Peer reviewed article

Prevalence of underweight, overweight and obesity in Turkish adolescents

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Summary

Background: The aim of this study was to determine underweight, overweight and obesity prevalence in a representative sample of adolescents living in urban and rural area of central Edirne, Turkey, and to compare the 95th percentile BMI curve to the curves of other countries.

Material and methods: Data concerning the height and weight of 989 adolescents, aged between 12 and 17 years were collected. The prevalence of underweight was defined as the percentage of adolescents below the 5th percentiles of the American adolescents' age and gender specific BMI; prevalence of overweight and obesity were based on the cut off points of the International Obesity Task Force values (excess of the 85th and 95th percentiles), respectively.

Results: This study demonstrated that the prevalence of underweight, overweight and obesity among adolescent girls was 11.1%, 10.6% and 2.1%, respectively, while it was 14.4%, 11.3% and 1.6% for adolescent boys. In the urban area the prevalence of underweight, overweight and obesity among adolescent girls was 10.0%, 10.3% and 2.1%, while it was 14.4%, 11.6% and 1.6% for boys, respectively. In the rural area; the prevalence of underweight, overweight and obesity among adolescent girls was 15.7%, 12.4% and 2.2%, while it was 14.5%, 9.6% and 1.2% for boys, respectively.

Discussion: Analyses of data collected during these studies support that adolescents living in the city of Edirne carry relatively lower further risk of overweight and obesity than adolescents in other countries do.

Key words: prevalence; underweight; overweight; obesity; adolescents; BMI

Introduction

Adolescence is characterized by rapid physical and sexual growth and changes in body fat which consequently result in adult weight and height. Therefore, it is an important period of human life. Childhood and adolescence obesity has been identified as a risk factor for obesity in adulthood, and is related to an increased adult morbidity and mortality by leading to a variety of conditions such as insulin resistance, lipid and lipoprotein abnormalities and elevated blood pressure [1, 2].

In contrast to studies of children and adults, relatively little information is available about the development of racial differences in weight status among adolescents [3–8]. However, it has recently been estimated that adolescent obesity prevalence is increasing not only in developed countries but also in some developing countries in which malnutrition used to be the major nutritional disorder [8–10].

Adolescents' growth is influenced by individual, racial, and environmental factors. During childhood and adolescence, BMI is the preferred method of expressing body fat percentile of groups. It is widely accepted that a BMI between the 85th and 95th percentiles is defined as overweight, and a BMI greater than the 95th percentile as obesity [11–13]. However, racial differences may be found in BMI values [14–17]. For example, the 85th percentile of children of the United States of America which brings the percentage of obesity to about 12.5%, fits to the 95th percentile of Brazilian children and 90th percentile of British children [9, 18–20]. Therefore, it is necessary to find out the values which are specific to our community.

Edirne is in the north-western part of Turkey where the three Thracian nations, Turkey, Greece and Bulgaria meet and it occupies a position linking Anatolia to Europe. The aim of this study was to determine BMI percentiles, overweight and obesity prevalence in a representative sample of

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adolescents living in the urban and rural area of the Edirne centre, and to compare the 95th percentile BMI curve to the curves of the other countries and the recently published International Obesity Task Force (IOTF) values [12].

Methods

Study design and subjects

Data were derived from current studies, namely "The Prevalence of Anemia Among the Adolescent Girls Living in Edirne" and "Pubertal Growth and Sexual Maturation in Adolescent Boys in the Province of Edirne" in which height and weight were measured simultaneously as blood samples were collected and physical examinations performed. These cross-sectional studies were carried out at the same time (between May 2001 and July 2001), and covered representative samples of the 12–17 years old Turkish (Edirne) adolescents. Written informed consent was obtained and a questionnaire to get demographic data was sent to the parents a day before the measurements. Participation was voluntary and consent from both the parents and the adolescents was obtained. These two studies were approved by the local Ethics Committee of the Trakya University, Faculty of Medicine.

Adolescents were selected with the cooperation of the Public Health Department of Trakya University. The data were collected during the 2001–2002 school year and were obtained from all the primary, secondary and high schools of urban and rural areas of the Edirne centre. At the end of the year 2000, the entire population of the Edirne centre was estimated to be 120000, with 14000 adolescents (51% boys, 49% girls) aged between 12 and 17 years [21]. The percentage of adolescents, aged between 12 and 17 years, attending schools was 91.4% for girls and 91.6% for boys.

In both studies, the sample size we reached was determined by the following weighing steps. First, the number of adolescents in the different age groups was determined according to their percentages in the whole population. Second, the number of subjects living in rural and urban areas was determined (while 17.4% of them lived in rural areas, 82.6% lived in urban areas). The number of students that were selected from each school was determined according to the total number of the student population of each school. Finally, the classrooms were chosen in systematic random basis, and each adolescent was determined randomly from the selected classrooms. In these studies, in each classroom we selected substitutes that represented half of the selected adolescents, and those individuals were used in case of non-participation of the main list members.

Anthropometric measurements

The measurements of body height and weight were carried out by two trained paediatricians in the morning when the adolescents were in fasting state. Body weight (in kilograms) was measured to the nearest 0.1 kg with an electronic scale (SECA 762; Vogel and Hakle, Hamburg, Germany). Body height was measured to the nearest 0.5 cm as the adolescents stood erect against a vertical wall-mounted scale with heels, buttocks, and occiput in the Frankfort plane with anthropometric square. The adolescents were dressed with light underclothing and wore no shoes throughout the measurements. BMI (kg/m^2) was calculated as the ratio of the body weight to the square of body height.

Statistical analysis

Descriptive statistics on BMI, weight and height measurements, including the median (50th percentile) and the other percentiles (5th – 15th – 75th – 85th – 95th for BMI) were performed. The estimations of the prevalence of overweight and obesity were based on the cut off points of IOTF values (in excess of the 85th and 95th percentiles, respectively). The prevalence of underweight was defined as the percentage of adolescents below the 5th percentiles of the American adolescents' age and gender specific BMI, recently published by Rosner et al. [14]. All statistical analysis was performed using Minitab Release 13, reference number: wcp 1331.00197 (Trakya University, Faculty of Medicine, Data Processing Center). Many associations, including the ethnic specific comparisons of BMI were examined graphically.

Results

The sample, representing adolescents aged between 12 and 17 years, consisted of 1064 subjects (526 girls, 538 boys, 7.6% of the target population). From these records, 70 of them were excluded because of lack of important demographic data such as date of birth. We also excluded 3 adolescents who had growth disturbances due to primary diseases (renal failure, diabetes and malignancy) and 2 adolescents who were receiving high dose steroid therapy for severe asthma. The final sample of this study included 989 adolescents, representing 93.0% of the original sample (476 of them were girls, 513 of them were boys) and 7.1% of the target population. While 17.2% of the 989 adolescents lived in rural area, 82.8% lived in urban area. Mean values (standard deviation) for body weight, height and calculated BMI for adolescents in relation to age are shown in table 1. Crude BMI percentiles for adolescents are shown in table 2.

In the adolescent girls, the prevalence of underweight, overweight and obesity were found as 11.1%, 10.6% and 2.1%, respectively, while those were 14.4%, 11.3% and 1.6% for adolescent boys, respectively. Underweight, overweight and obesity prevalence for different ages of Turkish adolescents are shown in table 3. Underweight, overweight and obesity prevalence with respect to living area are shown in table 4.

Ethnic specific comparisons of BMI were illustrated graphically (figures 1 and 2). When we examined the adolescent girls' 95th BMI percentile

Table 1
Mean values (SD) [range] for body weight, height and BMI for Turkish adolescents in relation to age.

Age (years) (girls/boys)	height (cm)		weight (kg)		BMI (kg/m²)	
	girls	boys	girl	boys	girls	boys
12 (123/116)	150 (8.6) [130–169]	148.7 (7.2) [135–165]	41.5 (10.1) [22.7–73]	39.5 (7.1) [27–58]	18.3 (3.3) [13.4–27.2]	17.8 (2.38) [13.2–24]
13 (99/104)	157.3 (6.4) [139–170]	154.3 (7.8) [141–173]	48.4 (9.1) [28.5–72]	44.1 (8.7) [30–70]	19.5 (3.1) [14.1–28.4]	18.5 (3.0) [14.5–28.3]
14 (71/80)	159.8 (6.1) [144–172]	159.4 (8.6) [147–185]	50.8 (8.4) [35.3–79.9]	49.1 (10.8) [35–85]	19.8 (2.8) [16–30.5]	19.2 (3.3) [14.1–31.6]
15 (66/75)	158.6 (6.5) [143–171]	167.5 (8.3) [153–187]	52.7 (8.7) [35.3–84]	55 (10.6) [40–84]	21.0 (3.2) [15.2–33]	19.5 (2.9) [15.4–29.4]
16 (55/60)	161.9 (6.4) [149–181]	171.6 (6.1) [160–185]	54.1 (9.2) [39.3–82.2]	60.4 (9.5) [45–85]	20.6 (3.2) [15.7–31.2]	20.5 (3.2) [16.3–31.2]
17 (62/78)	161.4 (5.6) [148–173]	173.8 (5.9) [162–189]	54.8 (8.6) [38–85]	66.2 (10.3) [50–92]	21.0 (3.1) [16.2–30.2]	21.9 (3.0) [16.9–29.8]

* Data presented as mean (SD) [min-max]

Table 2
Crude percentiles for BMI (kilograms per square meter) in our subjects.

percentiles	age (years)											
	12		13		14		15		16		17	
	girls n = 123	boys n = 116	girls n = 99	boys n = 104	girls n = 71	boys n = 80	girls n = 66	boys n = 75	girls n = 55	boys n = 60	girls n = 62	boys n = 78
5	14.1	14.8	15.2	15.1	16.5	14.9	16.4	16.4	17.2	16.7	16.9	17.7
10	14.5	15.1	15.8	15.6	17.1	16.2	17.3	16.7	17.5	17.3	17.5	18.8
25	15.9	16.0	17.3	16.4	17.9	17.1	18.8	17.5	18.6	18.5	19.0	19.7
50	17.4	17.3	19.1	17.7	19.1	18.5	20.4	18.7	20.0	19.7	20.3	21.4
75	20.0	19.0	21.6	19.2	21.5	20.5	22.8	20.7	21.0	22.1	22.2	23.0
85	21.5	20.1	22.6	21.7	23.2	23.0	23.9	22.6	23.7	24.1	24.0	25.5
90	23.0	21.7	23.6	23.2	23.7	24.3	24.5	23.5	25.3	25.4	24.8	26.4
95	25.7	23	25.8	25.4	25.8	25.9	26.6	26.1	26.7	28	28.3	28.4

Table 3
Underweight, overweight and obesity prevalence at different ages in Turkish adolescents.

	adolescent girls			adolescent boys		
	underweight	overweight	obesity	underweight	overweight	obesity
12	24 (19.4%)	14 (11.3%)	3 (2.4%)	14 (12.1%)	14 (12.1%)	0
13	11 (11.0%)	13 (13.0%)	1 (1.0%)	12 (11.5%)	11 (10.6%)	3 (2.9%)
14	4 (5.6%)	7 (9.7%)	1 (1.4%)	13 (16.3%)	10 (12.5%)	2 (2.5%)
15	4 (6.1%)	7 (10.6%)	2 (3.0%)	15 (20.0%)	7 (9.3%)	2 (2.6%)
16	4 (7.3%)	6 (10.9%)	1 (1.8%)	14 (23.3%)	8 (13.3%)	1 (1.7%)
17	6 (9.7%)	4 (6.5%)	2 (3.2%)	6 (7.7%)	8 (10.3%)	0
Total	53 (11.1%)	51 (10.6%)	10 (2.1%)	74 (14.4%)	58 (11.3%)	8 (1.6%)

Table 4
Overweight and obesity prevalence among Turkish adolescents with respect to living area.

	adolescent girls			adolescent boys		
	underweight	overweight	obesity	underweight	overweight	obesity
Urban	10.0%	10.3%	2.1%	14.4%	11.6%	1.6%
Rural	15.7%	12.4%	2.2%	14.5%	9.6%	1.2%
Total	11.1%	10.6%	2.1%	14.4%	11.3%	1.6%

curves, American-Black, Hispanic and White adolescent girls' percentiles stayed highest on the figure [14]. IOTF standards followed these values [12]. American-Asian and Turkish curves stayed on the same position and the curve of the Swedish adolescent girls stayed at the bottom of the figure [14, 16]. Interestingly, 95th BMI curve of the Iranian adolescent girls lied at the bottom on early ages of adolescence and increased more sharply with age [17].

American-Hispanic adolescent boys' curve was at the top on the figure [14]. It was followed by American-White, Black, IOTF, American-Asian, Turkish, Iranian and Swedish curves, respectively [12, 14–16]. American-White and Black adolescents' curves and Turkish and American-Asian curves stayed at the same level on the figure [14].

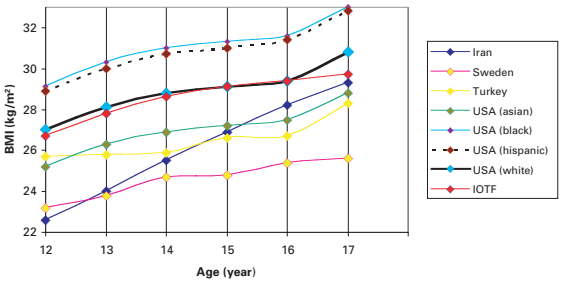

Figure 1
Comparison of the 95th percentile of BMI values in adolescent girls from various parts of the world [11, 13–16].

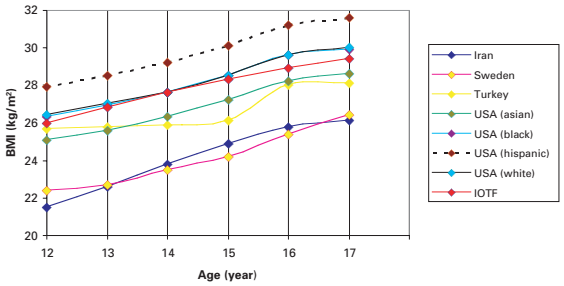

Figure 2
Comparison of the 95th percentile of BMI values in adolescent boys from various parts of the world [11, 13–16].

Discussion

Analyses of data collected during these studies support that adolescents living in the city of Edirne carry relatively lower amounts of adipose tissue than other countries' adolescents do. The reasons for the lower prevalence of overweight and obesity among our adolescents are largely unknown. But its reason may be Mediterranean type diet containing more vegetables and less meat and carbohydrate.

The prevalence of overweight and obesity in children and adolescents have recently been investigated in different countries. But there are only a few studies concerning the prevalence in Turkish adolescents, most published in Turkish Medical Journals. Obesity prevalence was found to be 0.9% in boys and 3.8% in girls, aged between 8 and 17 years, in Elazıg, in Middle Eastern Turkey [22]. Contrary to these low prevalence rates, Neyzi et al. [23] found higher obesity prevalence such as 11.2% in adolescent boys, and 9.4% in adolescent girls in 9–17 years old school children in Istanbul.

The obesity prevalence of children and adolescents in Europe increased gradually when traced towards east and south. Dutch, Belgium and Swedish adolescents are slimmer than Middle and Eastern European adolescent populations [24, 25]. On the other hand, Hungarian, Austrian, Croatian adolescents have higher overweight and obesity prevalence [25–27]. Bellizzi et al. [28] compared prevalence of overweight and obesity in 15-year-old boys and girls in different Asian and European countries. Among these populations, the prevalence of total overweight (obesity and overweight) in boys ranged from 5.8% (in the Netherlands) to 30.5% (in Taiwan), and in girls from 6.3% (in Hong Kong) to 21.1% (in Taiwan). In Asia, higher obesity prevalences were found among the Taipei and Saudi Arabian adolescents [8, 10].

Overall, the prevalence of overweight and obesity in American adolescents is relatively high compared to European adolescents [18, 22, 25]. It was determined that 16.3% of black adolescent girls are obese [18] and the 95th BMI percentile curves of Black and Hispanic adolescents stayed highest as show Figures 1 and 2. According to another report from the American continent, Neutzling et al. from Brazil [9] determined that overweight and obesity prevalence were 6.5% and 1.2% among all adolescents. He also reported that total overweight prevalence was found to be 10.4% among adolescent girls while it was 4.8% among adolescent boys.

Some countries showed significant gender differences in overweight and obesity prevalence of adolescents. In particular, most of the studies done in Asia and Europe (Taiwan, Finland and Austria), showed higher rates among adolescent boys than among girls [10, 25, 26]. On the other hand, Saudi Arabian and Brazilian adolescents demonstrated the opposite trend [8, 9]. We did not observe high gender differences in overweight and obesity prevalence of adolescents.

As overweight and obesity is increasing worldwide, it is important that countries monitor weight status of children and adolescents. The critical issue is which definition is used. IOTF recommended the use of BMI percentiles, which have been supplied by the results of the studies conducted on children aged 2–18 in four continents (Asia, Europe, North and South America), with the aim of bringing an international definition for obesity into use [12]. In the international community, the standard definition published by Cole et al. [12] is the accepted definition, and increasingly more papers on prevalence are based on these definitions. Krassas et al. [29] from Thessalonica which is very close to Edirne, used also IOTF standards and he reported high overweight and low obesity results primarily in adolescent boys. However, there are some suspicions about IOTF standards. Ramachandran et al. [30] think that the criteria of Cole et al. [12] are not appropriate for determining overweight in Asian-Indian adolescent populations. Moreover, Cole et al. [12] did not report 5th BMI percentiles. Therefore, in order to determine underweight cases we used recently published American standards [14].

The prevalence of underweight of our subjects is relatively higher than other countries data. Wang et al. [31] examined the trends of weight status of adolescents aged 10–18 years from 4 countries including Russia, Brazil, China and United States of America. According to their study, China had the highest (11.5% in girls, 14.4% in boys) and the United States had the lowest underweight prevalence (3% in girls, 3.6% in boys). Brazilian adolescents and Russian adolescents had similar data

(6.5% in girls, 10.6% in boys and 8.6% in girls, 7.7% in boys, respectively). In contrast to our data, the prevalence of underweight was greater in rural than urban areas in Brazil and China. These differences may be related to unbalanced economical status between rural and urban areas in these countries.

This article provides descriptive information on the current prevalence of overweight or obese adolescents in the city of Edirne, Turkey. However, it had some limitations. The quota sampling was used to select the subjects. The estimation of the prevalence in this sampling method may not always be exact, even though the sample may be representative of the population as far as age and locality is concerned. Therefore, this may not guarantee the sample representativeness for the quantity of BMI. On the other hand, all schools were sampled and this should improve representativeness. The other limitation of this study is that the measurements of the subjects could only be performed once, and it has not provided direct indications of the chronology of overweight and obesity development. Despite those limitations, the data described in this study still provides a valuable profile for the physical characteristics of a major segment of the adolescent population of Edirne. New longitudinal studies are needed for a better estimation of adolescents' body fat status.

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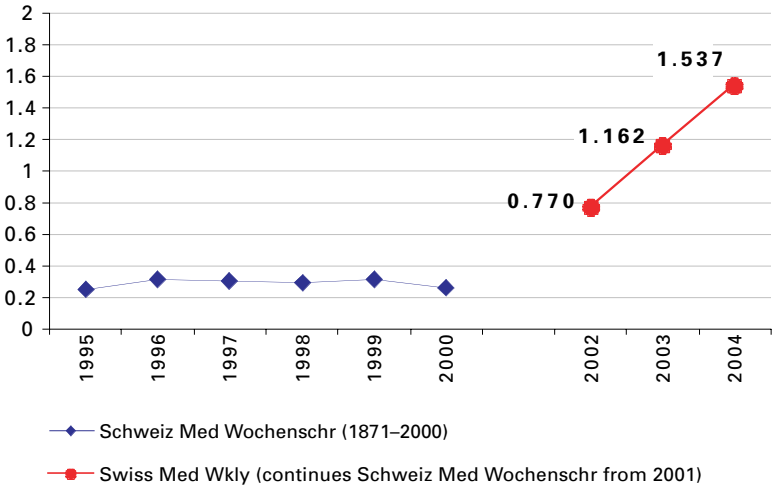

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