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Original Article

Prevalence of hypertension and its association with obesity in children of selected schools of Bengaluru city

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ABSTRACT

Background: Childhood hypertension and its association with obesity are becoming important issues worldwide. The prevalence of hypertension and obesity are increasing in both developed and developing countries. **Objectives:** To determine the prevalence of hypertension among school-aged children in Bengaluru and to determine whether or not obesity is associated with hypertension. **Materials and Methods:** Six schools were selected at random from an area in Bengaluru. A total of 3,000 students studying from 1 to 10 grades were included in the study. The students were visited at school, and their weights, heights, and blood pressures (BP) were measured. The World Health Organization's references were used to determine the prevalence of overweight, obesity, and hypertension. **Results:** The prevalence of hypertension and obesity were 3.5% (n=106) and 8.2% (n=247), respectively. Sex and obesity were found to be positively associated with hypertension. **Conclusion:** The prevalence of obesity and hypertension are high among school children of 6-15 years of age in Bengaluru. Obesity is positively associated with hypertension. BP measurements should be part of routine school health examination, especially in obese children.

Key words: *Hypertension, Obesity, School children*

Obesity and obesity-related disorders are growing concerns in both developing and developed countries. Many chronic metabolic diseases are associated with obesity; hence, the management of obesity and other-related disorders has been the focus of investigation. Hypertension is a major chronic disorder, which is associated with obesity [1]. The prevalence of childhood hypertension has been on rising trend. It currently occurs at a rate of 1-2% in developed countries and at the rate of 5-10% in developing countries [2,3]. There is less information about the screening and management of obesity and hypertension in children than in adults, despite pediatric hypertension being a field of increasing interest and importance. Even asymptomatic children with elevated blood pressure (BP) are prone to developing target organ damage, and have increased risk of adulthood cardiovascular disease. Hence, early detection, proper evaluation, and appropriate management of hypertension at an early age are important for the prevention or restriction of the diseases related to hypertension later in life [4-7]. This study aims to determine the prevalence of hypertension among school-aged children in Bengaluru and to determine whether obesity is associated with hypertension or not.

MATERIALS AND METHODS

This cross-sectional study was conducted among school students in Bengaluru. A total of six schools were selected at random in an area in the city and students from all grades (1-10th standards) were asked to participate. 2-3 days before collecting the data, the aims of the study were explained to students and their family, and written informed consent was obtained from the families. The questionnaires were sent to the students' families to obtain information related to age, sex, socioeconomic status of the students, and whether they or their families had any diseases such as diabetes or hypertension .The study participants were children aged between 6 and 15 years of age. Children with any chronic systemic disease, those were absent during the time of conduction of the study due to any reason and those were unwilling for study were excluded from the study.

The students were visited at school, and their weight, height, waist-hip ratio, and BP were measured. A stadiometer was used to measure the height while the children with barefoot with a sensitivity of 0.1 cm. The weight was measured with a standard portable scale with children wearing standard school clothes without shoes with sensitivity of 0.1 kg. BP was recorded in the right upper limb in sitting posture using mercury sphygmomanometer after a rest of 30 min. Due care was taken in the choice of the sphygmomanometer. The width of the cuff bladder taken was 40% of the arm circumference midway between olecranon and acromion. BP was measured 3 times, at intervals of 5 min, and the mean of the 3 BP measurements was calculated. BP was evaluated in accordance with the report published by the American Pediatrics Academy's National High Pressure

Education Program Working Group on high BP in children and adolescents [8].

Hypertension was defined as having the average systolic BP (SBP) or diastolic BP (DBP) fall between 95th and 99th percentile for sex, age, and height. Pre-hypertension was classified as the average SBP or DBP falling between 90th and the 95th percentile. Body mass index (BMI) was calculated as the body weight in kilograms divided by the square of height in meters. Since there was a wide range of ages, from 6 to15 years, a BMI for age curve was used to classify the nutritional status of the students in accordance with 2007 the World Health Organization (WHO) growth charts [9]. BMI value in the 95th percentile or greater was defined as obesity, and a value between the 85th and 95th percentiles for age and sex was considered as overweight.

The necessary permissions were obtained from the local representatives, school administration, and parents. The families of students who were found to be hypertensive and obese were informed about the same and referred to family doctors for further observation. The data were analyzed using SPSS 16. In the descriptive analysis, the categorical variables were presented as frequencies and the continuous variables as measures of central tendency and dispersion. Univariate analysis to identify variables associated with hypertension was done using the Chi-square test. The results were presented as odds ratios (ORs) with 95% confidence intervals. The values were considered statistically significant when $p<0.05$.

RESULTS

Of 3096 children, 96 were excluded in the study as parents were uncooperative and due to absenteeism. A total of 3000 students aged between 6 and 15 years were evaluated in our study. Among the total students, 63.4% (n=1904) were male and 36.5% (n=1096) were females. Distribution of hypertension cases by age, sex, and BMI is given in Table 1 The mean age was 11.45±2.3 years for girls and 11.34±2.3 years for boys. The prevalence of hypertension and obesity was 3.5% (n=106) and 8.2% (n=247), respectively.

The relationship between obesity and hypertension is presented in Table 2.

In obese group, 8.3% had >90th percentile BP for the age and sex, and 5.6% had >95th percentile, and in the non-obese group, 3.1% had >90th percentile, and 1.7% had >95th percentile. The difference between the obese and non-obese group was statistically significant.

In the obese group, mean SBP was 125.7 mmHg while in the non-obese group; it was 118.2 mmHg which was statistically significant. In obese group, mean DBP was 81.2 mmHg while it was 75.6 mmHg in the non-obese group which was statistically significant. It was found that a higher percentage of students who were obese had high BP when compared with children who were not obese (Table 3).

When the relationships between hypertension and BMI, age and sex were considered, the significant variable was BMI. In obese group, the prevalence of hypertension was significantly higher than in normal weight groups (Table 4).

Table 1: Distribution of hypertension cases by age, sex, and BMI

BMI	Hypertensive cases n=106			
	Male n (%)		Female n (%)	
	<10 years	>10 years	<10 years	>10 years
Normal	5 (55)	25 (69)	8 (50)	28 (62)
Overweight	1 (11)	5 (13.8)	3 (18)	10 (22)
Obese	3 (33)	6 (16.6)	5 (31)	7 (15.5)
Total	9 (100)	36 (100)	16 (100)	45 (100)

BMI: Body mass index

Table 2: Relationship between obesity and hypertension

BP	Obese (%)	Non obese (%)	Total (%)
90th-95th	7 (2.8)	38 (1.4)	45 (1.5)
>95th	14 (5.6)	47 (1.7)	61 (2)
Normal	226 (91.6)	2668 (96.9)	2894 (96.5)
Total	247 (100)	2753 (100)	3000 (100)

BP: Blood pressure

Table 3: Relationship of mean BP with obesity

Group	Number	Mean BP	SD	t value	p value
SBP					
Non obese	2753	118.2	7.3	1774.05	p<0.05
Obese	247	125.7	5.9		
DBP					
Non obese	2753	75.6	3.5	2035.08	p<0.05
Obese	247	81.2	3.4		

BP: Blood pressure, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SD: Standard deviation

Table 4: Univariate analyses showing the relationship between hypertension, sex, and BMI

Variables		Univariate analysis			
		n (%)	OR	95% CI	p value
Sex					
	Male	45 (2.3)	0.41	0.2-0.6	0.006
	Female	61 (5.6)			
BMI					
	Normal	70 (2.8)	0.413	0.29-0.6	0.235
	Over weight	15 (5)	1.532	0.8-2.5	0.135
	Obese	21 (8.5)	2.916	1.7-4.7	<0.0001

BMI: Body mass index, OR: Odds ratio, CI: Confidence interval

DISCUSSION

In the present study, we found a high prevalence of hypertension and obesity among school children 6-15 years of age in Bengaluru. Sex and obesity were found to be associated with hypertension in children. In this study, 3000 students were examined, and the prevalence of hypertension and obesity were 3.5% (n=106) and 8.2% (n=247), respectively. 5.6% of obese children had high BP compared to 1.7% in non-obese children. Both mean SBP and DBP were higher in obese children than in non-obese children. This was comparable with the results of a study by Gupta and Ahmad [10]. The exact prevalence of childhood hypertension is difficult to assess, as the results vary significantly depending on the age, selection of children for the survey (general population

compared with school-based survey), BP measurement methods and a number of BP readings.

The present study found the significant rise of hypertension with obesity in both sex groups, around 5.6% of the obese children in our study had hypertension, and 8.3% had pre-hypertension for the age and sex. This association also demonstrated in many studies such as the Norwegian study [11] and the Taiwan study [12] and the Framingham study [13] which also showed increased the prevalence of obesity in participants with hypertension as well increase in BP in established obesity. Many studies from India [10,14-16] had similar observations. Similar observations were also reported among the adolescent population in Hungary [17] and France [18] and such association in early childhood with SBP alone was reported by British cohort [19]. Andriska et al. [20] found 41% of their hypertensive children were obese, so they concluded that obesity plays very important role in development of childhood hypertension.

Children who are at risk for hypertension should be identified earlier to prevent them from developing adult hypertension. Primary health care centers have routine pediatric well-child visits and hence are important for early identification of hypertension. In these visits, a child's weight, which is an important predictor of hypertension, must be measured and BMI should be evaluated. For this reason, school health programs and school health centers must be well established. Using these strategies to prevent the disease in childhood can affect the reduction of disease in adulthood, which remains one of the most important public health challenges. Findings of our study suggest a need for larger population-based studies to accurately estimate the prevalence and risk factors for hypertension among the adolescents and young adults in our country.

Limitations of our study were that the study was conducted in an urban area. The children in urban settings and higher socioeconomic groups had a higher prevalence of overweight and obesity; all BP measurement was taken by a single observer, which may be a source of bias. We have not studied other factors such as physical activity, diets, and salt intake. We also did not follow-up, so we did not know how many of children require antihypertensive medications, and do they develop any complications.

CONCLUSION

The prevalence of obesity and hypertension are high among school children of 6-15 years of age in Bengaluru. Obesity is associated with hypertension and it is more common in females. BP measurements should be part of the routine clinical examination, especially in obese children.

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