

The Incidence of Asymptomatic Hypertension in School Children

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Abstract

Background: Although hypertension is a well-documented risk factor for cardiovascular diseases, including myocardial infarction and stroke, in adults, only recently has knowledge about childhood hypertension increased significantly.

Aim: To determine the incidence of asymptomatic hypertension in school-age children.

Subjects and Methods: Children in primary school were chosen with a randomized sampling method. During measurement of blood pressure, a calm, comfortable setting was provided. Blood pressure measurements were performed by only 1 researcher. For accurate measurement of blood pressure, recommended standards were followed.

Results: A total of 1,963 children were included in the study. The incidence of systolic hypertension and diastolic hypertension were 7% and 2%, respectively. Obesity was present in 10.5% girls with hypertension and 13.9% of boys with hypertension.

Conclusion: Our findings indicate that hypertension is an important health problem in children, and its prevalence is quite high. Blood pressure measurements must be a part of routine clinical examinations. Further studies should be performed in high-risk populations to prevent hypertension and to establish methods of early diagnosis and treatment in children.

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Key words: hypertension, school children

Introduction

The blood pressure level in childhood is a reliable indicator of the blood pressure level in adulthood¹. For this reason, diagnosis and treatment of hypertension of children and adolescents, who are at high risk of developing essential hypertension in adulthood, is very important². Furthermore, high blood pressure can cause different organ damages including cardiac disease, stroke and renal failure, so

early diagnosis should be done³. Hypertension incidence in pediatric population is 1% to 3%⁴. Hypertension in childhood is determined according to percentile graphics that are adapted for age, height, and sex. To diagnose hypertension early, blood pressure measurements should be a part of regular physical examinations⁵.

In the present study, measured blood pressures of children were analyzed on the basis of blood pressure standards obtained by a 1,997 study by Tümer et al. in 5,599 subjects ranging in age from

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Table 1 The 95 percentile of blood pressure by age and sex

Sex	Blood Pressure (mm Hg)	Age (years)									
		7	8	9	10	11	12	13	14	15	16
Boy	Systolic	119	121	123	124	125	126	127	128	129	130
	Diastolic	78	80	82	83	84	86	87	88	89	90
Girl	Systolic	119	121	123	124	125	126	127	128	129	130
	Diastolic	78	80	82	84	85	86	87	88	89	90

birth to 18 years; these standard values are still being used at the Ankara University School of Medicine Pediatrics Clinic⁶. In this study, we aimed to determine the incidence of asymptomatic hypertension in school-age children. Hypertension was diagnosed on the basis of a systolic blood pressure or diastolic blood pressure or both greater than the 95 percentile, and the prevalence of hypertension was calculated and compared with values in recent studies.

Material and Methods

This study was performed to determine the prevalence of asymptomatic hypertension in school children; therefore, a primary school in Van, Turkey, was identified. Students of this school were chosen with a randomized sampling method.

First, students' height and weight were determined, followed by blood pressure measurements. During measurement of blood pressure, a calm, comfortable setting was provided. Blood pressure measurements were performed by only 1 researcher. For accurate measurement of blood pressure, recommended standards were followed. None of the children were agitated, and none of them had pain.

For measurement of blood pressure, appropriate cuff sizes were chosen. The length of the upper arm was the distance between the acromion and olecranon measured while the arm of the child in a relaxed position was bent 90 degrees at the elbow. The circumference of the upper arm was measured with a tapeline without indenting the skin at the middle point of the relaxed, hanging upper arm. All blood pressure cuffs were commercially available, and the sizes were chosen to select a bladder width of at least 40% of the length of the upper arm and a

length greater than the circumference of the upper arm. Blood pressures were measured at least 3 times from the right arm, and means were calculated from these 3 separate measurements. If the mean measured systolic and diastolic blood pressures were in the 95 percentile or greater in terms of the standards of Tümer et al, blood pressures were measured 3 times more (total, 6 times), and mean values were again calculated from all 6 measurements.

On the basis of the data obtained, children were divided into age groups, and the number of girls and boys participating in this study from each age group was calculated. Blood pressures were then measured. Subjects with a blood pressure measurement in the 95 percentile or greater were considered to have hypertension. To determine whether hypertension was present, the systolic and diastolic blood pressure percentile curves for age group and sex of Tümer et al were used (**Table 1**). Rates of hypertension were calculated, and prevalences of diastolic and systolic hypertension were calculated. Furthermore, rates of obesity in girls and boys with hypertension were calculated. Children with a body mass index (BMI) above the 95 percentile were considered obese. The screening and evaluation of BMI were performed according to reference BMI curves for Turkish persons 6 to 18 years of age⁷. The BMI was calculated with the following formula: weight/height^2 (kg/m^2). Body weight, height and the minimums-maximums, means, and standard deviations of systolic and diastolic blood pressures were determined separately for girls and boys.

According to blood pressure curves at blood pressure measurements, the following terms were defined:

Normal: If systolic and diastolic blood pressures

Table 2 Distribution of children by age and sex

Age (years)	Girl		Boy		Total	
	n	%	n	%	n	%
7	80	50.63	78	49.37	158	8.04
8	108	44.26	136	55.74	244	12.42
9	109	44.31	137	55.69	246	12.53
10	117	46.80	133	53.20	250	12.73
11	114	44.53	142	55.47	256	13.04
12	124	45.58	148	54.42	272	13.85
13	117	53.92	100	46.08	217	11.05
14	103	48.82	108	51.18	211	10.74
15	28	41.18	40	58.82	68	3.46
16	11	26.82	30	73.18	41	2.08
Total	911		1,052		1,963	100

Table 3 Distribution rates and variety of subjects with hypertension according to age and sex

Age of Subjects (years)		7 (n=80)		8 (n=108)		9 (n=109)		10 (n=117)		11 (n=114)		12 (n=124)		13 (n=117)		14 (n=103)		15 (n=28)		16 (n=11)	
Girls	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Boys	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	5 (6.2)	8 (10)	8 (7.4)	3 (2.7)	7 (6.4)	2 (1.8)	8 (6.8)	1 (0.8)	9 (7.8)	0 (0)	9 (7.2)	1 (0.8)	10 (8.5)	0 (0)	6 (5.8)	1 (0.9)	1 (3.5)	1 (3.5)	0 (0)	0 (0)	
	7 (8.9)	3 (3.8)	8 (5.8)	11 (8)	9 (6.5)	2 (1.4)	13 (9.7)	3 (2.2)	8 (5.6)	2 (1.3)	7 (4.7)	1 (0.6)	10 (10)	0 (0)	5 (4.6)	1 (0.9)	5 (12.5)	0 (0)	4 (13.3)	0 (0)	

SBP: systolic blood pressure DBP: diastolic blood pressure

were less than the 90 percentile by age, sex, and height.

Borderline hypertension (high-normal): If the mean systolic blood pressure or mean diastolic blood pressure or both were in the 90 to 95 percentiles by age, sex, and height.

Hypertensive: If the mean systolic blood pressure or mean diastolic blood pressure or both were in the 95 percentile or greater by age, sex and height on 3 separate measurements.

Results

A total of 1,963 children were included in study. Subject characteristics by sex and age group are shown in **Table 2**. Blood pressures in the 95 percentile or greater distributed by age group and by sex and the rates of hypertension among all subjects are shown in **Table 3**. Of the children in this study, 179 (9.1%) were considered to have hypertension. The prevalence of systolic hypertension was 7%, and the prevalence of diastolic

hypertension was 2%. Of the 911 girls, 80 (8.7%) had hypertension. Of the 1,052 boys, 99 (9.4%) had hypertension. Among girls, the highest rate of hypertension (10%) was in those 7 years old. Among boys, the highest rate of hypertension (13.3%) was in those 16 year old. The rate of obesity among those with hypertension was 10.5% for girls and 13.2% for boys.

Discussion

Blood pressure is a physiologic variable. Hypertension is an independent risk factor for cardiovascular morbidity, cerebrovascular events, and renal disease⁸. Essential hypertension in adults starts at an early period of life. For this reason, blood pressure measurement should be a part of the examination of children and adolescents. Blood pressure increases with age⁹. In the study of Tümer et al, blood pressure increase with age in both boys and girls. According to that study, the mean increase in systolic blood pressure was 2.34 mm Hg

for boys and 2.42 mm Hg for girls⁶. Blood pressure increases not only with age but also with body weight and height¹⁰. For evaluating blood pressure in the United States, the second Task Force report, which was published in 1987, has been used¹¹. The present study used the blood pressure percentile curves of Tümer et al, in which systolic and diastolic blood pressure values of children were determined according to age and sex⁶. A study published in 1991 which included blood pressure measurements and percentile curves for 6 European countries¹² found that the mean blood pressure in American children was 6 mm Hg lower than that in European children. The differences between various studies have been attributed to differences in measurement techniques and measurement settings as well as to differences in study locations. In these studies, due to many factors that affect blood pressure and blood pressure measurement, exact standardization is not possible. The distribution of blood pressure levels and the prevalence of hypertension differ between various ethnical groups^{13,14}. In our study, hypertension was found to be more common in boys than in girls. Among all children with hypertension, the prevalence of systolic hypertension was higher than that of diastolic hypertension.

A review of the literature shows that the reported incidences of hypertension range from 0.6% to 11%⁵. Jung et al.¹⁵ have determined that the prevalence of hypertension among children is 1% to 3%. However, in the same study, the rates of hypertension in adolescents were 9% to 30%. In a 1,992 study by Ferrara et al.¹⁶ the prevalence of hypertensive among 168 11-year-old children was 6.5%. In a study performed at the Beijing Medicine Faculty in children aged 8 to 11 years, the prevalence was hypertension was 7.2%¹⁷. In an extensive study of 10,641 school children performed in Dallas, Texas, the prevalence of hypertension was 1.57%. Additionally, of all subjects enrolled the study, 1.2% had systolic hypertension and 0.37% had diastolic hypertension¹⁸. Some published articles have declared that the incidence of hypertension ranges from 2.7% to 5.8% in school children^{19,20}. In a study of 2,460 students aged 12 to 16 years performed in Houston, Texas, the prevalence of hypertension was

2.88% (71 of 2,460 students). Of 71 children with hypertension, 46 (64.8%) were males and 25 (35.2%) were females. Furthermore, of children with hypertension, 51 (71.8%) were obese, whereas 20 (28.2%) were not obese²¹. Lurbe et al.²² used repeated blood pressure measurements to examine the prevalence of hidden hypertension in children and adolescents. A total of 587 subjects aged 6 to 19 years of age were included in their study, and the prevalence of hypertension was 4.6%²². The results of our study and those of these previous studies are similar, but there are some differences. These differences can be attributed to the different standardization measurement techniques and other factors affecting blood pressure which could not be eliminated. Also some studies of blood pressure measurements of children are influenced by ethnic and geographic differences^{23,24}. The different results that we have found may be due to ethnic and geographic differences.

An important determinant of blood pressure in children is body size^{10,25}. Blood pressure standards depend on sex, age, and weight^{4,26}. In our study, along with increases in body weight and height, increases in diastolic and systolic blood pressures were observed. These increases were observed in both girls and boys. The relationships of blood pressure to height and weight have been examined in many previous studies. The second Task Force Report, which was published in 1987, stressed that blood pressure values should be evaluated with height and weight²⁵. Lurbe et al. showed a positive correlation between systolic hypertension and BMI²². Blood pressure values of the second Task Force were re-analyzed, considering height, in 1996, and height-specific systolic and diastolic blood pressure percentiles were determined.

Several studies have also examined variations of blood pressure in children according to race, ethnic group, or geographic region. In the study of Tümer et al, a distinct difference between girls and boys was not found⁶. In a study of 136 subjects (59 male and 79 female) aged 6 to 25 years in Japan by Matsuoka et al, the overall prevalence of hypertension was 11%, but the prevalence of hypertension was higher in boys than in girls²⁷. In

our study, considering mean, minimum, and maximum blood pressure values, both systolic and diastolic blood pressure were higher in boys than in girls. This difference increased with age. The hypertension rate among boys was highest, 13.3%, in those aged 16 years.

Experimental and clinical findings show that chronic cardiovascular diseases, including essential hypertension, originate in childhood²⁸. Essential hypertension is mild in children and adolescents and present with other cardiovascular risk factors. Reinehr et al have found a relationship between hypertension, obesity, and cardiovascular disease²⁹. In a study by Jones et al. left ventricular wall thickness was increased in children with hypertension³⁰. Garzon et al. have shown a decrease in left ventricular diastolic function³¹. Furthermore, blood pressure may be associated with the initiation and acceleration of atherosclerosis. High blood pressure may cause endothelial injury in vessels. The treatment of hypertension in adults decreases the risk of cardiovascular disease.

The children with blood pressures in the 90 percentile have a 2- to 4-fold higher risk of hypertension in adulthood than do children with blood pressures in the 50 percentile³². In a study by Macedo et al.³³ a significant percentage of children who had hypertension at the first measurement had hypertension in the future. All of these studies emphasize the importance of blood pressure monitoring in childhood. High blood pressure in childhood is an important risk factor for high blood pressure in adulthood.

In conclusion, we should be aware that hypertension is an important health problem in children as well as in adults and that its prevalence is high. Hypertension in childhood is an important risk factor for hypertension in adulthood. All physicians who deal with children should be alert for this subject and should regularly measure and monitor blood pressure. Children in the high-risk group should be identified and be treated with an individualized approach. A healthful, well-balanced diet should be advised for all children.

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