Prevalence and risk factors of obesity in school children in Antalya, Turkey

Doga Turkkahraman, MD, Iffet Bircan, MD, Ozgur Tosun, MSc, Osman Saka, PhD.

ABSTRACT

Objectives: To determine the prevalence and risk factors of obesity and to obtain the age and gender-specific body mass index (BMI) percentiles in a cohort of children aged 6-17 years, living in the province of Antalya, Turkey.

Methods: The study included 15 schools throughout the city center of Antalya, Turkey during the period November 2002-March 2003. A total of 2465 school children (boys 1233, girls 1232) aged 6-17 years were chosen using a population based stratified cluster sampling method. We calculated the BMI (kg/m^2) by measuring the weight and standing height. Overweight was defined as BMI between 85th and 95th percentile, and obesity as BMI above the 95th percentile. A questionnaire was distributed to the parents to determine obesity-related risk factors.

Results: The overall prevalence of obesity was 3.6% while overweight was 14.3%. According to gender, the prevalence of obesity in boys was 3.9% and overweight was 12.8%, while in girls, obesity was 3.2% and overweight was 15.8%. We found that obesity might be related with some factors such as number of regular meals, number of siblings, high birth weight, having computer at home, skipping breakfast and high socioeconomic status of parents.

Conclusions: There is no difference in obesity prevalence among school children according to gender, but the mean BMI of girls is significantly higher than that of boys. Obesity prevalence among children in Antalya is very low compared to Europe and the United States.

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Obesity is an important nutritional disorder in most developed countries, and is assuming an issue of increasing significance in the developing ones. Obesity in childhood is associated with increased incidence of hypertension, diabetes, coronary artery disease, osteoarthritis and overall increase in morbidity and mortality during adult life. Early detection of obesity is crucial since tracking of weight can be seen starting in the first year of life. Interventions must be instituted at a young age as once obesity is well established; it is difficult to treat, especially if it continues into adolescence.[1,2]

In Turkey, studies for obesity prevalence in childhood are not sufficient in number, and the exact value of obesity prevalence is not known. The aim of this study is to determine the prevalence and risk factors of obesity and to obtain the age and gender-specific body mass index (BMI) percentiles in a cohort of children aged 6-17 years, living in the province of

From the Department of Pediatric Endocrinology (Turkkahraman, Bircan) and the Department of Biostatistics (Tosun, Saka), Akdeniz University Hospital, Antalya, *Turkey.*

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Address correspondence and reprint request to: Dr. Doga Turkkahraman, Akdeniz Universitesi Tıp Fakultesi Hastenesi, Pediatri Klinigi, Antalya, *Turkey.* Tel. +90 (242) 2274343/33500. Fax. +90 (242) 2274320. E-mail: dogatkahraman@akdeniz.edu.tr

Antalya, Turkey. Antalya is one of the biggest cities in Turkey, with a city center population of more than one million.

Methods. Out of 156 primary and secondary schools throughout the city center of Antalya (total student population is 123.400, approximately), 15 schools (10 primary and 5 secondary schools) were selected by using population based stratified cluster sampling method (cross-sectional design). The data of 2465 students (boys 1233, girls 1232) aged 6-17 years were obtained during the period November 2002-March 2003. Weight was measured using a digital weighing scale (SECA 841, Hamburg, Germany) to the nearest 100 g, while the subjects were wearing light clothes and were bare footed. Height was measured using a portable stadiometer (Holtain Instruments Ltd, Crymych, UK) to the nearest 0.1 cm, while the subjects were standing without shoes on a horizontal surface with their bodies stretched upward to the fullest extension and their heads in the horizontal plane. A questionnaire was distributed to all of the student's parents to determine the obesity-related risk factors and to assess demographic variables of the students. Birth weight was obtained from parental vaccination cards. Validity of the questionnaire was tested in a small group of parents before the study has begun. All of these procedures were carried out by 3 trained medical personnel. Informed consent was obtained from all students and their parents. The BMI was calculated as weight/height^2, and expressed as kg/m^2. Data were grouped by one-year intervals from 6 years through 17 years. Age was truncated to the nearest full year, for example; 6 years (6-6.99 years), 7 years (7-7.99 years) and so forth. Age and gender-specific international cutoff points of BMI, recommended by Cole et al[3] were used to determine the prevalence of obesity and overweight. According to Cole et al[3] overweight is defined as BMI between 85th and 95th percentile, and obesity as BMI above the 95th percentile. We used Cole's international cutoff points, to calculate obesity and overweight prevalence rates for international standardization. Thus, we made our prevalence rates comparable with the other countries' rates calculated or will be calculated by the same method. On the other hand, LMS method was used to construct our own age and gender-specific BMI percentile chart and to obtain standard deviation (z) scores.[4] In this method, the effective degrees of freedom (edf) were equal to 3 for the L curve (representing skewness), 7 for the M curve (representing the median) and 4 for the S curve (representing the coefficient of variation). Obesity and overweight prevalence were not recalculated according to our own cutoff values and, we also defined obesity and overweight as Cole's definition described above while constructing BMI percentile charts.

Data were analyzed using Statistical Package for Social Sciences version 11 software. Differences between groups were tested by Pearson and Fisher chi-square tests. The association of obesity with the demographic variables was assessed using chi-square test for linear-by-linear association (Mantel-Haenszel test). Differences in the means of BMI values were tested by Student t-test. Data assessment in the questionnaire was carried out over the answered questions. Missing values were neglected. Differences were considered to be significant at $p<0.05$. The LMS 1.26 software was used for the LMS method.

Results. The overall prevalence of obesity was 3.6% while overweight was 14.3%. There was no significant difference between boys and girls for obesity prevalence ($p>0.05$). However, overweight prevalence was significantly higher in girls ($p<0.05$) (**Table 1**). **Figure 1** shows the distribution of obesity and overweight prevalence in different age groups. Additionally, the mean BMI (± standard deviation) was 19.4 ± 3.6 for girls, and 18.9 ± 3.6 for boys considering all age groups. The mean BMI of girls was significantly higher than that of boys ($p<0.05$, by t-test). However, the analysis of mean BMI distribution for different age groups showed that the mean BMI value was significantly higher only for 12 and 13 year old girls (for both, $p<0.001$) (**Table 2**). The cutoff points of BMI obtained by LMS method for overweight and obesity (85th and 95th percentiles) by gender between 6 and 17 years are shown in **Table 3**.

Assessment of the questionnaire. When the number of regular meals (defined as formal meals excluding snacks) eaten daily by each student was analyzed, we observed that obesity was the least frequent (2.2%) in the group eating at least 4 meals a day (Odds ratio (OR)=0.59, 95% CI=0.21-1.62) and the most frequent (7%) was in the group eating 2 meals a day (OR=2.49, 95% CI=1.56-3.98). Obesity frequency increases markedly as the number of regular meals decreases and this linear association is found to be statistically significant ($p<0.001$, by chi-square test for linear-by-linear association). Assessment of the students for their number of siblings revealed that obesity was the most frequent in the students who have no any siblings (OR=1.52, 95% CI=0.81-2.83). Obesity prevalence decreases significantly as the number of siblings increases ($p<0.05$). Students having more than 4 siblings, have the minimum OR (OR=0.15, 95% CI=0.02-1.06). Analysis of birth

Table 1 - Percentage of overweight and obese Turkish school children, 6-17 years old in Antalya.*

Gender	No. of children (%)			Total
	Non-obese	Overweight	Obese	N
Boys	1027	158 (12.8)	48 (3.9)	**1233**
Girls	997	195 (15.8)†	40 (3.2)‡	**1232**
Total	**2024**	**353 (14.3)**	**88 (3.6)**	**2465**

*Using the cut-off points recommended by Cole et al.[3]
†$p<0.05$, by chi-square test.
‡$p>0.05$, by chi-square test.

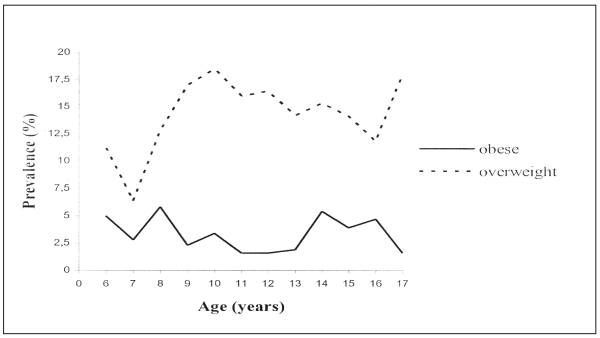

Figure 1 - Prevalence of obesity and overweight among Turkish school children 6-17 years old in different age groups.

Table 2 - The mean body mass index (BMI) values of Turkish school children 6-17 years old, by age and gender (N=2465).

Age (years)	Boys		Girls	
	N	BMI (±SD)	N	BMI (±SD)
6	88	16.2 ± 1.9	73	15.7 ± 1.9
7	68	16.4 ± 1.5	76	15.9 ± 1.9
8	92	16.7 ± 1.9	80	17.1 ± 2.5
9	113	17.3 ± 2.5	105	17.4 ± 2.7
10	96	17.8 ± 3	109	18.1 ± 2.8
11	102	18 ± 2.9	86	18.2 ± 2.8
12	108	18.3 ± 3	75	19.8 ± 3.1*
13	102	18.9 ± 2.6	109	20.5 ± 3.6*
14	139	20.9 ± 3.9	154	21 ± 3.6
15	133	21.6 ± 3.4	141	21.3 ± 3.1
16	115	21.7 ± 3.5	140	21.6 ± 3.4
17	77	22.3 ± 3.3	84	22 ± 3.1
6-17	**1233**	**18.9 ± 3.6**	**1232**	**19.4 ± 3.6†**

*$p<0.001$ by t-test.
†$p<0.05$ for whole students aged from 6-17 years by t-test.

Table 3 - Body mass index (BMI) percentiles of Turkish children aged 6 to 17 years.*

Age (years)	Overweight 85th p (kg/m²)		Obese 95th p (kg/m²)	
	Male	Female	Male	Female
6	17.9	17.7	19.5	19.2
7	18.1	18.4	19.8	20.1
8	18.7	19.5	20.7	21.6
9	19.4	19.9	21.8	22.4
10	20	20.8	22.8	23.5
11	20.6	21.6	23.5	24.5
12	21.2	22.7	24.3	25.7
13	22.2	23.6	25.5	26.7
14	23.6	24.2	26.9	27.3
15	24.6	24.6	27.9	27.7
16	25.2	24.9	28.6	27.9
17	25.8	25.2	29.1	28.2

*LMS method was used to construct age and gender-specific BMI percentile chart. The effective degrees of freedom were equal to 3 for the L curve (representing skewness), 7 for the M curve (representing the median) and 4 for the S curve (representing the coefficient of variation).

weights of the students showed that obesity was not seen in those whose birth weights were less than 2 kg (0%) (OR was not calculated) and the most frequent in those whose birth weight exceeds 5 kilograms (12.9%) (OR=4.44, 95% CI=1.51-13.10). There is a positive linear association between birth weight and obesity ($p<0.01$, by chi-square test for linear-by-linear association). Furthermore, obesity prevalence of the students having computer at home was significantly higher (5.4%) (OR=1.90, 95% CI=1.23-2.93) than the ones who have not (2.9%) (OR=0.52, 95% CI=0.34-0.81) ($p<0.01$). In addition, it was found that eating breakfast regularly may prevent the development of obesity. Thus, students who eat breakfast regularly had an obesity frequency of 2.7% (OR=0.39, 95% CI=0.25-0.61) while the ones who skip breakfast had of 6.6% (OR=2.51, 95% CI=1.61-3.91) ($p<0.001$) (**Table 4**). No relation was found between obesity and television (TV) watching. Obesity frequency of students watching TV at home for more than 2 hours was 3.9% (OR=1.24, 95% CI=0.80-1.91) while of those watching TV less than 2 hours was 3.2% (OR=0.80, 95% CI=063-1.23) ($p>0.05$)

When the educational backgrounds of parents were analyzed, we observed that obesity was the most frequent among the students whose mothers were a university graduate (OR=2.54, 95% CI=1.38-4.65) or whose fathers were university graduate (OR=1.77, 95% CI=1.03-3.05) and the least frequent among the ones whose mothers were illiterate (OR=0.36, 95% CI=0.08-1.48) or whose fathers where illiterate (OR= not calculated). In this group, it was quite conspicuous that obesity frequency significantly increases as the level of their parents' education increases (for mother, $p<0.001$; for father, $p<0.05$, by chi-square test for linear-by-linear association). We also analyzed the

Table 4 - Assessment of the questionnaire; frequency and prevalence of obesity among Turkish school children 6-17 years old, by number of regular meals, number of siblings, birth weight, having computer at home, and breakfast habit.

Variables	Frequency (Obese/ Total)	Prevalence (%)	OR	95% CI
No. of regular meals*				
2	27/387	(7)	2.49	(1.56-3.98)
3	56/1872	(3)	0.54	(0.34-0.84)
≥4	4/183	(2.2)	0.59	(0.21-1.62)
No. of siblings†				
0	12/236	(5.1)	1.52	(0.81-2.83)
1	54/1292	(4.2)	1.46	(0.94-2.26)
2	17/563	(3)	0.80	(0.47-1.37)
3	4/200	(2)	0.53	(0.19-1,46)
≥4	1/174	(0.6)	0.15	(0.02-1.06)
Birth weight (kg)‡				
<2	0/22	-		-
2-2.9	9/385	(2.3)	0.63	(0.31-1.29)
3-3.9	41/1222	(3.4)	0.97	(0.58-1.64)
4-4.9	10/231	(4.3)	1.35	(0.68-2.68)
≥5	4/31	(12.9)	4.44	(1.51-13.10)
Having computer*				
yes	36/670	(5.4)	1.90	(1.23-2.93)
no	52/1795	(2.9)	0.52	(0.34-0.81)
Breakfast habit††				
regular	53/1943	(2.7)	0.39	(0.25-0.61)
nonregular	34/516	(6.6)	2.51	(1.61-3.91)

OR= odds ratio; CI= 95% CI confidence interval.
Total denotes the total number of students whose parents chose that option in the questionnaire.
*p<0.001, †p<0.05, ††p<0.01 by chi-square test for linear-by-linear association.
**p<0.01, ††p<0.001, by chi-square test.

income levels (monthly) of parents and observed that obesity was seen the least frequent in the students whose mother was unemployed (OR=0.49, 95% CI=0.29-0.82) or whose father was unemployed OR=0.30, 95% CI=0.07-1.23). It was shown that obesity frequency significantly increases as the level of parent's income increases (for mother, p<0.001; for father, p<0.05) (**Table 5**).

Discussion. Previous studies regarding obesity emphasize that the overall prevalence of obesity does not reveal gender-dependent differences for all ages.[5,6] We also could not find any significant difference in the total prevalence of obesity between the 2 genders (boys 3.9%, girls 3.2%). However, in our study when we compared the obesity prevalence between different age groups irrespective of gender, it was found that children aged between 11-13 years, have the lowest frequency of obesity (mean:1.7%), while the prevalence reaches its peak values at ages 8 (5.8%) and 14 (5.4%). Similarly, in a study of Mohsen et al,[6] which was conducted between 1994 and 1998 among 12071 children aged 1-18 years; obesity prevalence was reported to drop to the lowest level for 11-13 year old children reaching its peak values at ages 7 and 15. Regarding the findings above, the peak obesity prevalence at mid-puberty can be explained by the fact that there is a great acceleration in adipose cell number as well as children's overall body weight during this period.[7]

Obesity prevalences for some European countries and the United States are as high as follows: 15.5%

Table 5 - Assessment of the questionnaire; frequency and prevalence of obesity among Turkish school children aged 6-17 years old, by income and level of education of their parents.

Variables	Mother				Father			
	Frequency	Prevalence			Frequency	Prevalence		
	(Obese/Total)	(%)	OR	95% CI	(Obese/Total)	(%)	OR	95% CI
Income (monthly)*								
Unemployed	43/1522	(2.8)	0.49	(0.29-0.82)	2/186	(1.1)	0.30	(0.07-1.23)
85-170 €	5/129	(3.9)	1.14	(0.45-2.90)	8/378	(2.1)	0.59	(0.27-1.25)
171-280 €	5/126	(4)	1.17	(0.46-2.98)	19/594	(3.2)	0.97	(0.56-1.67)
281-560 €	14/178	(7.9)	2.77	(1.50-5.11)	29/632	(4.6)	1.76	(1.07-2.93)
>560 €†	-	-	-	-	7/202	(3.5)	1.07	(0.48-2.38)
Level of education††								
Unlettered	2/154	(1.3)	0.36	(0.08-1.48)	0/30	(0)	-	-
Primary school	27/1035	(2.6)	0.62	(0.38-1.01)	21/829	(2.5)	0.65	(0.38-1.09)
Secondary school	4/232	(1.7)	0.47	(0.17-1.31)	9/296	(3.0)	0.90	(0.44-1.83)
High school	23/465	(4.9)	1.73	(1.04-2.89)	20/551	(3.6)	1.13	(0.66-1.93)
University	14/194	(7.2)	2.54	(1.38-4.65)	19/373	(5.1)	1.77	(1.03-3.05)

OR= odds ratio; CI= 95% CI confidence interval.
Total denotes the total number of students whose parents chose that option in the questionnaire.
†None of the mothers in this questionnaire earn more than 560 euro.
*for mother p<0.01, for father p<0.05, by chi-square test for linear-by-linear association
††for mother p<0.001, for father p<0.05, by chi-square test for linear-by-linear association

in the United States,[8] 9.2% in England,[9] 13.8% in Belgium[5] and 10% in Italy.[10] These rates are approximately 3-4 times greater than the rates of Turkey (All prevalence values above calculated with the same method).

While comparing the frequency rates between different studies, it is important to pay attention to the differences in methods, which describe obesity; like BMI, relative BMI, relative body weight and others. Obviously, it is not scientifically accurate to compare prevalence rates of obesity calculated with different methods. Today, the commonly accepted method used in obesity studies for assessing body fat is the calculation of BMI. Thereafter, BMI values above 95th percentile are defined as obesity. [3,9]

In the present study, evaluation of risk factors showed that skipping regular meals increases the risk of being obese. High caloric snack consumption may be the possible reason for this. Regular meals probably depress hunger and hinder obesity by preventing snack consumption.[11] The same reason might be valid for the fact that obesity rates are higher among the children who skip breakfast.

It is well known that there is a close relation between socioeconomic level of family and obesity in children.[12] In threshold countries like Turkey, obesity is more common among children whose parents have better socioeconomic conditions, while it is just the opposite in developed ones.[13] We also found similar relation between socioeconomic conditions of the parents and obesity frequency of their children. Furthermore, it was shown that obesity frequency decreases as the number of sibling increases. In these 2 findings above, reasons might be the same that per capita income diminishes for each child. Surprisingly, no significant relation between TV watching and obesity were detected in our study. In literature, there are many studies regarding this controversial subject, that is, some studies[14] show close relation between obesity and TV watching while the others do not.[15] However, in the present study, it was found that having computer at home is an important risk factor for obesity. As computer usage among children increases and computer games become popular, time consumed on computer also increases. This sedentary behavior possibly accelerates the obesity development in children. As a result of increasing time consumed on computer, probably remaining time for TV watching decreases. Maybe, this is why we could not find any relation between TV watching and obesity in this study. In many studies, macrosomic birth had been shown to be a risk factor for obesity development.[16] We also found out that obesity is significantly more frequent among the children whose birth weight exceeds 5 kilograms.

In conclusion, there is no difference in obesity prevalence among school children according to gender, but the mean BMI of girls is significantly higher than that of boys. Furthermore, obesity prevalence among children in Antalya is very low compared to Europe and USA. Thus, in Turkey obesity is not an alarming danger for children but must be kept under careful consideration. Unfortunately, obesity prevalence increases dramatically all over the world. Additional studies using similar methods must be conducted periodically in the same regions and the results must be compared and discussed. Undoubtedly, obesity treatment is a hard and long process that requires intense efforts. Detecting the possible factors related to obesity in childhood, and taking appropriate measures seemed to be the most brief and simple strategy for preventing obesity.

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