Hypertension and overweight among Turkish adolescents in a city in Aegean region of Turkey: a strong relationship in a population with a relatively low prevalence of overweight

Türkiye'de Ege Bölgesi'ndeki bir kentte yaşayan adolesanlarda hipertansiyon ve fazla kilolu olma: Fazla kiloluluğun düşük olduğu bir toplumda güçlü ilişki

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ABSTRACT

Objective: A school-based survey was performed in 1346 adolescents aged 15-18 years to determine the relationship between "overweight" and hypertension among adolescents in a western city in Turkey with a low prevalence of "overweight".
Methods: The data were collected by a self administered questionnaire. Weight and height of adolescents were measured. US CDC pediatric anthropometric reference data were used to establish the body mass index (BMI) percentile. "At risk of overweight" (BMI-for-age and sex ≥85th, and <95th percentile) and "overweight" (BMI-for-age and sex ≥95th percentile) were defined. Hypertension (systolic and/or diastolic blood pressure that is ≥95th percentile for sex, age and height percentile) was defined according to the 4th Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents (2004). The Chi-square test, Chi-square test for trend and logistic regression models were used for analysis.
Results: Overall, prevalence of "at risk of overweight" and "overweight" were found to be 10.7% and 3.2%, respectively. About 3.5% of the adolescents were hypertensive. After adjustment for sex and age, income, family history of hypertension, the factors positively associated with hypertension were "at risk for overweight" (Odds Ratio [OR]=5.09, 95% CI: 2.57-10.07) and "overweight" (OR=7.60, 95% CI: 2.90-19.89).
Conclusion: The results of this study confirm low hypertension risk among adolescents in Manisa, which may be attributed to the low prevalence of "overweight". The relatively low cardiovascular disease risk factor profile of these adolescents needs to be encouraged through adulthood. Thus, a school program of health promotion should be established to prevent the epidemics of cardiovascular diseases in our region. *(Anadolu Kardiyol Derg 2009; 9: 450-6)*
Key words: Overweight, hypertension, epidemiology, Turkish, adolescent, logistic regression analysis

ÖZET

Amaç: Türkiye'de batı bölgesinde "fazla kiloluluk" prevalansının düşük olduğu bir kentte "fazla kiloluluk" ve hipertansiyon ilişkisini tanımlamak amacı ile 15-18 yaş grubu 1346 adolesan üzerinde okul tabanlı bir enine-kesitsel çalışma yürütülmüştür.
Yöntemler: Adolesanların yaş, cinsiyet özellikleri sorgulanmış, ağırlık ve boyları ölçülmüştür. Vücut kütle indeksi yüzdelikleri US CDC tarafından yaş ve cinsiyete göre geliştirilmiş olan referans veriler kullanılarak "fazla kilolu olanlar (≥95. yüzdelik)" ve "fazla kiloluluk için riskli olanlar (≤85. yüzdelik- <95. yüzdelik)" tanımlanmıştır. Hipertansiyon (yaş, cinsiyet ve boy yüzdeliğine göre sistolik ve/veya diyastolik kan basıncı 95. yüzdelik ve üzerinde olanlar) "Çocuklarda ve Adolesanlarda Yüksek Kan Basıncının Tanısı, Değerlendirmesi ve Tedavisi Konusunda Dördüncü Rapor (2004)"a göre tanımlanmıştır. İstatistiksel analizlerde Ki-kare testi, eğimde Ki-kare testi ve lojistik regresyon modeli kullanılmıştır.
Bulgular: Araştırma grubunun %10.7'si "fazla kiloluluk için riskli", %3.2'si "fazla kilolu" olarak saptanmıştır. Araştırma grubunun %3.5'i hipertansiftir. Yaş, cinsiyet, gelir düzeyi ve ailede hipertansiyon öyküsüne göre düzeltilmiş analizlerde "fazla kiloluluk açısından risk altında olma" (Olasılık Oranı [OR]=5.09, %95GA: 2.57-10.07) ve "fazla kiloluluk" (OR=7.60, %95 GA: 2.90-19.89) hipertansiyon açısından risk oluşturan faktörler olarak saptanmıştır.
Sonuç: Araştırmanın sonuçları Manisa'da adolesanlarda fazla kiloluluk ve hipertansiyon prevalansının düşük olduğunu göstermektedir. Adolesanların düşük kardiyovasküler risk profilinin yetişkinlikte de sürdürülmesi önem taşımaktadır. Obesite ve hipertansiyondan primer korunmada okul tabanlı bir sağlığı geliştirme programı oluşturulmalıdır. *(Anadolu Kardiyol Derg 2009; 9: 450-6)*
Anahtar kelimeler: Fazla kiloluluk, hipertansiyon, epidemiyoloji, Türk, adolesan, lojistik regresyon analizi

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Introduction

The early 21st century has seen the development of a global epidemic of childhood "overweight/obesity". Various studies estimate that 8-25% of adolescents (14-17 years) in developed countries carry excess body fat (body mass index (BMI)-for-age and sex ≥85th percentile) (1). With the BMI ≥95th percentile, "overweight" prevalence has been found 20% (2002) and 17% (2003-2004) among American teenagers in two different surveys (2, 3). Developing countries have relatively lower prevalence rates for "overweight". "Overweight" prevalence (equivalent to adult BMI of 25 kg/m^2 or more) has been found 4.7% in boys and 15.2% in girls in Brazil (1989) while they were 11.7% vs 9.8% for Hong Kong (1993) and 10.5% vs 7.0% in Singapore (1993) (4). The studies on Turkish adolescents indicate that 9.0% to 15.8% of adolescents are "at risk of overweight" (BMI-for-age and sex ≥85th, and < 95th percentile), and 1.1 to 3.6% of adolescents are "overweight" (BMI-for-age and sex ≥95th percentile) (5-8). The recent surveys on Turkish children aged 6-17 years revealed similar prevalence of "at risk for overweight" between 14.3% and 10.5%; the prevalence of "overweight" between 3.6% and 6.1% (9-11). The overweight epidemic is spreading at particularly alarming rates in children in both developed and developing countries. The increase has accelerated in recent years: according to the International Obesity Task Force, the annual increase in prevalence of around 0.2% during the 1970s rose to 0.6% during the 1980s and to 0.8% in the early 1990s, and in some cases reached as high as 2.0% by the 2000s (12).

Child and adolescent overweight is associated with both immediate and long-term medical and psychosocial problems, including risk factors like hypertension for development of cardiovascular disease and diabetes. In concert with this increase in the prevalence of "overweight", primary hypertension in children has become increasingly common (3, 13-16). There is much evidence showing that "overweight" and hypertension are associated; however, most of these studies were carried out in developed countries where high overweight prevalence was recorded (13, 14, 17-19). There are only a few published data available in developing countries, which have relatively lower "overweight" rates analyzing the relationship between overweight and hypertension. The results of these studies have shown that there is a strong relationship between BMI and hypertension (20-22).

In this cross-sectional study, we aimed to assess the relationship between overweight and hypertension among adolescents in a city in Aegean Region of Turkey where the prevalence of overweight is relatively low.

Methods

Study sample

The survey was conducted on a representative sample of high school children aged 15-18 years in Manisa, Turkey. Manisa is a non-coastal city in the Aegean region of Turkey. The mid-year census of Manisa city was 218,314 in 2000. The study has been approved by the Bureau of Statistics of the Provincial Education Administration of Manisa, and the Governorship of Manisa. The study population was comprised of 11,551 students of all 9 public and 3 private high schools. 56.3% of the study population was male. Among the study population, 7.4 % were at pre-high school grade, 35.5% were at grade 1 of high school, 25.8% were at grade 2 and 31.3% were at grade 3 of high school.

The sample size was calculated using an estimated prevalence of overweight for the analyzed age group: 3%. A 95% CI and a precision of 1% were used. Overall, 1117 of 11,551 students from 12 high schools were calculated as the sampling group. Each school had three or four grades with approximately 40 students in each class. The number of students to be selected from each school was determined by probability proportional to size sampling method. Classes were selected from schools with the intent of providing an overall age distribution comparable to the population's age distribution. All of the students from randomly chosen classes were interviewed. The students who were not at the school during the data collection days were not included into the study. A total of 1385 school adolescents were accessed in this survey. 39 (2.8%) of them were not included in the analysis since they did not record their sex information on the questionnaires. Analysis was carried out in 1346 adolescents.

Among the study sample: 56.9% were male; 16.2% were at pre-high school grade, 30.7% were at grade 1 of high school, 33.5% were at grade 2 and 19.6% were at grade 3 of high school. The data on class distribution of study sample and study population was similar except for the minimal differences in the percentages of pre-high school and grade 3 of high school.

Data collection

A self-administered questionnaire was used with the assistance of teachers. The questionnaire solicits demographic data as well as information concerning families' income level compared to the expenses as perceived by the child, family history of hypertension defined as the presence of hypertension in either one of the parents. Weight, height and and blood pressure were measured by two nurses.

Measurements

a) Anthropometric measurement and definition

For each child; weight was measured using a calibrated scale to the nearest 0.1 kg in light clothes, and height was taken using a calibrated height stand to the nearest 0.1 cm without shoes. Body mass index was calculated as weight/(height)^2 (kilograms/square meter). Pediatric anthropometric reference data, specific for sex and age as described by the United States Centers for Disease Control (US CDC) were used to establish the BMI percentile for each student (23). BMI percentile categories of ≤5th, 10th, 25th, 50th, 75th, 90th, and ≥95th were generated by rounding the exact BMI percentile to the nearest categorical threshold. Using accepted conventions, we use "overweight" to describe those with ≥95th percentile BMI for age and sex and "at risk for overweight" to describe those in the 85th to 95th percentile for age and sex (24).

b) Blood pressure measurement and definition

Blood pressure was measured in a sitting position after 5 minutes of rest, using a standard adult sphygmomanometer. (Erkameter; width 13 cm and the length 23 cm). Phase I Korotkoff sound (K1) was used to indicate systolic blood pressure (SBP). Phase V Korotkoff sound (K5), was used to indicate diastolic blood pressure (DBP). Students, who were found to have SBP or DBP greater than or equal to the sex, age, and height-percentile-specific 90th percentile, were measured again after 15 min (second measurement). Students, in whom both blood pressures (BP) (first and second measurements) were found to be elevated, were measured for a third time in the same visit. Only the last measurement was recorded for students with repeated measurements. Hypertension and prehypertension prevalences were calculated according to "The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents". "Hypertension" is defined as SBP and/or DBP that is ≥95th percentile for sex, age and height percentile. "Prehypertension" is defined as SBP or DBP levels that are ≥90th percentile but <95th percentile (25). To define the height percentile, we used the US CDC growth charts (23).

Analysis

All statistical analyses were performed using SPSS for Windows® 10.0 (Chicago, IL, USA). The χ^2 test and χ^2 test for trend were used for analysis. Two logistic regression models were developed to examine the associations between "overweight" and prehypertension/hypertension, hypertension. Adjusted odds ratios (ORs) and their corresponding 95% CIs were calculated. Age, sex, income level (11), and family history of hypertension (26) were included as confounders in multivariate analysis.

Results

Overall, 1346 adolescents were enrolled in the study and 766 (56.9%) of these were male. Among the students, 31.4% were 15 years old, 35.3% were 16 years old, 23.1% were 17 years old and 10.2% were 18 years old. Frequency of self reported family history of hypertension was 297 (22.0%). Overall, 113 (8.6%) reported that their family's income exceeded the expenses.

Overall, 3.2% were overweight and 10.8% were at risk for overweight. We found no significant associations between "at risk for overweight" and age, gender, family income. Similar statistically nonsignificant results were obtained between "overweight" and age, gender, family income (Table 1).

Systolic hypertension was found in 2.5%, while 1.8% had diastolic hypertension. The percentages of prehypertension or hypertension for systolic BP was 3.7% while it was 15.4% for diastolic BP. We found that 14.0% of the adolescents were prehypertensive (SBP or DBP levels that are ≥90th percentile but <95th percentile) and 3.5% were hypertensive (SBP and/or DBP that is ≥95th percentile). Thus, 17.5% of the adolescents were found to be prehypertensive or hypertensive. Hypertension prevalence was almost the same for boys (3.7%) and for girls

Table 1. The distribution of the children according to body weight categories

	Body weight*			Total
	Normal (%)	At risk for overweight† (%)	Overweight†† (%)	
Sex (n)				
Male (766)	85.9	10.2	3.9	100.0
Female (580)	86.0	11.7	2.2	100.0
Age (years) (n)				
15 (423)	85.3	11.1	3.5	100.0
16 (475)	84.0	12.2	3.8	100.0
17 (311)	87.5	9.6	2.9	100.0
18 (137)	91.2	8.0	0.7	100.0
Income vs expenses (n)#				
Income ≥ expenses (113)	79.6	15.0	5.3	100.0
Income = expenses (985)	86.2	10.7	3.1	100.0
Income < expenses (220)	88.2	9.5	2.3	100.0
Total (1346)	86.0	10.8	3.2	100.0

†85th to 95th percentile BMI for age and sex, ††≥95th percentile BMI for age and sex
#28 missing
*p>0.05 for all comparisons, χ^2 test: "at risk for overweight or overweight" vs "normal" according to sex, age and income level
p>0.05 for all comparisons, χ^2 test: "overweight" vs "normal" according to sex, age and income level
BMI – body mass index

(3.3%) (p>0.05). Females, compared to males, had a higher prevalence of prehypertension or hypertension (20.1% vs 15.2%; p<0.05). The prevalence of hypertension was similar in different ages (p>0.05). The prevalence of prehypertension/hypertension was highest among children aged 15 years old (25.5%) (p<0.001), while the percentages were 17.1%, 11.1 % and 9.7% for 16 years, 17 years and 18 years, respectively (Table 2).

Percentage of hypertensive adolescents increased progressively as the BMI percentile increased from <3rd percentile (0.0%) to ≥97th percentile (16.0%) (p<0.001). We also found a linear increase in the percentage of prehypertensive or hypertensive adolescents as the BMI percentile increased from the <3rd (11.6 %) to the ≥97th percentile (32.0 %) (p<0.001) (Table 3).

As shown in Table 4, in the first logistic regression model, adolescents aged 15 (OR=3.24, 95% CI: 1.71-6.14) and aged 16 (OR=1.91, 95% CI: 1.01-3.64) had a significantly higher risk of prehypertension/hypertension when compared to the ones at age 18. Moreover, the risk of prehypertension/hypertension was significantly increased in the "at risk for overweight" (OR=2.22, 95% CI: 1.48-3.31) and "overweight" (OR=2.35, 95% CI: 1.18-4.69) groups when compared to normal weight adolescents. In the second model, the factors positively associated with hypertension among hypertensive and normotensive adolescents were "at risk for overweight" (OR=5.09, 95% CI: 2.57-10.07) and "overweight" (OR=7.60, 95% CI: 2.90-19.89).

Table 2. The distribution of the children according to blood pressure categories

	Blood pressure categories**			Total
	Normal (%)	Prehypertension# (%)	Hypertension## (%)	
Sex (n)				
Male (766)	84.9	11.5	3.7	100.0
Female (580)	79.3	17.4	3.3	100.0
Age (years) (n)				
15 (423)	74.5	22.0	3.5	100.0
16 (475)	82.9	13.7	3.4	100.0
17 (311)	89.1	8.0	2.9	100.0
18 (137)	90.5	4.4	5.1	100.0
Income vs expenses (n)†				
Income ≥ expenses (113)	76.1	19.5	4.4	100.0
Income = expenses (985)	83.2	13.2	3.6	100.0
Income < expenses (220)	81.8	15.5	2.7	100.0
Family history of hypertension (n)				
Yes (297)	80.5	15.8	3.7	100.0
No (1049)	83.0	13.5	3.4	100.0
Total (1346)	82.5	14.0	3.5	100.0

#Hypertension is defined as systolic BP and/or diastolic BP that is ≥95th percentile for sex, age and height percentile, ##Prehypertension is defined as systolic BP or diastolic BP levels that are ≥90th percentile but <95th percentile
†28 missing
**p<0.01 for all comparisons, χ^2 test:"prehypertension or hypertension" vs "normal" according to sex, age
p>0.05 for all comparisons, χ^2 test:"prehypertension or hypertension" vs "normal" according to income level, family history of hypertension
p>0.05 for all comparisons, χ^2 test:"hypertension" vs "normal" according to sex, age, income level, family history of hypertension
BP - blood pressure

Table 3. Distribution of prehypertension and hypertension by BMI percentiles†,††

	Normal (%)	Prehypertension# (%)	Hypertension## (%)
BMI percentiles (n)			
<3 (43)	88.4	11.6	0.0
3-10 (97)	89.7	10.3	0.0
10-25 (199)	85.4	13.1	1.5
25-50 (358)	85.5	12.3	2.2
50-75 (326)	82.8	14.1	3.1
75-85 (134)	78.4	17.2	4.5
85-90 (82)	75.6	13.4	11.0
90-95 (64)	65.6	26.6	7.8
95-97 (18)	72.2	16.7	11.1
>97 (25)	68.0	16.0	16.0
Total (1346)	82.5	14.0	3.5

†p<0.001, χ^2 test for trend (prehypertension/ hypertension vs normal)
††p<0.001, χ^2 test for trend (hypertension vs normal)
BMI - body mass index

Discussion

The current study shows that our study group has a lower overweight risk compared to the adolescents from both developed countries and some other developing countries (1-3, 12). On the other hand, our results are similar to the results of the other Turkish studies (5-8). We found that only 3.9% of boys and 2.2% of the girls were overweight while 10.2% and 11.7% were found to be at risk for overweight, respectively. Oner et al. (6) demonstrated that the prevalence "at risk of overweight" and the prevalence of "overweight" among adolescent girls were 10.6% and 2.1%, while they were 11.3% and 1.6% for adolescent boys, respectively. Ozmen et al. (5) has also found similar rates as 10.3% and 1.1% for boys and 7.7% and 1.1% for girls aged between 15-18 years old. The other surveys have similar rates that range between 10.7%- 15.8% for "at risk of overweight" and 3.6%- 3.4% for "overweight" among Turkish adolescents (7, 8). The variations of the prevalence rates in Turkish studies may be due to using different standards like International Obesity Task Force (IOTF) definitions or reference values from the US CDC. However, it can be concluded that Turkish adolescents have relatively lower "overweight" risk compared to the "overweight" risk of adolescents from developed countries. In our study, we have used US CDC reference values, therefore, the prevalence of "at risk for overweight" and "overweight" might have been under-estimated since Turkish children's reference is estimated to have a lower overweight prevalence compared to US children's (5-8, 11). This is also true for other Turkish originated studies that have used Western references.

On the other hand, approximately one fifth of the adolescents were found to be "at risk of overweight" in some of the developed countries (13, 19). Reasons for lower prevalence of "overweight" among Turkish adolescents are largely unknown but this may be attributed to the Mediterranean type diet containing more vegetables and less meat and carbohydrate. Studies on Turkish immigrants in western countries support this explanation. Fredriks et al. (27) studied on Turkish immigrants in the Netherlands and they showed that 23.4% of Turkish boys and 30.2% of Turkish girls were "overweight". These rates are quite high compared to the rates found in Turkey (27).

According to our findings, 3.5% of adolescents were hypertensive. The results of another Turkish adolescent study by Uçar et al. confirmed the relatively lower hypertension rate with a hypertension prevalence of 3.1% for girls and 3.6% for boys (28). Studies about prevalence of hypertension in school-aged children and adolescents in international studies have revealed varying prevalence rates, between 1.2% and 13.3%. Such variations may be the consequence of methodological differences, number of measurements used and different

Table 4. Logistic regression models for prehypertension/hypertension and hypertension

	Beta	Standard error	p	OR (95% CI)
Model I: (prehypertension/ hypertension vs normal) †,††				
Sex				
Male (ref)				1
Female	0.28	0.14	0.055	1.33 (0.99-1.78)
Age				
15	1.17	0.32	0.001	3.24 (1.71-6.14)
16	0.64	0.32	0.049	1.91 (1.01-3.64)
17	0.21	0.35	0.55	1.23 (0.61-2.47)
18 (ref)				1
BMI categories				
Normal (ref)				1
At risk for overweight	0.79	0.20	0.001	2.22 (1.48-3.31)
Overweight	0.85	0.35	0.015	2.35 (1.18-4.69)
Constant	-2.52	0.31	0.001	
Model II: (hypertension vs normal) †,††				
BMI categories				
Normal (ref)				1
At risk for overweight	1.62	0.34	0.001	5.09 (2.57-10.07)
Overweight	2.02	0.49	0.001	7.60 (2.90-19.89)
Constant	-3.60	0.19	0.001	

†The independent variables included in the models: sex (male/female), age (15,16,17,18), income vs expenses (income≥expenses/income=expenses/ income<expenses), family history of hypertension (yes/no), BMI categories (normal/ at risk for overweight/ overweight)

††R square=0.069 for Model I, R square=0.083 for Model II

BMI - body mass index

reference criteria and variations between BMI distribution (2, 13, 14, 17-22). The results of these surveys showed that hypertension is more prevalent among adolescents of developed countries with higher overweight prevalence. We found relatively lower hypertension rate among adolescents compared to the studies carried out in developed countries. Moreover, we measured the blood pressure three times in the same visit for the students who have a SBP or DBP greater than or equal to the sex, age, and height-percentile-specific 90th percentile. The Task Force recommendation is that "elevated BP must be confirmed on repeated visits before characterizing a child as having hypertension" (25). Sorof et al. (2) found the prevalence of elevated blood pressure among adolescents on the first screening was 19.4 % while it was 9.5 % and 4.5 % after the 2nd and 3rd screenings, respectively. McNiece et al. (19) has also found that 9.4% of the children were hypertensive at initial screening while only 3.2% were found to be hypertensive after three screenings. This reduction in prevalence is consistent with the Task Force expectation. Therefore, we expect that we would have found a lower prevalence of hypertension if we could repeat the BP measurements in subsequent visits.

Relatively lower hypertension prevalence in the current study population may depend on the lower overweight prevalence. The prevalence of adolescents with a BMI ≥95 percentile was found to be 3.1 % in our study group, whereas, it was reported to be between 11-20 % in some studies in western countries (2, 14). The strongest determinant of hypertension in our study population was BMI percentile. In other words, BMI was found to be significantly higher in hypertensive adolescents compared to normotensive and prehypertensive adolescents. Moreover, a linear increase in the prevalence of hypertension was found concordant with the increase in BMI. The same linear increase was also found by Rosner et al for diastolic hypertension (17) and by Sorof et al for systolic hypertension (18). Sorof et al. (18) reported that the overall prevalence of hypertension after 3 sets of measurements was 4.5% among adolescents. In their study, high prevalence of hypertension seemed to depend on the overall prevalence of overweight in the total study population of 20%. More than fourfold increase in the prevalence of elevated blood pressure at first screening was observed as BMI percentile increased from <5th percentile (9%) to ≥95th percentile (38%) in Sorof et al's study (2). In our study we found that 2.4% of the adolescents with a BMI value<85th percentile were found as hypertensive. Hypertension prevalences were obtained 9.5% and 13.6% for the adolescents at risk for overweight and overweight, respectively. Thus, the results indicated more than twofold increase in the prevalence of elevated blood pressure among adolescents who are at risk for overweight compared to the data of adolescents with BMI values <85th percentile. Overweight adolescents have a five-fold higher risk of hypertension compared to normal weight ones. The strong relationship between overweight and high blood pressure has also been confirmed by other studies (29, 30).

Strengths and limitations of the study

This was a random-selected, school-based study. Similarity between gender and school grade values demonstrated that the study sample was representative of the study population. However not all the children in this age group attend school, even in Manisa city since schooling at high school in Turkey is not obligatory. According to the results of Manisa Demographic and Health Survey, 63.9% of male adolescents (between 15-18 years) were attending high school while it was only 53.5% in girls (31).

Measurement bias was avoided by using two experienced nurses for anthropometric and blood pressure measurements. However, since self-reported information was obtained for family income and history of hypertension from the adolescents, this might have led to measurement bias but since this bias is expected to be independent of BMI level of the adolescent, it may be undifferentiated bias. This bias might have led to a weaker estimated OR between "overweight" and "hypertension" (32).

"Overweight" was diagnosed according to the reference data of the US CDC since there was not national representative reference data for Turkish children up to date. There is a lack of a continuous growth-monitoring program involving children and adolescents in Turkey. Recent studies have just been published using the data of healthy school children in different three cities. Neyzi et al. (33) published the growth charts on Turkish children based on measurements of children of well-to-do families in Istanbul. They found that heights of the boys and girls in all age groups were close to the updated US CDC growth references. They also found body mass index references were quite similar to the references reported from some European countries (33). But this study is criticized as centile curves were developed only from children representing higher social status, addressing the upper socio-economic strata (33) In another study conducted among healthy schoolchildren aged 6-17 years from different social classes in Ankara, comparison of height of Turkish children with the US CDC growth charts showed that the former are shorter (11). According to another study conducted in Kayseri, BMI references of Turkish children are lower than in South East Europe, UK and North American populations, but higher than in Central European and Scandinavian countries (34). As regard to the surveys, the results of these studies revealed that Turkish adolescents have a lower overweight prevalence compared to the studies conducted in USA (5-8). Therefore, we think that if we could have used a national representative updated reference data we could have found higher prevalence of "overweight" and "at risk for overweight".

There is a strong relationship between "overweight" and "hypertension" but since this is a cross sectional study, direction of causality cannot be definitely stated (32).

Conclusion

The results of this study confirm low overweight and hypertension risks among adolescents in Manisa. The low hypertension prevalence may be attributed to the low prevalence of "overweight" since the strongest determinant of hypertension was the BMI percentile. The relatively low cardiovascular disease risk factor profile of these adolescents needs to be encouraged through adulthood. Thus, a school program of health promotion should be established to prevent the epidemics of cardiovascular diseases in our region, as predicted by the World Health Organization for countries in epidemiological transition.

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