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Effective sociodemographic and clinical factors in weight loss in childhood obesity

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Abstract

Aim: Obesity is a more common and important health problem in childhood. We aimed to determine sociodemographic and clinical factors contributing weight loss.

Material and Methods: Medical records of 120 obese patients (6-18 years old) applied at least twice for follow-up between 2012 (January)-2016 (September) were reviewed. Age, gender, socioeconomic status, family obesity, comorbidities, medications, operations, exercise frequency, screen time, physical examination findings and biochemical/hormone values [thyroid hormone, fasting insulin/glucose, cholesterol levels, Homeostasis model assesment insulin resistance (HOMA-IR), oral glucose tolerance test results (if applied) were recorded. Patients with a difference between the initial and last body mass index standart deviation higher than -0.2 were defined as "the good losing weight" group; the rest as "the poorly losing weight" group. The SPSS 22.0 program was used for analyzes.

Results: Puberty stage showed a significant difference (p=0,019); 65% of patients in the poorly losing weight group but 54% of other group were at stage 4-5 . The initial body mass index standart deviation and exercise frequency were higher in the good losing weight group, the last measured body mass index standart deviation was lower (p=0). In the other group, baseline HOMA-IR was higher (p=0.037); there were more metformin-initiated patients but the difference was not significant.

Conclusion: We observed that exercise frequency was higher in cases with good weight loss; therefore, we consider that increasing physical activity is an important step. Other crucial outcomes are that the initial body mass index standart deviation is higher while HOMA-IR is lower in those cases and that puberty stage is higher in poorly weight losing patients.

Keywords: Exercising frequency, metformin, obesity in childhood, sociodemographic factors, weight loss

Introduction

The prevalence of obesity is gradually increasing in childhood worldwide (1); one in three children in the United States of America is obese or overweight, and the prevalence ranges between 2.3% and 27% in studies conducted in different years and regions in our country. The Republic of Turkey Ministry of Health Basic Health Services General Directorate Follow-up of Growth in School Age Children (6-10 years of age) in Turkey Research Project (TOÇBİ) reported the prevalence of obesity between the ages of 6 and 10 years as 6.5% (2, 3). The World Health Organization (WHO) includes Turkey in the group of countries in which the prevalence of obesity below the age of 5 years is between 10% and 14.9% (4).

It is observed that morbidity and mortality are increased in adulthood in individuals who were obese in childhood and a significant portion of the individuals who enter puberty as obese individuals are also obese in adulthood. Subjects should be examined in terms of diseases that develop secondary to obesity including high blood pressure, Type 2 diabetes mellitus (DM), non-alcoholic liver disease, obstructive sleep apnea, and dyslipidemia, and precautions should be taken immediately (1).

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In many obese children, an underlying endocrine factor or single gene disease or syndrome is not found. The cause of weight gain should be examined when evaluating these cases. These causes may be classified as prenatal/early period problems, low physical activity, nutritional errors, and socioeconomic causes. These factors affect the basic equation (energy intake=energy consumption) and may lead to obesity in children with a genetic predisposition (1).

Lifestyle change has a limited role in losing weight, especially in individuals with severe obesity. Increasing physical activity is one of the most important methods. Our knowledge about the efficacy and safety of drugs in losing weight in children is limited and controversial (1). Therefore, we aimed to specify sociodemographic factors that were effective in losing weight in late childhood obesity.

Material and Methods

One hundred twenty subjects aged between 6 and 18 years who presented to our outpatient clinic with excessive weight and were diagnosed as having external obesity and whose outpatient visits were performed at least twice, were included in this study. Subjects who were outside the age group specified, whose outpatient visits were performed less than twice, who had known endocrine-metabolic disease, who used drugs that could affect body weight, and those with a diagnosis or signs of genetic disease were not included in the study.

The outpatient clinic files of the subjects were screened. Deficient data were completed through phone calls. Age, sex, socioeconomic levels, presence of obesity and additional morbidity in the family and if they used any medication for these, surgical operations performed, follow-up times, daily time periods for watching screens and physical activity habits, physical examination findings, and biochemistry and hormone tests were recorded. The height, weight, body mass index (BMI), which was calculated with the following formula: BMI= weight (kg)/height^2 (m^2), values were recorded retrospectively. The percentile and standard deviation (SDS) values were calculated using the ÇEDD-Çözüm program and were evaluated according to tables compatible for age and sex (5, 6). Subjects with a BMI at or above the 95th percentile were considered obese (1). The subjects were evaluated in five stages according to their pubertal period and Tanner and Marshall staging was used for evaluation (7). A fasting blood glucose level of 100-125 mg/dL was considered impaired fasting glucose (IFG). Insulin resistance was calculated using the homeostasis model assessment of insulin resistance [HOMA-IR; fasting insulin (μu/L) x fasting glucose (mmol/L) /22.5)]; values above 2.5 before puberty and above 3.16 during puberty were considered as the presence of insulin resistance (8-10). The oral glucose tolerance test (OGTT) was peformed in patients who had a familial history of DM, those with acantosis nigricans on physical examination and a high HOMA-IR value, or those with a high fasting glucose value but had not undergone a previous OGTT and gave written informed consent, even though these criteria were not met. These subjects were given 1.75 g glucose/kg (maximum 75g); vanous plasma glucose and insulin values were obtained at the 0, 30, 60, 120th minutes. A blood glucose level below 140 mg/dL at the second hour was considered normal and a blood glucose level between 140 and 200 mg/dL at the second hour was considered impaired glucose tolerance (IGT) (8). A fasting cholesterol level above 170 mg/dL was considered hypercholesterolemia (11). Thyroid function tests were evaluated according to free thyroxine (t4) and thyroid stimulating hormone (TSH) laboratory ranges. Metformin treatment had been initiated in the subjects who had high initial HOMA-IR levels and who had a familial history of obesity/diabetes and/or who were found to have IFG and/or IGT independent of the HOMA-IR value.

The patients were divided into two groups as the ones who could and could not achieve successful weight loss. Successful weight loss was defined as a difference between the initial and final BMI values (ΔSDS) above -0.2, which was the value found in similar studies and considered statistically significant. Unsuccessful weight loss was defined as a ΔSDS value below -0.2 (12).

Written approval (date: 06.10.2016, decision number: 122) was obtained from the Ethics Committee of Health Sciences University Zeynep Kamil Womens' and Childrens' Diseases Training and Research Hospital for the study.

Statistical analysis

Mean, standard deviation, median, minimum, maximum, frequency, and percentage values were used in descriptive statistics of the data in statistical analysis. Distribution of the variables was measured using the Kolmogorov-Smirnov test. The Mann-Whitney U test was used in the analysis of the quantitative independent non-parametric data, and the Chi-square test was used in the analysis of qualitative independent data. The Statistical Packages for the Social Sciences (SPSS) version 22.0 (IBM Corp.; Armonk, NY, USA) statistics package was used in the analyses.

Results

Seventy-eight (65%) of the subjects in the study group were female and 42 (36%) were male. The unsuccessful weight loss group consisted of 39 girls (63%) and 23 boys (37%). The successful weight loss group comprised 39 girls (67%) and 19 boys (19%). There was no statistically significant difference between the groups in terms of sex (p=0.619) (Table 1).

The ages of the patients in the study group ranged between 72 months and 214 months. The mean age was found as 153.6 months in the unsuccessful weight loss group and 157.2 months in the successful weight loss group. There was no statistically significant difference between the groups in terms of mean age (p=0.574) (Table 1).

Follow-up visits were continued between the 3rd and 6th months by 93% of the successful weight loss group and 94% of the unsuccessful weight loss group. There was no significant difference regarding follow-up frequency between the groups (p=0.922) (Table 1).

In the unsuccessful weight loss group, the initial value for BMI SDS was 2.5±0.6, the mean value was found as

Table 1. Sociodemographic characteristics and physical examination findings of the groups

		Subjects	Unsuccessful weight loss group	Subjects	Successful weight loss group	P
Sex		n	%	n	%	
	Male	23	37	19	33	0.619$^{X^2}$
	Female	39	%63	39	%67	
Age (Months)		Mean±SD	n-% Median	Mean±SD	n-% Median	
		153.6±35.3	160.0	157.2±31.1	160.5	0.574^{m}
Follow-up frequency	3-6 Months	58	94%	54	93%	
	>6 Months	4	6%	4	7%	0.922$^{X^2}$
Body Mass Index		Mean±SD	n-% Median	Mean±SD	n-% Median	
	Initial	2.5±0.6	2.5	2.9±0.8	2.7	0.007^{m}
	Final measurement	2.7±0.7	2.7	2.3±0.8	2.2	0.004^{m}
	Variance	0.2±0.3	0.1	-0.6±0.5	-0.5	<0.001^{m}
		n	%	n	%	
	1	9	14	3	5	
	2	10	16	10	17	
Pubertal stage	3	3	5	14	24	0.019$^{X^2}$
	4	8	13	4	7	
	5	32	52	27	47	
Familial history		n	%	n	%	
	No obesity	44		71	42	73
	Obese mother	8	13	6	10	0.93$^{X^2}$
	Obese father	6	10	7	12	
	Both parents are obese	4	6	3	5	
Income level		n	%	n	%	
	1300-2500 TL	15	24	24	42	
	2500-5000 TL	39	63	28	48	0.133$^{X^2}$
	>5000 TL	8	13	6	10	

^{m}: Mann-Whitney U test

$^{X^2}$: Chi-square test

2.5, the final measurement value was 2.7±0.7, and the median value was found as 2.7 (Table 1). In the successful weight loss group, the initial value for BMI SDS was 2.9±0.8, the mean value was found as 2.7, the final measurement value was 2.3±0.8, and the median value was found as 2.2. The mean and median BMI SDS variation values were 0.2±0.3 and 0.1 in the unsuccessful weight loss group and -0.6±0.5 and -0.5 in the successful weight loss group, respecetively. The initial BMI SDS value was significantly higher in the successful weight loss group compared with the unsuccessful weight loss group (p=0.007). The final BMI measurement was significantly lower in the successful weight loss group compared with the unsuccessful weight loss group (p=0.004) (Table 1).

The subjects were examined in 5 stages according to their pubertal period. When the groups were compared, a statistically significant difference was found between the groups (p=0.019) (Table 1). In the successful weight loss group, 14 (24%) subjects were in pubertal stage 3, whereas only 3 subjects (5%) were in stage 3 in the unsuccessful weight loss group. Subjects with stage 4 and 5 pubertal development constituted 65% (n=40) of the patients in the unsuccessful weight loss group, whereas they comprised 54% (n=31) of the successful weight loss group.

Data related to the presence of obesity in the family, and monthly familial income of the subjects are summarized in Table 1. The presence of obesity in the family (p=0.936) and monthly familial income (p=0.133) showed no significant difference between the groups.

Screen times and activity habits of the subjects were examined. In the successful weight loss group, there were 31 (53%) subjects whose screen times were above two hours and 27 subjects (47%) whose screen times were two hours and below. In the unsuccessful weight loss group, there were 39 (63%) subjects whose screen times were above two hours and 23 (37%) subjects whose screen times were two hours and less (Table 2). No significant difference was found between the groups in terms of screen times (p=0.152). In the successful weight loss group, 3 patients (5%) had never performed physical activity, 35 (60%) performed physical activity less than three days a week, and 20 (35%) performed physical activity more than three days a week. In the unsuccessful weight loss group, 16 (26%) patients had never performed physical exercise, 39 (63%) performed physical exercise less than 3 days a week, and 7 (11%) engaged in physical activity more than three days a week. The rate of performing physical activity was significantly higher in the successful weight loss group compared with the unsuccessful weight loss group (p<0.001) (Table 2).

Table 2. Exercise and screen times

	unsuccessful weight loss		successful weight loss		
	n	%	n	%	p
Egzersiz					
None	16	26	3	5	
1-3 days	39	63	35	60	<0.001$^{X^2}$
3-5 days	7	11	20	35	
None	4	6	1	2	
1-2 hours	19	31	26	45	0.152$^{X^2}$
2-5 hours	37	60	31	53	
>5 hours	2	3	0	0	

$^{X^2}$: Chi-square test

The presence of comorbidities was interrogated in the study. Comorbidity was found in 12 of the patients (21%) in the successful weight loss group and these comorbidities included systemic diseases (10%, n=6), asthma (9%, n=5), and allergic rhinitis (2%, n=1). In the unsuccessful weight loss group, comorbidities were found in 12 patients (19%) and these included systemic diseases (15%, n=9) and asthma (5%, n=3). No significant difference was observed between the groups in terms of comorbidity rates (p=0.855).

In the successful weight loss group, 10 (17%) patients were using drugs and these drugs included antihypertensive drugs (5%, n=3), drugs for anemia (3%, n=2), and other drugs (9%, n=5). In the unsuccessful weight loss group, drug use was found in 7 (11%) patients and these drugs included drugs for anemia (3%, n=2) and other drugs (8%, n=5). There was no significant difference between the groups in terms of drug use (p=0.350).

In the successful weight loss group, 7 (12%) patients had a history of surgery and these operations included adenoidectomy (7%, n=4), tonsillectomy (2%, n=1), and other interventions (3%, n=2), respectively. In the unsuccessful weight loss group, 6 (9.7%) patients had a history of surgery, including adenoidectomy (3%, n=2), other interventions (3%, n=2), and tonsillectomy (2%, n=1), respectively. Having a surgical history showed no significant difference between the groups (p>0.674).

The fasting blood glucose, insulin level, TSH and free t4 values, and total blood cholesterol levels of the subjects were examined and the HOMA-IR values were calculated. Insulin resistance was found in 51 (43%) subjects in the study population. The HOMA-IR value was found to be high in 19 (33%) of the patients in the successful weight loss group and in 32 (52%) of the patients in the unsuccessful weight loss group. The number of patients with an increased HOMA-IR value was significantly higher in the unsuccessful weight loss group compared with the successful weight loss group (p=0.037). Impaired fasting glucose as found in 9 (8%) of the patients in our study population (successful weight loss n=4, unsuccessful weight loss group n=5). OGTT was applied in 36 of all patients and IGT was observed in 30 (83%) patients. It was found that 67 (56%) of the patients in the study population received metformin treatment, 38 (57.9%) were in the unsuccessful weight loss group, and 29 (43%) were in the successful weight loss group. Hypercholesterolemia was found in 79% (n=95) of the entire study population. The mean initial TSH level was found as 2.8±1.3 in the patients. The initial TSH level was 2.7±1.2 in the unsuccessful weight loss group and 2.9±1.4 in the successful weight loss group. There was no significant difference between the groups in terms of OGTT and the presence of IGT or IFG, metformin use, presence of hypercholesterolemia, and initial TSH level (p>0.05) (Table 3).

Table 3. Laboratory findings and use of metformin

		unsuccessful weight loss		successful weight loss		
		n	%	n	%	p
HOMA-IR	High	32	52	19	33	
	Low	30	48	39	67	0.037^{X^2}
OGTT	Present	22	36	14	24	
	Absent	40	64	44	76	0.175^{X^2}
IGT (n=36)	Yes	16	74	14	76	0.833^{X^2}
IFG	Yes	5	8	4	7	
	No	57	92	54	93	0.808^{X^2}
Metformin	Yes	38	61	29	50	
	No	24	39	29	50	0.213^{X^2}
Hypercho-	Yes	46	74	49	85	
lesterolemia	No	16	26	9	15	0.165^{X^2}
TSH		IU/mL	Median	IU/mL	Median	
		2.7±1.2	2.4	2.9±1.4	2.6	0.182^{m}

IFG: impaired fasting glucose; IGT: impaired glucose tolerance; HOMA-IR: homeostasis model assessment insulin resistance (HOMA-IR); m: Mann-Whitney U test; OGTT: oral glucose tolerance test; TSH: thyroid-stimulating hormone; $^{X^2}$: Chi-square test

Discussion

In our country, some studies related to childhood obesity have found a higher frequency in boys, whereas others reported conflicting findings (3, 13-15). This difference may be related to different age ranges, assessment criteria, and regional characteristics. In our study, the majority of the subjects were female (65% girls, 35% boys). No significant difference was observed between the groups in terms of sex (p=0.619). Bohlin et al. (16) conducted a study with 37 children aged between 5 and 14 years in which they investigated the effectiveness of phone call visits and face-to-face visits and found that sex was not associated with BMI SDS variance.

In our study, no statistically significant difference was found between the groups in terms of age (p=0.574). However, a significant difference was observed between the groups regarding pubertal stage (p=0.019). The number of patients with stage 3 puberty was higher in the successful weight loss group, whereas pubertal stage 4-5 was found in 65% of the subjects in the unsuccessful weight loss group. In the study conducted by Moens et al. (17) in which eight-year follow-up results were given, it was found that age was a positive predictor for losing weight. Jansen et al. (18) conducted a study in which they also treated parents, and similarly, showed that age was a positive predictor and BMI variance was better at younger age. Our follow-up time is similar to the follow-up time of the study by Jansen et al. (18); although we have different results in terms of age, it is notable that in our unsuccessful weight loss group majority of the patients were in pubertal stage 4 and 5.

In the literature, it has been reported that the risk of being obese is higher in children of obese families. The presence of obesity in one parent increases the risk by 2-3-fold, the presence of obesity in both parents increases this risk by approximately 15-fold (1). In addition family participitation to the studies enabled a positive response in weight loss (1, 17, 18). In our study, obesity was found with a rate of 27.6% in the successful weight loss group and 29% in the unsuccessful weight loss group; there was statistically significant difference (p=0.936). We think that this may be related to inadequate family support, as we mentioned before.

The prevalence of obesity is higher in low-income countries (1). When examined in terms of losing weight, Jansen et al. (18) emphasized that low socioeconomic status was a positive predictor in their study. In our study, the monthly incomes of the families showed no significant difference between the groups (p=0.133). We think that this is related to the fact that families did not efficiently participate in the therapeutic process in our study and access to unhealthy snacks with a high glycemic index was economically easier.

In various studies, it has been emphasized that there is a close relation between screen time and presence of obesity (1). In a study conducted in Istanbul with 99 students aged between 6 and 15 years, frequency of obesity was found to be significantly higher in children who spent four hours or more daily in front of a television or a computer (p<0.05). The proportion of children who were on the border of being overweight was found as 26.7% (n=80), and the proportion of children who were on the border of being obese was found as 8.4% (n=25). In total, 35.1% of the children (n=105) were specified to be obese with different degrees (19). The relationship between obesity and time spent in front of any screen (computer, video games, and television) are associated with low energy consumption, poor eating habits, and consumption of snacks. In addition, food advertisements are ever present while watching television and this increases the consumption of fast food and sugar-sweetened beverages in children, and decreases the consumption of fresh vegetables and fruit, milk, and dairy products (20-22). It is recommended that the daily screen time should be less than two hours in order to lose weight in obesity (1, 21). In our study, the number of patients who had a screen time above two hours was 31 (53%) in the successful weight loss group and 39 (63%) in the unsuccessful weight loss group. Although the number of patients who had a screen time longer than recommended was relatively high in the unsuccessful weight loss group, there was no significant difference between the groups (p=0.152). We think that this is related to the fact that our data were based on family observation.

Physical activity is one of the important elements for both enabling weight loss and maintaining body weight. Daily physical activity for one hour is recommended to prevent obesity. The target for physical activity is 60 minutes daily above 6 years of age, 90-120 minutes in preschool children, and 60-90 minutes every eight hours in young children. Playing outside is recommended for young children, and structured physical activity is recommended for older children (1, 21). Continuous physical activity prevents regaining weight. Initially, increasing daily life activities including walking, swimming, and using the stairs is important. Subjects are encouraged for more strict exercise according to physical capacity and the amount of weight loss (brisk walking, cycling, rowing, skiing, aerobic dance, skipping with rope). Increased physical activity is also useful in preventing muscle mass loss during weight loss in addition to augmenting fat loss. It leads to weight loss and a reduction in corporal adiposity and less weight gain is observed in the long term. Children who perform physical exercise show markedly lower storage of visceral adipose tissue compared with those who do not perform physical exercise. In addition, physical exercise helps preservation of fat-free mass or may reduce loss of fat-free mass (1, 23). In our study, the frequency of exercise was found to be statistically significantly higher in the successful weight loss group compared with the unsuccessful weight loss group, similar to the literature (p<0.001).

In the study conducted by Moens et al. (17), it was found that patients who had higher BMI initially lost weight more easily and similar results were found in other studies (1, 18). In our study, the initial BMI SDS values were found to be significantly higher in the successful weight loss group compared with the unsuccessful weight loss group (p=0.007), and the final BMI SDS was found to be significantly lower (p=0.004).

In our study, no statistically significant difference was found between the groups in terms of biochemical and hormonal test results excluding previous surgical interventions, drugs used, and increased initial HOMA-IR values. The initial HOMA-IR index was found to be statistically significantly higher in our unsuccessful weight loss compared with the successful weight loss group (p=0.037). Similarly, in a study in which Chiavaroli et al. (24) followed up two obese pediatric groups with and without insulin resistance for one year, the authors observed that the reduction in BMI was greater in children who had no insulin resistance at the end of the program and proposed that insulin resistance influenced adiposity. In addition, the number of patients who were initiated metformin treatment was higher, but no significant difference was observed when compared with the successful weight loss group. There are different views on the effects of metformin use on weight loss in childhood obesity (1). In a systematic review in which McDonagh et al. (25) examined studies conducted with children related to this issue, it was concluded that metformin provided a slight reduction, albeit statistically significant, in BMI together with lifestyle change, but it did not show superiority compared with other treatment methods. The results of our study also support this view. However, we added metformin to treatment in approximately half of our subjects, which we consider a high rate, and we think the criteria for initiating metformin treatment in childhood obesity should be specified.

Eating systems and habits, compatibility with the recommended diet, and daily intake of calories were beyond the scope of the study because they require collaboration of different disciplines. Another limitation was the fact that blood lipid values other than cholesterol could not be presented because these values could not be reached. In addition, only exercise frequencies were evaluated without considering exercise times and intensity of physical exercise.

Conclusion

Obesity is gradually increasing in children and threatens public health. It is essential to prevent obesity and to diagnose patients in the early stage and initiate necessary follow-up and treatment without delay. In our study in which the sociodemographic and clinical characteristics effective in weight loss were examined, it was observed that the frequency of exercise was higher in subjects who achieved successful weight loss, although a significant difference was not found in terms of other factors. Therefore, we think increased physical activity is an important step in losing weight. In addition, other important findings are as follows: the initial BMI SDS values were higher and HOMA-IR values were lower in the subjects who achieved successful weight loss.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Zeynep Kamil Maternity and Children's Training and Reseach Hospital (10.06.2016/122).

Informed Consent: Informed consent was not obtained from patients due to the retrospective nature of the study.

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References

1. Kumar S, Kelly AS. Review of childhood obesity: from epidemiology, etiology, and comorbidities to clinical assessment and treatment. Mayo Clin Proc 2017; 92: 251-65. [CrossRef]
2. Akıncı A. Obezite. In: Cinaz P, Darendeliler F, Akıncı A, Özkan B, Dündar B, Abacı A, Akçay T (yazarlar). Çocuk Endokrinolojisi. İstanbul: Nobel Tıp Kitabevleri; 2013.p.371-93.
3. T.C. Sağlık Bakanlığı Temel Sağlık Hizmetleri Genel Müdürlüğü. Türkiye'de okul çağı çocuklarında (6-10 yaş grubu) büyümenin izlenmesi (TOÇBİ) projesi araştırma raporu. 1. Baskı, Ankara: Kuban Matbaacılık Yayıncılık, 2011.
4. World Health Organization. Report of the commission on ending childhood obesity. 2016. Available from URL: www.who.int/entity/end-childhood-obesity/publications/echo-report/en (16.01.2017)
5. Demir K, Özen S, Konakçı E, Aydın M, Darendeliler F. A Comprehensive online calculator for pediatric endocrinologists: ÇEDD çözüm/TPEDS metrics. J Clin Res Pediatr Endocrinol 2017; 9: 182. [CrossRef]
6. Neyzi O, Bundak R, Gökçay G, et al. Reference values for weight, height, head circumference, and body mass index in Turkish children. J Clin Res Pediatr Endocrinol 2015; 7: 280-93. [CrossRef]
7. Marshall WA, Tanner JM. Variations in pattern of pubertal changes in girls. Arch Dis Child 1969; 44: 235: 91.
8. Craig ME, Jefferies C, Dabelea D, et al. Definition, epidemiology, and classification of diabetes in children and adolescents. Pediatr Diabetes 2014; 15: 4-17. [CrossRef]
9. Valerio G, Licenziati MR, Iannuzzi A, et al. Insulin resistance and impaired glucose tolerance in obese children and adolescents from Southern Italy. Nutr Metab Cardiovasc Dis 2006; 16: 279-84. [CrossRef]
10. Keskin M, Kurtoğlu S, Kendirci M, Atabek ME, Yazıcı C. Homeostasis model assessment is more reliable than the fasting glucose/insulin ratio and quantitative insulin sensitivity check index for assessing insulin resistance among obese children and adolescents. Pediatrics 2005; 115: e500-3. [CrossRef]
11. Daniels SR, Greer FR. Lipid screening and cardiovascular health in childhood. Pediatrics 2008; 122; 198-208. [CrossRef]
12. McGovern L, Johnson JN, Paulo R, et al. Clinical review: treatment of pediatric obesity: a systematic review and meta-analysis of randomized trials. J Clin Endocrinol Metab 2008; 93: 4600-5. [CrossRef]

13. Süzek H, Arı Z, Uyanık BS. Muğla'da yaşayan 6-15 yaş okul çocuklarında kilo fazlalığı ve obezite prevalansı. Türk Biyokimya Dergisi 2005; 30: 290-5.
14. Şimşek F, Ulukol B, Berberoğlu M, Gülnar SB, Adıyaman P, Öcal G. Ankara'da bir ilköğretim okulu ve lisede obezite sıklığı. Ankara Üniversitesi Tıp Fakültesi Mecmuası. 2005; 58: 163-6.
15. Şimşek E, Akpınar S, Bahçebaşı T, Senses DA, Kocabay K. The prevalence of overweight and obese children aged 6-17 years in the West Black Sea region of Turkey. Int J Clin Pract 2008; 62; 1033-8. [CrossRef]
16. Bohlin A, Hagman E, Klaesson S, Danielsson P. Childhood obesity treatment: telephone coaching is as good as usual care in maintaining weight loss- a randomized controlled trial. Clin Obes 2017; 7: 199-205. [CrossRef]
17. Moens E, Braet C, van Winckel M. An 8-year follow up of treated obese children: Children's, process and parental predictors of treatment success. Behav Res Ther 2010; 48: 626-33. [CrossRef]
18. Jansen E, Mulkens S, Jansen A. Tackling childhood overweight: treating parents exclusively is effective. Int J Obes (Lond) 2011; 35: 501-9. [CrossRef]
19. Öztora S, Hatipoğlu S, Barutçugil MA, Salihoğlu B, Yıldırım R, Şevketoğlu E. İlköğretim çağındaki çocuklarda obezite prevalansının belirlenmesi ve risk faktörlerinin araştırılması. Bakırköy Tıp Dergisi 2006; 2: 11-4.
20. Boutelle KN, Rhee KE, Liang J, et al. Effect of attendance of the child on body weight, energy intake, and physical activity in childhood obesity treatment: a randomized clinical trial. JAMA Pediatr 2017; 171: 622-8. [CrossRef]
21. Koplan JP, Liverman CT, Kraak VI. Institute of Medicine, Committee on the Prevention of Obesity in Children and Youth. Preventing childhood obesity: health in the balance: executive summary. J Am Diet Assoc 2005; 105: 131-8 [CrossRef]
22. Guran T, Turan S, Akcay T, et al. Content analysis of food advertising in Turkish television. J Paediatr Child Health 2010; 46: 427-30. [CrossRef]
23. Kim Y. Effects of Exercise Training Alone on Depot-Specific Body Fat Stores in Youth: Review of Recent Literature, Pediatr Exerc Sci. 2017; 1-25. [CrossRef]
24. Chiavaroli V, Giannini C, D'Adamo E, et al. Weight loss in obese prepubertal children: the influence of insulin resistance. Endocr Res 2013; 38: 48-57. [CrossRef]
25. McDonagh MS, Selph S, Ozpinar A, et al. Systematic review of the benefits and risks of metformin in treating obesity in children aged 18 years and younger. JAMA Pediatr 2014; 168: 178-84. [CrossRef]