertension and obesity

As per Table 5, in the present study, the association of mixed diet (veg + non-veg), with hypertension was found to be statistically significant (p value = 0.00). In a meta-analysis done by Yoko Yokoyama in 2014, (a total of 21,604 participants), consumption of vegetarian diets was associated with lower mean systolic BP (−6.9 mmHg; 95% CI, −9.1 to −4.7; $P < .001$; $I2 = 91.4$; $P < .001$ for heterogeneity) and diastolic BP (−4.7mmHg; 95%CI, −6.3 to −3.1; $P < .001$; $I2 = 92.6$; $P <.001$ for heterogeneity) compared with the consumption of omnivorous diets. In a study by Appel et al, the fruits and vegetable diet reduced systolic and diastolic blood pressure by 2.8 mmHg and 1.1 mmHg from the mean value of 131 and 84 mmHg (p value <0.001).[25] Thereby suggesting that a diet rich in fruits, vegetables and low-fat dairy foods and reduced saturated and total fat can substantially lower blood pressure. Similar studies done by Margetts et al and Rouse et al states that, vegetarian diet helps in controlling the blood pressure.[26,27]

Physical inactivity as described by the American Medical Association (AMA) expert committee as less than 60 minutes of physical activity per day or use of television or computers for more than 2 hours a day.[28] In the present study, 1.47% of the children were found to be physically inactive. The association of physical inactivity with hypertension was statistically significant (p value = 0.00). Lack of physical activity causes obesity, high risk for atherosclerosis and insulin resistance, thus leading to hypertension. Boreham et al studied 1015 children and found 24% prevalence of physical inactivity which is much higher than that found in the present study.[29]

As per Boreham et al physical inactivity amongst the school children is a major coronary risk factor for the development of hypertension in children. Similarly, in the present study, physical inactivity was significant risk factor associated with development of hypertension.

Other risk factors

Family history of hypertension: only 2 children amongst 16, with family history were found hypertensive, both were girls, one each in urban and rural area, which is statistically not significant. While in a study done by Fava et al, significantly high heritability values of systolic (37%) and diastolic (32%) blood pressure were found.[30]

Socioeconomic status: In this study, classes were divided into high/middle/low based on Kuppuswamy scale. Amongst them, 90 children belonged to lower class in which 4 children were found hypertensive and none were obese.1399 children belonged to middle class in which 49 children were hypertensive and 13 were obese. These values were not statistically significant.

Cause of hypertension

On investigating, the cause of hypertension in the 53 cases, it was found to be renal in 21 cases (39.62%), hypercholesterolemia in 2 cases (3.77%) and no cause of hypertension was detected in 30 cases (56.60%) in the present study. From this it is clear that, essential hypertension is the most common cause of hypertension in children as is seen in adults, followed by renal cause and hyper-lipidemia.

This is in congruence to Panja et al, who had essential hypertension followed by renal and then endocrine causes for hypertension.[31] But, it differs from that reported by Khalil et al where renal disease was the leading cause of hypertension in children followed by endocrine and then essential hypertension.[32] Also, Pankaj et al had found similar causes of hypertension in children i.e. renal cause followed by endocrine, which is followed by essential hypertension.[33] This difference might be due to the availability of better investigation facility at their centers.

CONCLUSION

Approximately 6 out of the 100 children between the age group of 6 to 12 years are hypertensive. Hypertension is more common in rural girls below 12 years. Obesity has strong association with both systolic and diastolic hypertension. Diet and physical inactivity are the important risk factors for development of hypertension. Essential hypertension is a commonest cause of hypertension in children. A higher prevalence of pre-hypertension and hypertension was seen in our study group. In developing countries like India, we urgently need school screening programs to identify pre-hypertension and hypertension in asymptomatic children. This can be achieved by government sponsored national programs, mandatory BP measurements by local physicians at office visits and regular school physical screening programs.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kamble MB, Chopde SG. A comparative study of hypertension and obesity with reference to risk factors in school children aged 6-12 years in urban and rural area. Int J Contemp Pediatr 2018;5:2326-32.