Prevalence and risk factors of hypertension among schoolchildren aged 12-14 years in Bursa, Turkey

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ABSTRACT

Objectives: To determine the hypertension prevalence and risk factors related to hypertension among schoolchildren aged 12-14 years in Bursa, Turkey.

Methods: We conducted this study at the Bursa Provincial Center between February and June 2006. Two thousand and four hundred seventy-eight schoolchildren were randomly selected. The evaluation of elevated blood pressure was carried out according to The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents.

Results: Of the 2,478 students screened, 350 (14.1%) has prehypertension, 147 (5.4%) has hypertension, and 40 (1.6%) has malign hypertension. There was a statistically significant relationship between hypertension prevalence and aged, gender, family history of hypertension, and body mass index ≥85th percentile.

Conclusion: Blood pressure measurements should be in physical examinations as part of continuing care of a child. The prevention of overweight and risk of overweight can decrease the prevalence of hypertension.

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Hypertension is one of the most widespread diseases that affects one billion people worldwide.[1] It is a known fact that high blood pressure and cardiovascular diseases are one of the leading reasons of premature deaths.[2] There are proofs that hypertension seen at childhood can lead to hypertension at adulthood.[3] Hypertension seen at childhood and adolescence that persists at adulthood and constitutes an important risk factor for cardiovascular diseases such as atherosclerosis, coronary artery disease, and cerebrovascular disease. There are studies relating uncured or borderline hypertension at childhood and adolescence with ventricular hypertrophy and atherosclerotic changes.[4,5] Early diagnosis and treatment are effective to prevent long-term complications.[5] However, essential hypertension in young people (<30 years old) is rare and most of these cannot be diagnosed because of non-existence of clinical symptoms, or relatively low blood pressure rises compared to adult patients and limited blood pressure measurement opportunity.[6] Cardiovascular diseases are one of the most common reasons of death in Turkey.[7] There are a limited number of studies made on hypertension at adolescence. The aim of this study is to determine the hypertension prevalence, and risk factors related to hypertension such as age, gender, and obesity among 12-14 aged middle school adolescents.

Methods. We conducted this study at the Bursa Provincial Center between February and June 2006. Schoolchildren aged 12-14 years were enrolled in the study. In the school year 2005-2006, students studying at 158 middle school (6-8 classes) were 67,672. There are 3 county boroughs at Bursa, Turkey: Nilufer, Osmangazi, Yildirim. At Nilufer there were 29 middle schools, Osmangazi 60, and Yildirim 69. Schools from each county borough were determined and weighted according to the total number of middle schools at each county borough. Participants in the study were randomly chosen from middle schools (Yildirim 7, Osmangazi 6, Nilufer 3). The boy and girl ratio was 1.17:1. We just included the 16 middle schools with 2,478 students. We determined the sample group of 2,478 among 67,672 students according to sample volume. Calculations were made by taking the prevalence of hypertension as 7.2 per 100 and field screening of 2,478 students were considered to be sufficient to identify hypertension patients

with one per 100 sensitivity.[8] Formula to calculate the sample size:[9]

$$n = NZ^2p\ (1\text{-}p)/d^2(N\text{-}1) + Z^2p\ (1\text{-}p)$$

Where N is population, Z is the statistic for a level of confidence, n is sample size, p is the probability of occurrence and d is precision.

Students to be chosen to sample from each school were weighted according to the total number of students at each school. Classes were determined with random sampling according to students who were chosen at each school. Girls and boys to be included were determined according to the boy-girl ratio, in all schools (1.17:1). The same number of students was chosen for each age group. Classes were chosen randomly in each school. In each class, students were included beginning with the first student in the class list. If students in age group or gender was not found in a class, a parallel class was chosen until the target was reached. The study was explained to students and the written permissions of the parents and children were taken. A survey form of 17 questions on the sociodemographic characteristics, family history of hypertension, smoking, and physical activities of the students were applied. One of the questions asked was: to evaluate physical activity patterns at leisure times of the students. State of physical activity was determined using the questions used for adults at various Scandinavian studies and modified by Ucar et al for the Turkish population.[10-12] Students were classified in 3 physical activity groups according to their answers: 1) Sedentary activity: students who ride to school, by vehicle, do activities that do not require physical effort such as watching TV, reading a book. 2) Moderate activity: students who walk or ride the bicycle to school and do moderate physical activities. 3) Active: students who do regular training at school sports teams, and do heavy garden work.

The children who smoked at least one cigarette per week were considered to be at risk of hypertension. To encourage truthful answers, children were reassured that parents and teachers would not receive the information on smoking. A team consisting of 3 doctors and one health officer visited the schools in the morning. Omron 705 IT automatic sphygmomanometer was used to measure blood pressure (BP).[13,14] The cuff size was approximately 140 mm x 480 mm. The blood pressure of students was measured from the right arm on heart level 3 times with a minimum of 5 minute breaks after letting them rest. Average systolic blood pressures (SBP) and diastolic blood pressures (DBP) were calculated and recorded. The evaluation was carried out according to the report published by the American Pediatrics Academy, 'National High Pressure Education Program Working Group on High Blood Pressure in Children and Adolescent', 'The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents'. According to age, gender, and height, the SBP and DBP under 90th percentile is normal, between 90-95th percentile as prehypertension, ≥95th percentile up to <99th percentile as hypertension, >99th percentile as malign hypertension.[15] The BP of the students in hypertension and malign hypertension groups were measured and calculated after 2 weeks with the same method and average SBP and DBP. The second measurement was applied to all students who were diagnosed with hypertension and malign hypertension at the first measurement. While calculating hypertension and malign hypertension prevalence, those averages were taken into account. Weight of the students was measured sensitive to 0.1 kg after taking off shoes and school uniforms, and height sensitive to 0.1 cm with height-weight measurer. Body mass indexes of students were calculated by using weight (kg)/height^2 (m). The evaluations of BMI's were carried out according to the percentage tables and graphs published in year 2000 by American Centers for Disease Prevention and Control (CDC): BMI <85th percentile normal, 85-94th percentile risk of overweight, ≥95th percentile overweight.[16] In statistical analysis student's t test, Chi square test, and logistic regressions were applied. All statistical analysis was carried out with SPSS 13.0 software system.

Results. All 2,478 students in the sample groups were reached. Of 2,478 adolescents, 1,338 were boys (54.0%), and 1,140 were girls (46.0%). We classified the average SBP and DBP according to age and gender (**Table 1**). The average SBP was significantly higher in girls except for 14 years of age. Average DBP was significantly higher in females at all ages. The second measurement was applied after 2 weeks to 293 (11.8%) students who were diagnosed with hypertension and malign hypertension at the first measurement and 147 (5.9%) students were diagnosed as hypertensive. Forty of them (27.2%) have malign hypertension. Hypertension prevalence was 8% in girls (n=91), and 4.2% in boys (n=56). Prehypertension, hypertension, and malign hypertension prevalence according to age and gender group is seen in **Table 2**. The prevalence of hypertension and malign hypertension increases with increasing age at males. The same situation was observed in females for hypertension, however, the malign hypertension prevalence was higher at age 13 than other ages. Some characteristics of hypertension groups and others are seen in **Table 3**. Prevalence is

Table 1 - The means and standard deviations of boys and girls' systolic and diastolic blood pressure.

Age (years)	Systolic blood pressure (mm Hg)				Diastolic blood pressure (mm Hg)			
	Boys Mean±sd (95% CI)	Girls Mean±sd (95% CI)	t test	*P* value	Boys Mean±sd (95% CI)	Girls Mean±sd (95% CI)	t test	*P* value
12 (boy=446; girl = 380)	109.5±8.9 (108.6-110.3)	110.8±10.0 (108.6-110.3)	1.98	0.04	65.5±6.6 (64.8-66.1)	66.9±7.2 (64.8-66.1)	2.92	0.003
13 (boy=446; girl=380)	112.6±10.1 (111.6-113.5)	114.9±10.0 (113.9-115.9)	3.30	0.001	66.7±6.6 (66.1-67.3)	68.4±7.2 (66.1-67.3)	3.46	0.001
14 (boy=446; girl=380)	115.9±11.07 (114.9-116.9)	115.0±11.3 (113.9-116.1)	1.05	0.29	66.3±7.7 (65.6-67.0)	69.0±7.1 (68.2-69.7)	5.64	0.000

CI - Confidence interval

Table 2 - Prevalence of prehypertension, hypertension, and malign hypertension according to age and gender.

Status of blood pressure	Boys (n=1338)			Girls (n=1140)			Total (n=2478)
	12 (n=446)	13 (n=446)	14 (n=446)	12 (n=380)	13 (n=380)	14 (n=380)	
Normal (%)	87.2	82.7	80.5	81.6	72.1	73.7	**79.9**
Prehypertension (%)	10.8	12.6	13.6	12.6	19.2	16.8	**14.1**
Hypertension (%)	1.6	3.4	4.3	4.2	6.1	7.4	**4.4**
Malign hypertension (%)	0.4	1.3	1.6	1.6	2.6	2.1	**1.6**
Total (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 3 - Some characteristics of hypertensive and normotensive children.

Variable	Hypertensive (n=147)		Normal (n=2331)		x^2	*P* value	Total (n=2478)	
	n	(%)	n	(%)			n	(%
Age								
12	31	(3.8)	795	(96.2)	11.95	0.003	**826**	**(100)**
13	54	(6.5)	772	(93.5)			**826**	**(100)**
14	62	(7.5)	764	(92.5)			**826**	**(100)**
Gender								
Girls	91	(8.0)	1049	(92.0)	15.90	0.000	**1140**	**(100)**
Boys	56	(4.2)	1282	(9.8)			**1338**	**(100)**
Family history of hypertension								
Absent	101	(4.9)	1955	(95.1)	22.49	0.000	**2056**	**(100)**
Present	46	(10.9)	376	(89.1)			**422**	**(100)**
Physical activity								
Sedentary	29	(7.7)	349	(92.3)	2.41	0.12	**378**	**(100)**
Moderate+ active	118	(5.6)	1982	(94.4)			**2100**	**(100)**
Smoking								
Yes	2	(11.8)	15	(88.2)	1.04	0.30	**17**	**(100)**
No	145	(5.9)	2316	(94.1)			**2461**	**(100)**
BMI(kg/m²) percentile*								
<85th	77	(3.6)	2054	(96.4)	117.3	0.000	**2131**	**(100)**
85-94 th	36	(14.9)	206	(85.1)			**242**	**(100)**
≥95 th	34	(32.4)	71	(67.6)			**105**	**(100)**

BMI* - Body mass index, x^2 - Linear by linear association

higher in girls (Linear by linear association [x^2]=15.9, p=0.000). Hypertension prevalence gets higher as age rises (x^2=11.95, p=0.003). The difference between the prevalence of students with (10.9%) and without family (4.9%) history was considered significant. While the prevalence of hypertension was 3.6% of those who have BMI <85th percentile, it was 14.9% for those with BMI percentile between 85-94th and increases to 32.4% for those with BMI ≥95th percentile. The prevalence of sedentary physical activity group was found to be higher compared to moderate-active group, but the difference was not significant. Hypertension prevalence was 11.8% for smokers and 5.9% for non-smokers. The difference was not considered significant. A statistically significant relationship was observed between hypertension prevalence and age, gender, family history of hypertension, and BMI ≥85th percentile (**Table 4**). The hypertension risk was 1.92 times higher in girls. while in family group the risk was 1.96 times higher. When BMI was ≥85th percentile the risk was 6.4 times higher. No statistically significant relationship was observed between physical activity and hypertension.

Discussion. Blood pressure values rise with age during childhood. This is observed in all populations that have been studied.[8,15,17] In our study for both boys and girls average BP rose with age. The rise in BP with increasing age is most probably caused by the growth of the child. Most authors suggest that the most powerful determinant of normal BP is not chronological age. Hence, body size (height and weight) must be taken into account when assessing BP.[15,17] Studies carried out in Turkey and all over the world on children and adolescents show that hypertension prevalence is between 0.46-11.1%.[8,12,18-24] In our study, hypertension prevalence was 5.9%. These differences may be attributed to variations in study design, definitions of hypertension, methods of BP recording, age range, ethnicity, and social class.[25] Malign hypertension was diagnosed less frequently in children. In our study, the malign hypertension prevalence was 1.6%. Very young children, children with malign hypertension, and children or adolescents with clinical signs that suggest systemic conditions associated with hypertension should be evaluated more completely than in those with hypertension.[15] We did not ask students if they have had any symptoms of hypertension. Children with malign hypertension should be examined further to detect real causes. We have found that hypertension prevalence gets higher as age rises. There are studies carried out in different countries, which support our observations.[19,26] While some studies have found no gender difference, others have found higher prevalence in boys. In the study of Ucar et al, no statistically significant relationship was observed between hypertension prevalence and gender. In the same study, SBP was 3.7% in boys and 8.5% in girls of 11-14 aged group.[12] Hypertension prevalence was found to be higher in girls in the study of Pileggi et al, but the difference is not significant.[19] There is no observed statistically significant relationship between gender and hypertension prevalence in Kardas et al's study and Garcia's study.[27,28] There are studies which claims that hypertension prevalence is higher in boys.[29,30] In our study, we observed that it is 1.91 times higher in girls. There are existing studies which disclose the relation between sexual maturation and BP.[31,32] It was found in girls of age 14 that there was a relation between age at menarche and DBP.[32] We did not consider the sexual maturation and the age at menarche. The reason for the high hypertension prevalence in young girls may be related to maturation. It will be advisable to make a further study on this high risk observed in girls.

It is found that adolescents who have BMI ≥85th percentile have 6.4 times more risk compared to ones

Table 4 - Results of logistic regression.

Variable	Odds ratio	95% Confidence interval	*P* value
Age	1.14	1.13-1.76	0.002
Gender*	1.92	1.34-2.75	0.000
Body mass index†	6.40	4.49-9.12	0.000
Positive family history‡	‡1.96	1.33-2.89	0.001
Physical activity§	1.42	0.91-2.22	0.12

*Reference category: Boys, Risk category: Girls
†Reference category: BMI <85, Risk category: BMI ≥85
‡Reference category: Negative family history of hypertension, Risk category: Positive family history of hypertension
§Reference category: Moderate and active physical activity, Risk category: Sedentary physical activity

that have BMI <85th percentile. It is indicated that hypertension risk at adolescents with BMI between 25-30 is 2.9 times more compared to adolescents with BMI <25 at Fricela study. The risk is 4.9 times more for ones with BMI >30 compared to ones with BMI <25.[33] There are epidemiological studies that indicate obesity in children and adolescents is an important risk factor for hypertension. Among obese/overweight children, hypertension prevalence is significantly higher than children and adolescents with normal weight. [19,25,26,28] Hypertension of family members increases the risk of hypertension. Adolescents with a family history of hypertension have 1.96 times more risk. The relation between family history and hypertension is also indicated at the study made in Poland.[23]

It is known that there is a relation between hypertension and physical inactivity. Although not significantly different in our study, the prevalence of hypertension in the sedentary group was higher than the moderate and active group. A weak relation between physical activity and hypertension is figured out at Belgian in children.[34] A negative relation is found between physical activity and SBP at the study of Bouziotas et al.[35] The physical activity state at our study was evaluated according to answers of students to a question. The duration and frequency of the activity were not investigated. This can be considered a limitation of our study.

Age, being at risk of overweight, being overweight, and family history of hypertension are important risk factors for hypertension. It will be reasonable to investigate the reasons of higher risk in girls. In Turkey, the Health Centers are responsible for school health. Measuring the BP of school children should be added to routine school health examinations. The public should be educated on hypertension. The prevalence of hypertension in children increases with overweight and risk of overweight. The prevention of overweight and risk of overweight can decrease the prevalence of hypertension.

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