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Prevalence of hypertension and its association with obesity among school children aged 6–15 living in Sakarya Province in Turkey

Fatih Muhammed ÖNSÜZ[1], Figen DEMİR[2,*]

[1]Department of Public Health, Faculty of Medicine, Eskişehir Osmangazi University, Eskişehir, Turkey
[2]Department of Public Health, Faculty of Medicine, Acıbadem University, İstanbul, Turkey

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Background/aim: Childhood hypertension and its association with obesity are becoming important issues worldwide. The prevalence of hypertension and obesity are growing in both developed and developing countries. This paper aimed to determine the prevalence of hypertension among school-aged children in Sakarya (western part of Turkey) and to determine whether or not obesity is associated with hypertension.

Materials and methods: Twelve schools were randomly selected from an area in the center of the Sakarya. A total of 2166 students participated in the study. The students were visited at school, and their weights, heights, and blood pressures were measured. The World Health Organization references were used to determine the prevalence of overweightness, obesity, and hypertension.

Results: The prevalences of hypertension and obesity were 15.1% (n = 326) and 18.0% (n = 390), respectively. Overweightness, obesity included, was found to be present in 26.3% of the children. Sex and obesity were found to be associated with hypertension; nevertheless, a positive family history of hypertension was not associated with hypertension in children.

Conclusion: The prevalence of obesity and hypertension are high among school children of 6–15 years of age in Sakarya. Obesity is associated with hypertension. Blood pressure measurements should be part of routine clinical examination, especially in obese children.

Key words: Obesity, hypertension, school children

1. Introduction

Obesity and obesity-related disorders are worldwide concerns in both developing and developed countries. Since many kinds of chronic metabolic diseases are associated with obesity, 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 increasing; it currently occurs at a rate of 1%–2% in developed countries and a rate of 5%–10% in developing countries (2,3).

Although pediatric hypertension is a field of increasing interest and importance, there is less information about the screening and management of obesity and hypertension in children than in adults. Even asymptomatic children with elevated blood pressure can develop target organ damage, and they are at an increased risk of cardiovascular disease in adulthood. Due to this, early detection, proper evaluation, and appropriate management of hypertension at an early age is important for the prevention or restriction of the diseases related to hypertension (4–6). However, there have been a limited number of studies carried out on hypertension in school-aged children. It is also important to note that cardiovascular disease, including hypertension, is one of the most common reasons of death in Turkey (7).

This study aimed to determine the prevalence of hypertension among school-aged children in Sakarya, Turkey, and to determine whether or not obesity is associated with hypertension.

2. Materials and methods

This cross-sectional study was conducted among all grades of primary school students in the center of Sakarya, Turkey, in February and March 2010. There were 109,327 students attending primary schools in the center of Sakarya. As the probable prevalence of overweightness and obesity was accepted as 15% with a margin of error of 0.05, it was calculated that a sample size of 1950 would be necessary for a 95% confidence interval. A total of 12 schools were randomly selected in an area in the center of the city. All students enrolled in all grades in these schools (n = 2466)

* Correspondence: figen.demir@acibadem.edu.tr

were asked to participate. The response rate was 87.8% (n = 2166).

The aims of the study were explained to students and their family, and written informed consent was obtained from the families 2–3 days before collecting the data. 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 students were visited at school, and their weights, heights, and blood pressures (BPs) were measured. The weight was measured with a standard portable scale with children wearing standard school clothes without shoes. A standard measuring tape was used to measure the height while the children were barefoot.

BPs were measured from the students' right arms after the students had been seated for 5 min. An appropriate cuff that fit the students' arms was chosen. 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 Blood Pressure in Children and Adolescents (8).

Hypertension was defined as having the average systolic BP (SBP) or diastolic BP (DBP) fall between the 95th percentile and the 99th percentile for sex, age, and height. Prehypertension was classified as the average SBP or DBP falling between the 90th percentile and the 95th percentile. Malignant hypertension was defined as having the average SBP or DBP at or above the 99th percentile (Table 1). However, malignant hypertension was used only in the descriptive analysis. Hypertension and malignant hypertension were classified together as hypertension, and prehypertension was classified as normotension in all other comparative analyses.

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 to 15 years, a BMI-for-age curve was used to classify the nutritional status of the students in accordance with the 2007 World Health Organization (WHO) growth charts (http://www.who.int/childgrowth/en/).

A 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 (Table 2).

The necessary permits were obtained from the local representatives of the Ministry of Health and Ministry of Education. Furthermore, the families of students who were found to be hypertensive and obese were informed about the situation 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 effects of sex and BMI on hypertension were investigated using logistic regression. The results were presented as odds ratios (ORs) with 95% confidence intervals. The values were considered

Table 1. Definition of hypertension.

Category	SBP or DBP percentile for age, sex, and height
Normal	Less than the 90th percentile
Prehypertension	90th percentile to less than the 95th percentile
Hypertension	95th percentile to less than the 99th percentile
Malignant hypertension	Equal to or greater than the 99th percentile

Table 2. Classification of the nutritional status in accordance with the WHO growth charts.

Weight-status category	Percentile range
Lean	Less than the 15th percentile
Healthy weight	15th percentile to less than 85th percentile
Overweight	85th percentile to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

statistically significant when P-values were lower than 0.05.

3. Results

A total of 2166 students aged between 6 and 15 years were evaluated in our study. A total of 49.1% (n = 1064) of the students were male. The mean age was 11.45 ± 2.3 years for girls and 10.34 ± 2.3 years for boys. The prevalence of hypertension and obesity was 15.1% (n = 326) and 18.0% (n = 390), respectively. The prevalence of prehypertension, hypertension, and malignant hypertension was 15.3% (n = 331), 9.0% (n = 196), and 6.0% (n = 130), respectively, in all age groups. The combined prevalence of overweightness and obesity in this study was 26.3%. The prevalence of both hypertension and obesity is presented in Table 3.

Almost one in every four students was overweight or obese. The prevalence of hypertension, including malignant hypertension, in lean, normal weight, overweight, and obese groups was 7.5%, 12.0%, 17.9%, and 27.7%, respectively. Distribution of hypertension (including malignant hypertension) by age, sex, and BMI is demonstrated in Table 4.

It was found that a higher percentage of students who were obese had high BP when compared with children who were not obese. When the relationships between hypertension and BMI, age, sex, family history, and maternal and paternal education variables were considered, the significant variables were BMI and sex. In overweight and obese groups, the prevalence of hypertension was significantly higher than in lean and normal weight groups. The hypertension prevalence was also higher in female students (P = 0.02) (Table 5).

After adjustment, both BMI status and sex remained significantly associated with hypertension. After adjusting for BMI status, being overweight or obese was associated with an increased OR of hypertension compared with being of normal weight. After adjustment for sex, the OR did not change. When the male sex was taken as the reference category, the OR for females was 1.4 (95% CI: 1.1–1.8, P = 0.007) (Table 5).

A positive family history of hypertension was reported for 755 (34.9%) of the students. However, a positive family history of hypertension was not associated with hypertension in children.

Table 3. Prevalence of obesity and hypertension.

	n	%
BP		
Normal	1509	69.7
Prehypertension	331	15.3
Hypertension	196	9.0
Malignant hypertension	130	6.0
BMI		
Lean	120	5.5
Normal	1477	68.2
Overweight	179	8.3
Obese	390	18.0
Total	2166	100.0

4. Discussion

In the present study, we found a high prevalence of hypertension and obesity among school children 6–15 years of age in Sakarya. Hypertension increases with age. Sex and obesity were found to be associated with hypertension in children.

Table 4. Distribution of hypertension cases by age, sex, and BMI.

	Hypertensive cases*, n = 326				Normotensive cases**, n = 1840			
	Male		Female		Male		Female	
BMI	<10 years, n (%)	≥10 years, n (%)	<10 years, n (%)	≥10 years, n (%)	<10 years, n (%)	≥10 years, n (%)	<10 years, n (%)	≥10 years, n (%)
Lean	-	4 (4.3)	-	5 (4.4)	11 (2.8)	46 (8.7)	12 (3.9)	42 (7.5)
Normal	30 (63.8)	43 (46.7)	49 (67.1)	55 (48.2)	284 (71.9)	363 (68.5)	274 (77.2)	379 (67.7)
Overweight	6 (12.8)	5 (5.5)	8 (11.0)	13 (11.4)	40 (10.1)	32 (6.0)	26 (7.3)	49 (8.8)
Obese	11 (23.4)	40 (43.5)	16 (21.9)	41 (36.0)	60 (15.2)	89 (16.8)	43 (12.1)	90 (16.1)
Total	47 (100.0)	92 (100)	73 (100)	114 (100)	395 (100)	530 (100)	355 (100)	560 (100)

*Including malignant hypertension.
**Including prehypertension.

Table 5. The relationship between hypertension, sex, and BMI of the students. Results of univariate and multivariate analyses.

Variable	Univariate analysis			Multivariate analysis		
	n (%)	Odds ratio	95% CI	Odds ratio	95% CI	P-value
Sex						
Male	139 (13.1)	1.0		1.0		
Female	187 (17.0)	1.4	(1.07–1.72)	1.4	1.1–1.8	0.007
BMI						
Lean	9 (7.5)	1.68	(0.84–3.37)	1.0		
Normal	177 (12.0)	1.0		0.6	0.3–1.2	0.15
Overweight	32 (17.9)	1.6	(1.05–2.41)	1.6	1.1–2.4	0.03
Obese	108 (27.7)	2.8	(2.14–3.69)	2.8	2.7–3.7	<0.001

In this study 2166 students were examined, and the hypertension and obesity prevalences were found to be 15.1% and 18.0%, respectively. Overall, 67.2% of the children had normal BMI values. The incidence and prevalence of hypertension in school children in Turkey has been studied by several other researchers. The rate of hypertension has been varied among studies from different countries, including those from Turkey. In the different regions of Turkey, studies have found the prevalence of hypertension to be 5.9% in the age group of 14–18 (9), 5.4% hypertension and 1.6% malignant hypertension in the age group of 12–14 years (7), 9.1% hypertension in the age group of 7–16 years (10), 7.2% hypertension in the age group of 13–18 years (11), and 4.8% hypertension among females and 3.8% among males of the age group of 7–18 years (12).

The results from published population studies show that the reported prevalence of hypertension ranges from 7.7% to 17.3% around the world (13). In a recently published study, the prevalences of hypertension and obesity were found to be 20.09% and 8.94%, respectively (14). The exact prevalence of childhood hypertension is difficult to assess, as the results vary significantly depending on age, selection of children for the survey (general population compared with school-based survey), BP measurement methods (auscultatory compared with oscillometric), number of BP readings, number of office visits, and ethnic differences. It is therefore difficult to compare the data from different studies around the world.

One of the main reasons for the difference between the prevalence of hypertension in this study and that in previous studies may be the utilization of different age groups. In one study conducted among 606 students aged 7–15 years, an age range very close to that of our study population, from 10 schools in northern Greece, 12.3% of boys and 15.1% of girls were diagnosed with hypertension (15).

Another reason for the difference between the prevalence of hypertension may be the prevalence of obesity. In this study, the combined prevalence of overweightness and obesity was found to be 26.3%. Studies on the epidemiology of obesity among children indicate that the prevalence of overweightness and obesity ranges from 15% to 45% (16).

In one study conducted among 1020 students in Sivas, Turkey, the prevalence of hypertension was determined to be 5.9%. Out of 1020 students, only 2 students were found to be obese in the same study. In our study, the prevalence of obesity was 18.0%. Clearly, our study provides a higher prevalence of overweightness and obesity. This could be attributed to the small sample size in previous studies and also the region where the study was conducted. We know that obesity is less common in rural areas. Therefore, the higher rate of obesity in our study may be related to the higher rate of hypertension.

There are studies that indicate that obesity in children and adolescents is an important risk factor for hypertension. As an example, the FRICELA study demonstrated that the hypertension risk in adolescents with BMI between 25 and 30 was 2.9 times higher compared to adolescents with BMI of <25. Similarly, the risk was 4.9 times higher for those with BMI of >30 compared to those with BMI of <25 (17). Furthermore, this positive association between BMI and blood pressure has been demonstrated by some other studies (18–22). The association of higher BP trends paralleling the rise in obesity has also been documented in numerous reports (22–27).

In our study, there was a significant increase in the prevalence of hypertension with an increase in BMI status (Table 4). Furthermore, it was also significantly associated with hypertension after the multivariate analysis. These increases were observed in both girls and boys. Similar

observations have also been reported in many other studies (7,24–26).

Our study was conducted in an urban area. This may be another reason for the high prevalence of obesity and hypertension. The children in urban settings and higher socioeconomic groups had a higher prevalence of overweightness and obesity. A study conducted in the western Black Sea region of Turkey found the obesity prevalence to be 7.7% in urban areas and 3.9% in rural areas in children 6–17 years of age (28). According to the results of the TOÇBİ study, the prevalence of obesity in school age children was 8.5% in urban regions and 7.5% in rural regions all over Turkey (29). Furthermore, according to the TBSA study results (20), the prevalence of obesity in the age group of 6–18 years is 9.7% in the urban regions and 4.5% in the rural regions all over Turkey. The westernization of the behavior patterns of children and living in an urban setting in a developing country are risk factors for obesity.

Another reason for the difference between the prevalence of hypertension may be the geographic and cultural differences.

In conclusion, children who are at risk of hypertension must be identified earlier in order to prevent them from developing adult hypertension. Hypertension in children can be identified easily by annual measurements of blood pressure. This measurement is recommended by the Task Force on Blood Pressure Control in Children for all children over 3 years of age (30).

Primary health care centers and school health centers should play important roles in the prevention of childhood obesity and hypertension. Primary health care centers are important for early identification of hypertension, because of their routine pediatric well-child visits. In these visits, a child's weight, which is an important predictor of hypertension, must be measured and evaluated using the BMI. Family doctors, whose duties include tracking the health of their patients, could measure the blood pressure and weight. Furthermore, new strategies should be developed in primary care centers for preventing obesity and hypertension. On the other hand, school health programs will play an important role in this prevention. For this reason, school health programs and, as a part of this program, school health centers must be developed. 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.

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