Review Article

Prevalence and Trends of Overweight and Obesity Among Children and Adolescents in Turkey: AMeta-analysis

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Abstract

Background: Over the past 40 years, the prevalence of overweight and obesity in children and adolescents has increased significantly worldwide, especially in low and middle-income countries. Studies have reported an increase in these rates also Turkey. ***Objective:*** to determine the prevalence of overweight and obesity based on articles published from 2000 to 2020 and conducted with children and adolescents ages 5-19. Besides, it was aimed to reveal the trend of overweight and obesity prevalence over the years.***Methods:***For this purpose, publications between 2000 and 2020 were searched in Pubmed, Web of Science and Ulakbim databases. Publications were reviewed considering the selection criteria and a total of 69 articles were included in the study. The heterogeneity of the studies was tested and funnel plot, Begg's test, Egger's test, Duval and Tweedie's trim and fill methods were used to determine publication bias.***Results:*** The pooled prevalence of overweight was 13.3% (95% Cl: 12.3-14.4), obesity was 7.8% (95% CI: 6.8-8.8). It was found that overweight and obesity prevalences increased between 2000-2004 and 2010-2019 periods. ***Conclusion:***More effective strategies and policies should be implemented to substantially reduce or prevent childhood overweight and obesity.

Keywords: Children and adolescents, obesity, overweight, meta-analysis

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Introduction

Obesity is a global health problem affecting children and adults in both developed and developing countries. It may occur depend on genetic, physiological and many environmental factors.[1] Obesity has negative health consequences both in the short and long term, it contributes to increasing the risk of diseases such as hypertension, stroke, some types of cancer, Type II diabetes. Besides, it is known that obesity reduces school success and self-confidence in children.[2,3] In addition, obesity can cause a decrease in the quality of life.[4] Particular attention should be paid to childhood overweight and obesity, because research shows that these can persist into adulthood.[5,6]

World Health Organization (WHO) states that there has been a dramatic increase in the rates of obesity and overweight among children and adolescents ages 5-19 worldwide in the last 40 years. According to 2016 data, more than 340 million children and adolescents were overweight or obese worldwide.[7] Although obesity and overweight have stabilized in some developed countries, the increase in overweight and obesity is much higher in some developing countries where both undernutrition and obesity are seen together.[8] It is specified that the overweight and obesity rate is higher in Middle East, Central and Eastern Europe and North America[9] According to many studies conducted with children and adolescents to determine the prevalence of overweight and obesity in Turkey, it was found these rates have increased.[10-12]

The study aims to determine the prevalence of overweight and obesity based on the studies conducted with children and adolescents aged 5-19 years in Turkey between 2000-2020. At the same time, it is aimed to evaluate the changes of these rates in 5-year periods between 2000 and 2019.

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Methods

Search and study selection criteria

Studies conducted in different regions and cities of Turkey and published between 2000 and 2020 were included in this meta-analysis research. While searching the literature, the following criteria were taken as the basis; 1) The sample included between the ages of 5-19, 2) studies included data collection year between 2000-2019, 3) studies used age and sex-specific cut-off points of World Health Organization (WHO)[13], Centers for Disease Control and Prevention (CDC)[14], International Obesity Task Force (IOTF)[15], Neyzi et al.[16] and Bundak et al.[17] to determine obesity in children and adolescents. In addition to these criteria, it was paid attention that the studies included in the study were in a cross-sectional model. Conducted with adults or not appropriate the age ranges, studies which are not cross-sectional research model and do not use the above-mentioned national and international age and sex-specific cut-off values in determining obesity were not included. As shown in Figure 1, PRISMA (preferred reporting items for systematic reviews and meta-analyses) flowchart for the study selection process was used.[18]

While searching the literature, PUBMED and Web of Science, ULAKBİM which is a Turkish database were used and the studies published between January 2000 and December 2020 in these databases were searched. The searching was (prevalence OR frequency OR incidence) AND (obesity OR overweight OR body mass index OR bmi OR weight gain) AND (children OR childhood OR adolescent OR young) AND (Turkey OR Turkish) in databases. The evaluation of the eligible of the results obtained in the screening was repeated with an interval of 2 weeks. After the publications to be included in the study were determined, in case of missing information in these studies, the authors of the publications were contacted, and the missing informationwas completed.

Statistical analysis

Q and I^2 tests were used to determine whether the study was heterogeneous or not. An I^2 value of <40% is considered to be low, between 40% and 75% as medium and greater than 75% as high heterogeneity.[19] It is recommended to use the fixed effect model if the I^2 value is lower than 25% and the random effects model if it is higher than 75%.[20] Fixed effect model and random effect model were used in the meta-analysis of the study, depending on whether it showed heterogeneity or not. Since different studies are used, publication bias may occur in studies. Funnel plot, Begg test[21], Egger's test[22] and also the Duval and Tweedie's trim and fill method[23] were used to reveal whether this bias was present or not. MedCalc and Comprehensive Meta Analysis (CMA) programs were used to perform meta-analysis. The overweight and obesity trends have been determined by evaluating the data collection year in 5-year periods (2000-2004, 2005-2009, 2010-2014, 2015-2019).

Results

Study characteristics

A total of 69 studies were included in the study.[24-92] Since there was no information about overweight in 2 of these studies, overweight was evaluated in 67 studies. The studies were published between 2000 and 2020. The authors, sample size and age, publication year and data collection year of these 69 articles included in the study are presented in supplementary material 1. Overweight and obesity pooled prevalence was calculated with a total of 234764 and 241955 individuals, respectively.

The pooled prevalence of overweight and obesity

I^2 values were examined in determining heterogeneity and as seen in Table 1, it was 97.8% (%95 Cl: 97.5- 98.0) for overweight and 98.6% (%95 Cl: 98.5-98.8) for obesity. Since this indicates the presence of high heterogeneity, the random effects model was used. The overall pooled prevalence of overweight was 13.3 % (95% Cl: 12.3-14.4), obesity was 7.8% (95% CI 6.8-8.8). The forest plots of overall overweight and obesity were shown in Figure 2. The pooled prevalence of overweight was found 13.2% in boys (95% Cl: 11.8-14.7), 12.9% in girls (95% Cl: 11.6-14.2). Prevalence of obesity was 7.5% (95% Cl: 6.3-8.9) and 6.2% (95% Cl: 5.2-7.3) in boys and girls, respectively (Table 1 & 2; Fig. 2).The funnel plots for overweight and obesity to determine publication bias were shown in Figure 3. According to the results of the Egger's test (p=0.175) and the Begg's test (p= 0.605) there is no evidence of publication bias (p>0.05) in obesity. Although the result of the Begg's test (p = 0.750) indicates no publication bias in overweight, Egger's test result (p = 0.0004) shows publication bias. In addition to these tests, Duval and

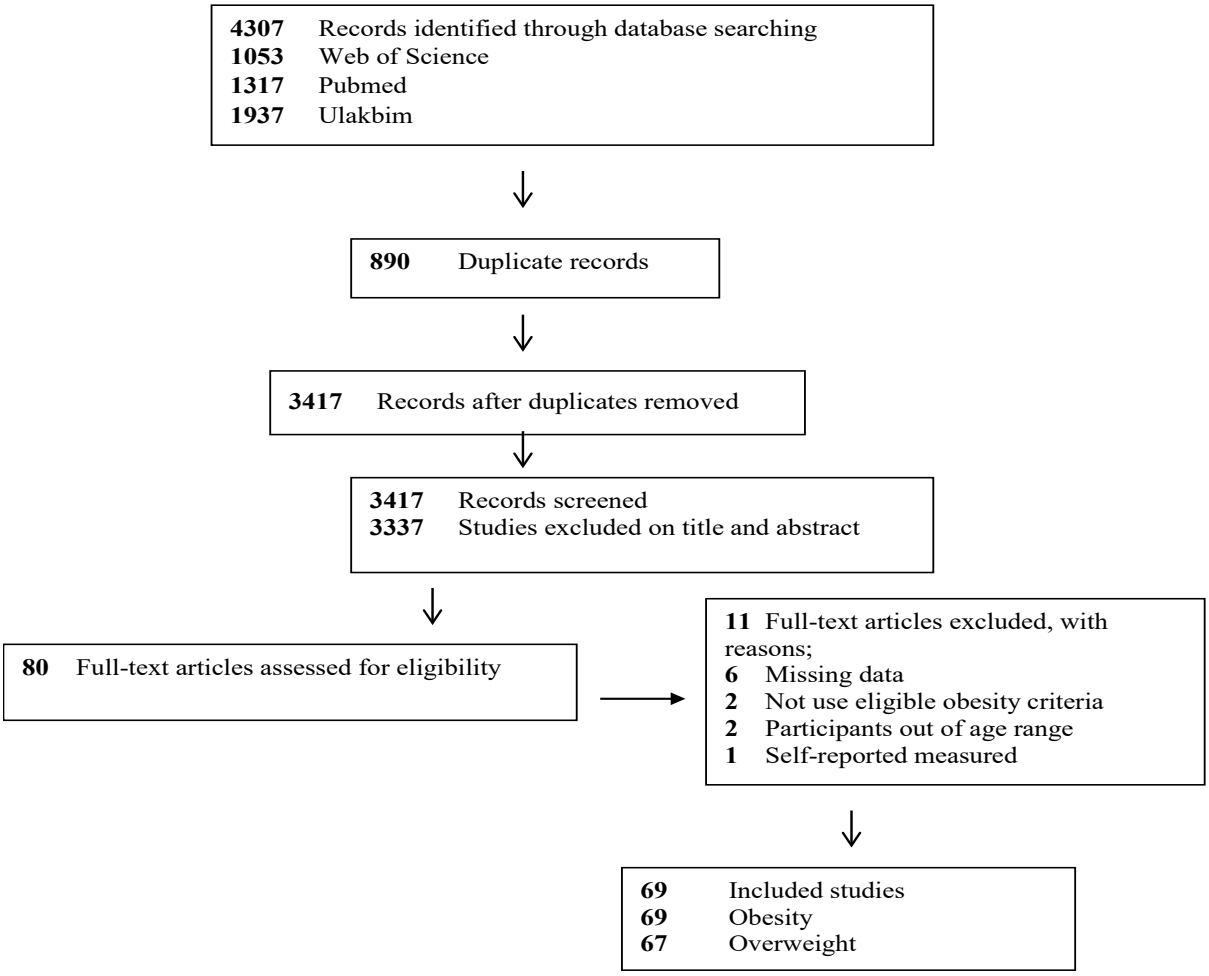

Figure 1. PRISMA flow-chart for the study Selection Process

Tweedie's Trim and Fill method was also used for overweight (Figure 4). In the random effect model, it was determined that the point estimate values were before and after the Trim and Fill method (15 studies trimmed) 0.13 (95% Cl: 0.12-0.14) and 0.15 (95% Cl: 0.13-0.16), respectively. It is seen that there is no significant difference (0.02) between these values, which indicates that the publication bias is negligible (Figure 4). While the pooled prevalence of overweight and obesity were 11.2% and 2.9% between 2000 and 2004, 17.9% and 13.5% between 2015 and 2019, respectively (Figure 5). Overweight rates increased 1.6-fold and obesity rates increased 4.7 fold between 2000-2004 and 2015-2019 among children and adolescents (Figure 5).

Table 1. Prevalence of overweight and obesity

	Overweight				Obesity			
Study and year	**Sample size**	**Proportion**	**95% CI**	**Weight % Random**	**Sample size**	**Proportion**	**95% CI**	**Weight % Random**
Akış et al. (2003)[24]	5795	8.71	8.00-9.47	1.58	5795	1.66	1.34-2.02	1.5
Manios et al. (2005)[25]	510	10.59	8.05-13.59	1.41	510	1.57	0.68-3.07	1.4
Öner et al. (2004)[26]	989	11.02	9.14-13.14	1.5	989	1.82	1.08-2.86	1.45
Ozumut et al. (2020)[27]	1479	14.87	13.10-16.79	1.53	1479	5.27	4.19-6.54	1.47
Sağlam and Tarım (2008)[28]	5368	12.41	11.54-13.32	1.58	5368	7.81	7.10 -8.56	1.5
Sur et al. (2005)[29]	1044	11.88	9.98-14	1.5	1044	2.01	1.25-3.06	1.46
Baş et al. (2005)[30]	300	19	14.72-23.90	1.31	300	5	2.83-8.11	1.33
Semiz et al. (2008)[31]	850	11.65	9.57-14	1.48	850	1.41	0.73-2.45	1.44
Turkkahraman et al. (2006)[32]	2468	14.30	12.94-15.75	1.56	2468	3.57	2.87-4.38	1.49
Bayat et al. (2009)[33]	610	7.21	5.29-9.56	1.44	610	2.13	1.14 -3.62	1.42
Nur at al. (2008)[34]	1020	3.53	2.48-4.85	1.5	1020	0.20	0.02-0.71	1.46
Süzek et al. (2005)[35]	4260	10.38	9.48-11.33	1.58	4260	6.32	5.60-7.09	1.5
Agirbasli et al. (2008)[36]	640	15.78	13.04-18.84	1.45	640	3.44	2.17-5.16	1.42
Discigil et al. (2009)[37]	1367	12	10.32-13.84	1.53	1367	3.66	2.73-4.80	1.47
Etiler et al. (2011)[38]	2491	11.80	10.56-13.13	1.56	2491	7.27	6.28-8.36	1.49
Kara et al. (2010)[39]	1912	11.77	10.36-13.30	1.55	1912	3.35	2.59-4.25	1.48
Kavak et al. (2014)[40]	1118	8.32	6.77-10.09	1.51	1118	3.22	2.27-4.43	1.46
Ozmen et al. (2007)[41]	2101	9	7.81-10.30	1.55	2101	1.14	0.73-1.70	1.49
Ozturk et al. (2009)[42]	5358	15.81	14.84-16.81	1.58	5358	3.30	2.84-3.82	1.5
Simsek et al. (2008)[43]	6924	10.46	9.74-11.20	1.59	6924	6.17	5.61-6.76	1.51
Arı and Süzek (2008)[44]	231	11.25	7.49 -16.06	1.24	231	12.99	8.94-18.02	1.29
Çalışır and Karaçam (2011)[45]	460	12.83	9.91-16.23	1.4	460	13.70	10.69-17.18	1.39
Yorulmaz and Perçin Paçal (2012)[46]	250	13.6	9.61-18.48	1.26	250	1.2	0.25-3.467	1.3
Borici et al. (2009)[47]	216	11.11	7.25-16.08	1.22	216	2.78	1.03-5.95	1.27
Pirinçci et al. (2010)[48]	4258	11.30	10.36-12.29	1.58	4258	1.41	1.08-1.81	1.5
Arı Yuca et al. (2010)[49]	9048	11.12	10.48-11.78	1.59	9048	2.19	1.90-2.51	1.51
Duzova et al. (2013)[50]	3622	9.14	8.22-10.12	1.57	3622	8.78	7.88-9.75	1.5
Albayrak and Kutlu (2012)[51]	276	14.86	10.88-19.61	1.29	276	7.61	4.77-11.40	1.32
Savaşhan et al. (2015)[52]	3963	11.10	10.14-12.12	1.57	3963	7.55	6.74-8.41	1.5
Yabancı et al. (2009)[53]	375	8.53	5.91-11.83	1.36	375	10.13	7.27-13.64	1.36
Akçam et al. (2013)[54]	5716	10.99	10.19-11.83	1.58	5716	12.46	11.61-13.34	1.5
Dündar and Öz (2012)[55]	2477	22.37	20.74-24.06	1.56	2477	10.25	9.09-11.52	1.49
Yabancı and Şimşek (2011)[56]	370	8.11	5.54-11.37	1.35	370	4.32	2.49-6.93	1.36
Ercan et al. (2012)[57]	8848	8.33	7.76-8.92	1.59	8848	7.66	7.12-8.24	1.51
Önsüz and Demir (2015)[58]	2166	8.26	7.14-9.50	1.55	2166	18.01	16.41-19.69	1.49
Yılmaz et al. (2018)[59]	1072	16.70	14.51-19.07	1.51	1072	3.92	2.84-5.26	1.46
Battaloğlu İnanç et al. (2012)[60]	3460	15.78	14.58-17.04	1.57	3460	10.58	9.57-11.65	1.5
Demirci et al. (2013)[61]	-	-	-	1.53	1000	11.2	9.31-13.32	1.45
Eker et al. (2018)[62]	1357	12.60	10.88-14.48	1.6	1357	2.58	1.80-3.57	1.47
Kaya et al. (2014)[63]	92933	8.66	8.48-8.84	1.56	92933	6.50	6.35-6.66	1.51
Kilinc et al. (2019)[64]	2718	13.17	11.92-14.50	1.57	2718	4.23	3.51-5.056	1.49
Geckil et al. (2017)[65]	3028	13.44	12.25-14.71	1.4	3028	8.69	7.71-9.75	1.49
Meseri et al. (2015)[66]	462	14.94	11.81-18.52	1.43	462	18.18	14.77-22.01	1.39
Özilbey and Ergör (2015)[67]	549	4.92	3.27-7.07	1.56	549	24.95	21.39-28.80	1.41

Polat et al. (2014)[68]	2826	13.87	12.62-15.20	1.51	2826	13.91	12.65-15.24	1.49
Turhan et al. (2015)[69]	-	-	-	1.55	6191	8.77	8.08 -9.50	1.5
Çam and Nur (2015)[70]	1175	18.81	16.61-21.16	1.58	1175	9.02	7.45-10.81	1.46
Daştan et al. (2014)[71]	2009	13.64	12.17-15.22	1.59	2009	10.80	9.48 -12.242	1.48
Özcebe et al. (2015)[72]	4958	13.55	12.61-14.54	1.52	4958	8.27	7.52-9.07	1.5
Koca et al. (2017)[73]	7116	13.60	12.81-14.42	1.52	7116	9.91	9.22-10.62	1.51
Öztürk Haney (2018)[74]	1289	12.72	10.95-14.67	1.54	1289	14.74	12.85-16.79	1.47
Yılmaz and Mayda (2017)[75]	1245	15.34	13.38-17.46	1.57	1245	10.12	8.50-11.93	1.47
Çelmeli et al. (2019)[76]	1687	23.24	21.24-25.33	1.48	1687	9.78	8.40-11.30	1.48
Yardim et al. (2019)[77]	3291	21.18	19.79-22.61	1.16	3291	14.68	13.48 -15.93	1.5
Karadeniz and Can (2019)[78]	832	9.13	7.26-11.30	1.54	832	8.53	6.73-10.64	1.44
Karakus et al. (2019)[79]	177	12.43	7.96-18.21	1.55	177	20.90	15.17-27.64	1.23
Comba et al. (2018)[80]	1684	13.60	12-15.33	1.49	1684	6.53	5.40 -7.82	1.48
Gökler et al. (2020)[81]	1997	13.82	12.34-15.41	1.49	1997	6.51	5.47-7.68	1.48
Korkmaz and Kabaran (2020)[82]	900	11.22	9.23-13.47	1.5	900	25.11	22.31-28.08	1.45
Meşe Yavuz and Koca Özer (2019)[83]	933	18.44	16-21.07	1.39	933	11.25	9.30-13.46	1.45
Yılmaz et al. (2019)[84]	1003	24.83	22.18-27.62	1.35	1003	9.67	7.91-11.67	1.45
Agadayı et al. (2019)[85]	449	13.81	10.75-17.35	1.55	449	7.35	5.11-10.17	1.39
Akyüz and Ural (2020)[86]	371	13.75	10.41-17.67	1.52	371	23.18	18.98-27.81	1.36
Deniz et al. (2020)[87]	1980	21.51	19.72-23.39	1.42	1980	14.60	13.07-16.23	1.48
Deniz and Oguzoncul (2019)[88]	1278	23.16	20.87-25.57	1.48	1278	7.04	5.70-8.59	1.47
Erdal et al. (2020)[89]	544	25.37	21.76-29.24	1.49	544	13.05	10.34-16.18	1.41
Ustuner Top et al. (2019)[90]	791	27.05	23.99-30.29	1.49	791	19.34	16.65-22.27	1.44
Çam and Top (2020)[91]	896	24.44	21.66-27.39	1.58	896	17.41	14.98-20.06	1.45
Meseri and Akanalci (2020)[92]	874	12.13	10.04-14.48	1.41	874	25.06	22.22-28.07	1.45
Total (random effect)	234764	13.33	12.33 -14.37	100	241955	7.79	6.81- 8.83	100
		Q=2936.826, df=66, p< 0.0001				**Q=5007.938, df=68, p< 0.0001**		
		I^2=97.75%, 95% CI= (97.48-98.00)				**I^2=98.62%, 95% CI= (98.51-98.77)**		

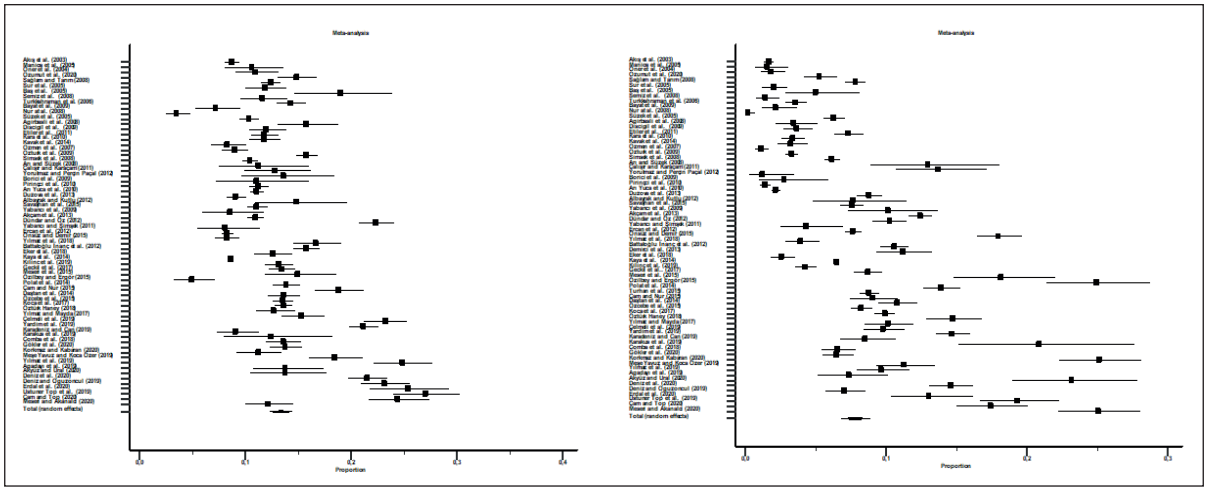

Figure 2. Forest plots of overweight and obesity (upper:overweight, lower: obesity)

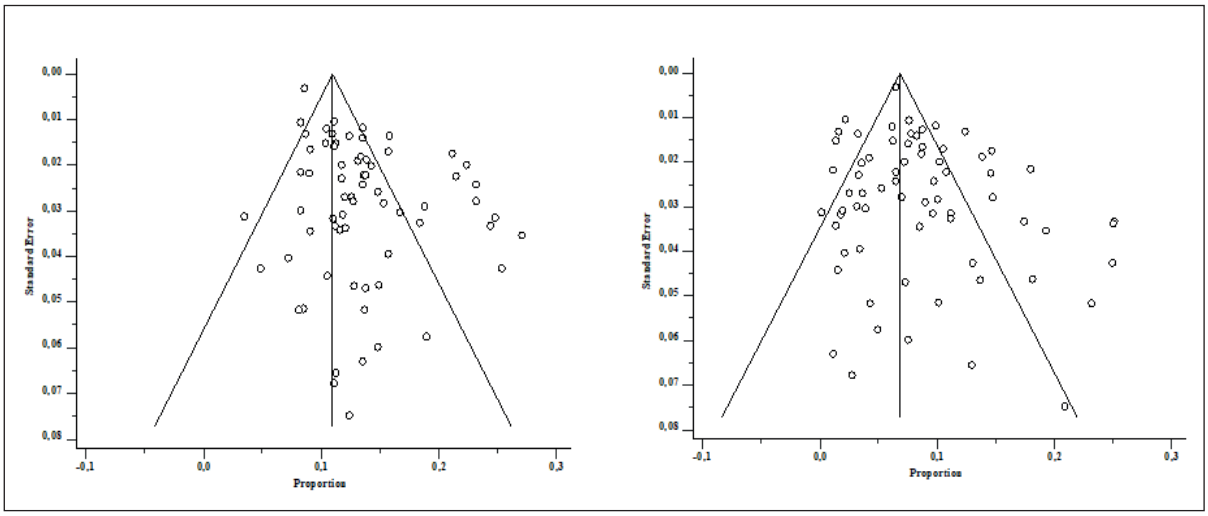

Figure 3. Funnel plots of overweight and obesity (upper:overweight, lower: obesity)

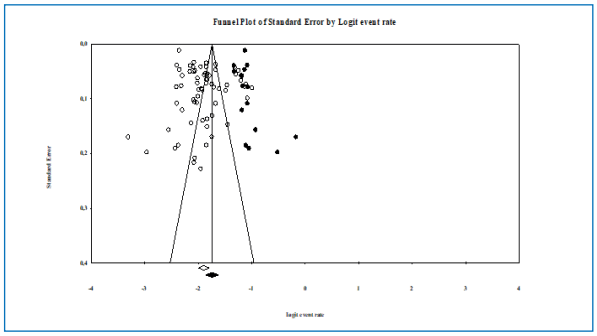

Figure 4. Trim and fill method in overweight

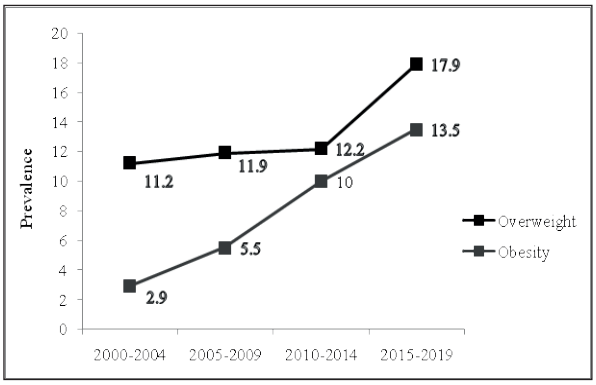

Figure 5. Trends of overweight and obesity prevalence between 2000 and 2019

Discussion

The research shows that there has been an increase in overweight and obesity rates over the years. The obesity rate was 6.5% and overweight was 14.3% according to the results of a study conducted in children between the ages of 6-10 in a national survey.[93] In another national study, the overall prevalence of overweight and obesity was 12.5% and 4.8% respectively, in children and adolescents between the ages of 6-17 in 2010.[94] According to a study conducted with 188 countries including Turkey it has been reported that in developing countries the prevalence of overweight and obesity increased from 8.1% to 12.9% and 8.4% to 13.4% in boys and girls, respectively between 1980 and 2013.[95] Olaya et al. (2015) stated overweight and obesity prevalence was higher in East Europe including Turkey than West Europe. In the study, the overweight prevalence was 21%, while the obesity rate was 7.7% in Turkey between 6-11 years.[96] In a meta-analysis study conducted in children and adolescents between the ages of 5-19 in Turkey, the obesity prevalence was found 5.8% and this rate increased between 1990 and 2015.[10] The current study was determined a higher rate of obesity than a meta-analysis study conducted in Iran[97] and a lower rate than a study in Brazil.[98]

It is clear that seen this trend worldwide, especially in low and middle-income countries, also influenced children and adolescents in Turkey. In the current study, it was determined that overweight increased from 11.2% to 17.9% and obesity increased from 2.9% to 13.5% between 2000-2004 and 2015-2019. Although many factors effect on the increase in overweight and obesity, factors such as economic development of countries, change in diet, increase in fast food consumption habits, sedentary life may affect obesity.[99-101] On the other hand, the increased amount of daily energy intake between the years

1960-2011 with the increase of welfare level in Turkey may affect obesity.[102] In addition, there are risk factors influencing childhood obesity such as family with high incomes, urban children, having obese parents, high birthweight, soft drinks or time spent in front of TV and PC in Turkey.[103]

Many studies have shown that overweight and obesity which cause some health problems and have an increasing trend are higher in boys than girls, as in the current study.[104,84] The fact that boys are more ecosensitive than girls can be considered as a reason for this situation.[105] Besides, it is stated that this difference according to gender is affected by the behavioral determinants of overweight and obesity and sociocultural factors.[106,107]

In conclusion, the rates of overweight and obesity have increased between 2000-2004 and 2015-2019 periods. In order to determine prevalences and trends of overweight and obesity in children and adolescent in Turkey, further national representative research systematically repeated are needed. Considering the increasing rates of overweight and obesity, it is necessary to raise awareness of individuals about the short and long-term consequences of obesity both in the family and in school programs and it is thought that more effective strategies and policies should be implemented to substantially reduce or prevent childhood overweight and obesity.

This study has a limitation. Since the age ranges were not suitable for each other in the studies included in the research, the changes and trends of overweight and obesity prevalence by age groups were ignored. Therefore, there is a need for studies examining the change in overweight and obesity according to age groups.

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