Original Article

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The Association between Basal Metabolic Index and Blood Pressure in School Children of Urban Area in Jaipur District

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ABSTRACT

Introduction: The trend of hypertension in children and adolescents has been on an incline in the past few decades. Principal factors held responsible for this increase include lifestyle changes and unhealthy eating habits. The aim of this study was to study the association of body mass index and blood pressure and factors contributing to an increase in the body mass index in school going children.

Methodology: This prospective cross-sectional observational study was conducted over a span of one year on randomly selected apparently healthy school going children of Jaipur, Rajasthan. A modified WHO questionnaire was used to collect the data including physical activity, dietary habits, and sleeping pattern. This was followed by anthropometric and blood pressure (BP) measurements.

Results: Out of 135 children recruited in the study, 62 (45.93%) were females and 73 (54.07%) were males. Pre-hypertension was found in 8.15% cases and hypertension was reported in 5.59% cases. There was a significant correlation between hypertension and BMI ($p<0.003$). In normal category, only pre-hypertension was reported in 2.22% cases and no case of hypertension were found. Amongst overweight children, both pre-hypertension and hypertension were present, 6.67% and 2.22%, respectively whereas, 15.65% of the obese children were found to have pre-hypertension and 13.33% had hypertension.

Conclusion: There was a significant positive correlation of an increased body mass index with unhealthy eating habits, reduced physical activity, and increased stress levels. This indicates that a healthy lifestyle, if adopted early in childhood can control and prevent future cardiovascular events.

INTRODUCTION

An increasing trend of high blood pressure (HBP) is a common phenomenon observed worldwide. The prevalence of hypertension in children and adolescents in developing countries has been established through systematic reviews to be between 1 and 5%.[1,2] High blood pressure among adolescents affects their health and results in other health problems in later life.[3] Yet, most studies on blood pressure have focused on the adult population and cases of childhood and adolescent hypertension often go unrecognized. Risk factors for elevated blood pressure (BP) during childhood include age, gender, body-size, socioeconomic status, obesity, family history of hypertension, changes in dietary habits, sedentary lifestyle, and increasing stress.[4-6]

A consistent positive association between body size and BP level has been observed throughout childhood and adulthood.[7] It is associated with many cardiovascular risk factors. Several studies that examined the relationships between overweight, obesity, and pre-hypertension have yielded different findings.[8,9] In India, the emergence of childhood obesity presents a cause for concern because of recent changes in lifestyle and economic development.[10,11]

Blood pressure studies in children provide crucial epidemiological information helpful in the modification of risk factors for coronary heart diseases and other non-communicable diseases later in life.[12] It is of utmost importance to identify risk factors to reduce the incidence and complications associated with elevated BP later in

adult life. The 1996 task force report on BP in children recommended that BP measurements be incorporated into routine pediatric examination for children aged three years and above.[13] Hypertension is believed to result from obesity, which is exacerbated by a high-energy, high-fat and high-salt diet, inadequate exercise, and stress.[14-16] It has been reported that high childhood BP predicts CVD in adulthood, and hypertension (HT) plus high body mass index (BMI) predicts even worse cardiovascular disease (CVD) in adulthood.[17]

Overweight and obesity in childhood are known to have significant impact on both physical and psychological health.[18] Albeit, the effect of lifestyle factors like obesity and physical inactivity on blood pressure has been studied in most of the developed countries, there is a dearth of similar studies in our country. Therefore, the present study was undertaken to identify children with pre-hypertension and those with hypertension in relation to basal BMI. This shall aid in introducing risk free interventions and treatment in both pre-hypertensive and hypertensive children respectively. Also, the findings of this study shall contribute in maintenance of healthy growth and development on the way to adulthood.

METHODS

The study population of this cross-sectional study was composed of children of age group 6-15 years of both genders. Children were randomly selected from urban school population of Jaipur district. Prior permission was taken from principals of the respective schools. All children were included after taking informed written consent from parent and ascent from children. The study was approved by the institutional ethics committee. The study was performed over a period of two months on 135 apparently asymptomatic and healthy children.

The anthropometric measurements (height and weight) were recorded according to the standard protocols. The weight of each participant was measured by using electronic scale (measuring up to 100 grams). Weight was recorded when children were wearing right clothes, without shoes while standing upright steadily. Standing height was measured without shoes to the nearest 0.1 cm with a use of a portable commercial stadiometer with children keeping their shoulder in relaxed position, their arms hanging freely, and their head alignment at frankfoot plane.

BMI categories were defined as normal, overweight, and obese. BMI was calculated by dividing weight (kg) of participant by the height in m^2. They were further classified into WHO approved CDC age specific BMI charts.[19] Blood pressure measurement was carried out by a pediatrician using auscultatory method by a mercury sphygmomanometer with appropriate cuffs. Blood pressure was recorded after at least 5 minutes of rest with children sitting and the cubital fossa supported at heart level.

Ambulatory blood pressure monitoring (ABPM) is based on the principle that repeated measurement of blood pressure through 24 hours provide an approximation of true blood pressure than does a single measurement, hence 3 measurements were taken. After initial measurements, a second reading was taken for each participant on the next visit after a week. In case a difference of 4 mm of Hg or more was observed between the two readings, a third reading was taken in the following week. Average systolic and diastolic pressure was then calculated using nearest of two BP values. The normative values are based on the "The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents"[20], as follows:

- Hypertension is defined as average systolic and/or diastolic pressure >95th percentile for gender, age, and height on >3 occasions.
- Pre-hypertension is defined as average systolic or diastolic pressures between 90-95th percentile. These children should be observed carefully and evaluated if risk factors like obesity are present; tracking data suggest that this subgroup is more likely to develop overt hypertension over time than normotensive children.
- Adolescents with blood pressure levels more than 120/80 mm Hg should be considered pre-hypertensive.
- A patient with blood pressure levels >95th percentile in a physician's office or clinic, who is normo-tensive outside a clinical setting, has white-coat hypertension.
- If the blood pressure is >95th percentile, it should be staged. If stage 1 (95th percentile to the 99th percentile plus 5 mm Hg), measurements should be repeated on 2 more occasions. If hypertension is confirmed, evaluation should proceed. If blood pressure is stage 2 (>99th percentile plus 5 mm Hg), prompt referral should be made for evaluation and therapy. If the

patient is symptomatic, immediate referral and treatment are indicated

Data regarding physical activity, dietary habits, and anxiety were gathered by means of a modified WHO global school-based student health survey questionnaire and a student-based nutrition questionnaire.[21] This question-naire was administered to the student to collect information on dietary habits, physical activity, and anxiety levels. Sample size was calculated using estimated prevalence of 6% based on available data in literature.[22] For affirmative results sample size was increased.

Descriptive and inferential statistical analysis was carried out in the present study using computer software (SPSS Trial version 23 and primer). The qualitative data were expressed in proportion and percentages, odds ratio with 95% confidence interval and the quantitative data expressed as mean and standard deviations. The difference in proportion was analyzed using a chi-square test. An odds ratio was used for between-group's comparisons. All tests were analyzed at significance level of 0.05.

RESULTS

The study population comprised of 135 children between the age 6 to 15 years. These were grouped in three different categories- normal, overweight, and obese. Each group comprised of 45 children. The study was started with distribution of 150 consent forms, 50 from each of the three categories normal, overweight, and obese. Out of these, 135 were returned with a positive parental consent and 45 children were included in the study from each category. Out of these 62 (45.93%) were females and 73 (54.07%) were males.

The association between blood pressure and BMI is shown in table 1. Pre-hypertension was found in 8.15% cases and hypertension was reported in 5.59% cases. In normal category, only pre-hypertension was reported in 2.22% cases and no cases of hypertension were found. Amongst overweight children, both pre-hypertension and hypertension were present, 6.67% and 2.22% respectively whereas, 15.65% of the obese children were found to have pre-hypertension and 13.33% had hypertension. There was a significant correlation between hypertension and BMI ($p<0.003$).

After interpreting the data collected via questionnaire for various risk factors of BMI, significant findings were observed for the effect of diet, physical activity, and anxiety levels on body mass index. On analysis of dietary behavior based on the questionnaire, it was found that more fast food consumption was strongly associated with higher anthropometric measurements i.e. (higher height, weight, and body mass index) ($p<0.001$) as children with normal BMI (75.56%) consumed fast food on 0-2 days in a week whereas majority of overweight children (60%) consumed it 2-3 times in a week, and obese children (66%) accepted that they consumed fast food more than three times a week.

Moreover, majority of normal children i.e. 68% consumed fruits 1-3 times per day, whereas majority of overweight children 62.13% consumed fruits 4-6 times or less in a week. The percentage was poorest for obese children who consumed fruits 1-3 times per week or less (Table 2).

The effect of anxiety on BMI was also analyzed by the information filled in questionnaire. Our study suggests a strong correlation between anxiety, insomnia, and BMI ($p<0.001$). According to our study, majority of children with a normal BMI showed rare anxiety as most of them (62%) opted that it would almost never or rarely occur' that they were not able to sleep at night due to anxiety. Compared to this, 48% overweight children had trouble sleeping 'sometimes' and alarmingly, 86% of the obese children reported that they were so tense, they had trouble

Table 1: Relationship between blood pressure and body mass index (BMI) in school children

BMI (Kg/m^2)	Normal		Pre-hypertension		Hypertension		Chi square Test
	N	%	N	%	N	%	
Normal (n=45)	44	97.78	1	2.22	0	0.00	15.948
Overweight (n=45)	41	91.11	3	6.67	1	2.22	(df = 4);
Obese (n=45)	32	71.11	7	15.56	6	13.13	$p < 0.001$
Total =135	117	86.67	11	8.15	7	5.19	

Table 2: Association of fast food consumption frequency with body mass index (BMI) of school children

Q. During the past 7 days, on how many days did you eat food from a fast food restaurant?

Fast food consumption Frequency/week	Normal		Overweight		Obese		Chi square Test
	N	%	N	%	N	%	
0 day	7	15.56	7	15.56	1	2.22	41.933 (df = 12); p < 0.001
1 day	15	33.33	3	6.67	0	0	
2 days	12	26.67	19	42.22	14	31.11	
3 days	9	20	8	17.78	14	31.11	
4 days	2	4.44	6	13.33	12	26.67	
5 days	0	0	2	4.44	3	6.67	
6 days or more	0	0	0	0	1	2.22	
Total	45	100	45	100	45	100	

Table 3: Effect of anxiety on body mass index in school children

Q. During the past 12 months, how often have you been so worried about something that you could not sleep at night?

	Normal		Overweight		Obese		Chi square Test
	N	%	N	%	N	%	
Never	12	26.67	5	11.11	1	2.22	86.752 with 8 degrees of freedom; p < 0.001
Rarely	16	35.56	1	2.22	2	4.44	
Sometimes	4	8.89	22	48.89	3	6.67	
Most of the time	10	22.22	12	26.67	39	86.67	
Always	3	6.67	5	11.11	0	0	
Total	45	100	45	100	45	100	

sleeping 'most of the time' (Table 3). Whether this is due to issues related to body image, peer pressure, or low self-esteem is a scope for further study.

DISCUSSION

The major findings of our study revealed that blood pressure levels were significantly higher in overweight and obese children.The increase was observed more in obese subjects as compared to overweight subjects. The overall prevalence of pre-hypertension was 8.15% and of hypertension was found to be 5.59%. This is in accordance to the results observed by Kajale et al[23], who observed hypertension in 5.6% cases. Similar results were suggested by He et al[24] as they observed that an increase of one BMI unit was associated with 0.56 mm Hg and 0.54 mm Hg increase in systolic blood pressure (SBP) and diastolic blood pressure (DBP), respectively, for obese children. In non-obese children, this increase in SBP and DBP was 1.22 mm Hg and 1.20 mm Hg, respectively. Furthermore, an increase in the adjusted BMI was associated with an increase in SBP and DBP in both obese and non-obese children.[24] Sukhonthachit et al[25] in their study corroborated our findings as they reported that obese children showed a significantly higher prevalence of pre-hypertension (pre-HT) and hypertension (HT) than non-obese children. They reported that pre-HT was 5.7% and 2.7% for boys and girls respectively, and HT was 4.7% for boys and 3.2% for girls, respectively, which was lower than the prevalence found in our study.

Considering the strong correlation of blood pressure and increase in BMI, we found that it is important to evaluate the factors contributing to an increase in body mass index. While potential contributors to the problem of childhood obesity are considered to be multiple and complex, in many countries fast-food has been implicated due to its increasing availability, energy density, and large portion

sizes. Our study reported an increased fast food consumption in obese and overweight children compared to normal children. Similar results were reported by Irene Braithwate et al,[26] as they found that frequent consumption of fast food is associated with a higher BMI in children compared with infrequent fast-food consumption.

The result of our study also suggests a strong correlation between anxiety, insomnia, and BMI ($p<0.001$). According to our study, majority of children with a normal BMI showed rare anxiety to an extent where they could not sleep. However, 86% of the obese child had trouble sleeping most of the time which clearly indicates that anxiety diagnosis is more likely to occur in obese children as compared to normal weight individuals.

The present study has few limitations. In the present study, study population might not be a truly representative sample from the district i.e, only urban schools were included and representation from rural schools was not there. As the research was conducted on a student level with significant financial and time bound limitations, the sample size was limited to 135. Large scale studies are recommended to corroborate the above-mentioned results. Scope for further research includes analyzing effect of body image, peer pressure, and issues of low self-esteem in children and adolescents with increased BMI and its subsequent effect on blood pressure.

CONCLUSION

In this study, the overall prevalence of pre-hypertension and hypertension was found to be 8.15% and 5.59%, respectively. There was a significant positive correlation of an increased body mass index with unhealthy eating habits, reduced physical activity and increased stress levels. Considering that high blood pressure in childhood is known to cause several health issues and remains undiagnosed most of the times, timely identification of childhood hypertension and implementing relevant intervention will be of paramount importance. Therefore, it will be beneficial to include a blood pressure screening in the routine school curriculum.

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