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The Effects of the Diet and Diet+Exercise on Changes in Weight during Adolescence

Çetin YAMAN

Aim: This study was carried out in 2121 primary school students in the Sakarya province of Turkey. The body mass index (BMI) of these 2121 students, between 10 and 14 years old, was calculated from their height and weight measurements. Two hundred twenty-nine students with a BMI value of 26 or above were included in the study.

Materials and Methods: Diet and diet+exercise were applied to the subjects for 14 weeks under the supervision of expert dieticians and sports trainers. The subjects' heights and weights were measured by the same staff at the end of the 14-week period and their BMI differences were determined. The data were evaluated by SPSS 10.0 and significant differences were found between the groups and measurements.

Results: There was a significant change between the first and last measurement in the diet and diet+exercise groups, and the difference was greater in the diet+exercise group compared to the diet group. The male subjects had a more significant weight change than the female subjects.

Key Words: Diet, exercise, body mass index (BMI)

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Adolesan Dönemdeki Çocuklarda Diyet ve Diyet+Egzersiz Kilo Değişimi Üzerindeki Etkisi

Amaç: Bu çalışma Sakarya'da eğitim görmekte olan 2121 ilköğretim okulu öğrencisi üzerinde yapılmıştır. Yaşları 10-14 arasında olan 2121 öğrencinin boy ve kiloları alınarak Vücut Kitle İndeksi (VKİ) hesaplanmıştır. Ölçümlerde 229 öğrenci 26 VKİ ve üzerinde bulunarak çalışmaya dahil edilmişlerdir.

Yöntem ve Gereç: Deneklere 14 hafta boyunca uzman diyetisyen ve spor eğitmenleri nezaretinde diyet ve diyet+egzersiz uygulaması yapılmıştır. Denekler 14 hafta sonunda yine aynı kişilerce boy ve kiloları alınarak kilo değişimleri ve VKİ farkları tespit edilmiştir. Veriler SPSS 10.0 istatistik programında değerlendirilmiş olup, gruplar ve ölçümler arasında anlamlılık tespit edilmiştir.

Bulgular: Bu çalışma sonunda diyet ve diyet+egzersiz gruplarının ilk ve son ölçümlerinde anlamlı bir değişim olduğu gözlenirken, diyet+egzersiz grubunun diyet grubuna nazaran daha anlamlı bir değişim gösterdiği görülmüştür. Deneklerin cinsiyetlerine göre de ölçümlerde farklılık gösterdiği belirlenmiştir. Erkek deneklerin bayan deneklere göre daha anlamlı kilo değişimine uğradığı tespit edilmiştir.

Anahtar Sözcükler: Diyet, egzersiz, vücut kitle indeksi (VKİ)

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Introduction

Obesity in children has increased dramatically in recent years and is now considered a global epidemic (1,2). It has adverse health consequences (3,4), and there is an urgent need for population-based interventions aimed at prevention (5,6). Systematic reviews have reported a dearth of high quality evidence from randomized controlled trials; most older intervention studies were short-term, often underpowered, and had other weaknesses, such as failure to include a control group (5,6). More recent interventions have usually been unsuccessful (7). Only a single long-term randomized controlled trial, reported as high quality in systematic reviews, found benefits of the intervention (attributed to the reduced time spent watching television) (7,8).

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Despite the need for trials in obesity prevention in children, a systematic review by the end of 2003 identified only 6 ongoing trials, most of which were focused on adolescent girls from minority groups in the United States (9).

British research studies suggest that the prevalence of overweight and obesity amongst children of all ages is increasing (1,3,10). One study reported substantial increases (between 1984 and 1994) in the prevalence of overweight and obesity amongst primary school children in England and Scotland (11). Additionally, data from a large survey in England showed a rise in the prevalence of overweight (14.7% to 23.6%) and obesity (5.4% to 9.2%) between 1989 and 1998 in preschool children (12). Estimates of actual figures vary due to ongoing discussions as to how best to measure childhood obesity (13). There is no consensus on the appropriate cut-off point for classifying a child as obese (BMI changes substantially depending on the age, height, and gender of a child) (3,7,14).

There is considerable debate about the reasons for the increasing prevalence of childhood overweight and obesity. Possible explanations include the increase in sedentary lifestyles and changes in dietary patterns and eating habits (14). Among adults it appears that average recorded energy intake in Britain has declined substantially as obesity rates have escalated, which may suggest that sedentary lifestyles are an important factor (15,16).

Obesity in childhood can cause dyslipidemia, hyperinsulinemia, and hypertension (17). Additionally, the first obesity-related cases of type 2 diabetes in white adolescents were reported in the UK (16). Overweight and obesity are also known to have a significant impact on psychological wellbeing, with many children developing a negative self-image and experiencing low self-esteem (19,20).

Research over the past 4 decades has demonstrated that childhood is a period when dietary and lifestyle patterns are initiated (21), and they influence the body composition in the long run. Data from Growth and Health study of the National Heart, Lung, and Blood Institute demonstrated a relationship between physical activity patterns, the number of hours spent watching television, and intake of saturated fats and body mass index and skin fold thickness in African American and

white adolescent girls. In both groups of girls, body fatness was significantly related to sedentary activity and high-fat diet (22).

There are numerous negative health outcomes and financial consequences related to childhood obesity. Researchers have found that childhood obesity is associated with a number of disorders including hypertension, insulin resistance, sleep apnea, menstrual abnormalities, and orthopedic problems. According to one estimate, insured children treated for obesity are approximately 3 times more expensive for the health system than the average insured child (23).

Obesity results from an imbalance between the amount of energy consumed and the amount of energy expended. While there are many elements that affect the energy balance (for example, genetics, growth, and physiology), children and their parents can influence both energy consumed through diet and energy expended through physical activity. Some researchers have suggested that childhood obesity is largely the result of a decline in regular physical activity. As stated in the United States Government Accountability Office's October 2005 report (24), they surveyed experts on the key strategies to include in the design or implementation of a program to prevent or reduce childhood obesity. The program strategy identified by experts as most important was "increasing physical activity." Physical activity and proper nutrition are 2 key components to preventing and treating the disease of obesity. Physical activity can prevent or delay hypertension, prevent diabetes, increase bone density, decrease anxiety, improve body image and mood, improve scholastic performance in school, develop good physical fitness, and promote weight control, just to name a few (25).

In Turkey, according to the TEKHARF (The Heart Disease and Risk Factors among Turkish Adults) study carried out in 2000, obesity is seen in 2.63 million males and 5.46 females (8.1 million in total) in Turkey, which shows that the rate of the obese people has reached 23.3% among people over the age of 20 (26).

The body mass index (BMI), which is easy-to-apply and cheap in the determination of the obesity and the validity of which has been proven by numerous scientific studies, is commonly used. BMI, which has been suggested by the World Health Organization (WHO) for classification of obesity, is an index calculated by dividing

the weight (kg) by the square of the height (m). BMI has a high correlation with body fat and seems useful in estimating the body composition in overweight children (3,26).

The WHO has defined the adolescents between the ages 10 and 19 who are over the 85th percentile as overweight. The International Obesity Training Group (IOTF) has also accepted the 85th-95th percentile as the limit for obesity and fatness (27).

Fatness, which is a serious health problem, is gradually increasing among children. Thus, similar to other diseases, overweight children should be determined by scans carried out at early ages. For this purpose, measurement tools that can be applied on children and, at the same time, are capable of determining the body fat accurately should be employed. Some of the methods used in measuring the body composition are hydrostatic densimetry, skinfold tests, X-ray absorptiometry (DEXA), magnetic resonance imaging, and bioelectric impedance analysis (BIA). Furthermore, in the field studies regarding fatness, BMI has been suggested by the WHO. The latest improvements in BIA devices have made them an alternative to BMI for obtaining valid and correct measurements (28).

In wide-scale epidemiological studies regarding obesity, BMI was used as the means of measuring (26). BMI is an index suggested by the WHO for the classification of obesity and is calculated by dividing the weight (kg) by the square of the height (m) (26).

In adults, the diagnosis of obesity is carried out based on BMI and can be associated with the mortality and morbidity. Likewise, during childhood obesity is diagnosed based on BMI, but there is currently no study showing the correlation between BMI in childhood and mortality and morbidity. There are numerous known and potential reasons for childhood obesity, namely genetic reasons, endocrine-related reasons, the reasons regarding the prenatal/early period, the reasons related to physical activity, the reasons resulting from the diet, and the socioeconomic reasons. These factors affect the basic equation: the energy intake = the energy consumption. Deteriorations in this equation may result in obesity (29). Diet and exercise are among the most commonly used methods in the prevention of obesity. These 2 methods can be used in the treatment and prevention of obesity together or separately.

The purpose of the diet treatment is to decrease the energy intake and provide a balanced diet including essential nutrient components (30). In the exercise applications, however, the purpose is to increase energy consumption.

Obese children often turn into obese adults and encounter health risks (26,30). Therefore, the study present study involved the age group 10-14 years. In the study, 2121 students who were between 10-14 years old, of varying socio-economic status, and attending 5 primary schools in Sakarya province in Turkey were measured for their heights and weights and their genetic factors, eating habits, physical activity, and the time they spend in front of the television and computer were investigated by a questionnaire.

Materials and Methods

In order to determine the effects of exercise and diet on obesity, 5 primary schools representing different socioeconomic groups in the city center of Sakarya were selected and the measurements were carried out in these schools in different pre-determined days after getting due permission from the appropriate authorities. In the present study, 2121 students between the ages of 10 and 14 years were reached.

The heights were measured using a steel tape while they were standing with bare feet juxtaposed to each other and back of their heads, their backs, hips and heels touching a wall.

Weight measurements were taken with a portable scale on a level floor. Students were wearing light clothes and were barefoot on the scale.

Using the height and weight measurements, the BMI [weight (kg) / height² (m²)] of all students were calculated. Using the excess weight and obesity table based on the BMI according to age groups, the children were divided into groups.

The subjects whose BMI values were 26 or above were included in the study. The number of the obese students was determined as 229. Of these, 90 were included in the diet application and 89 were included in the diet+exercise application on a voluntary basis. Fifty obese subjects with similar age, gender, and BMI characteristics as the experimental groups were included as the control group.

Results

Of 2121 children reached, 229 were selected for the study (82 male (47.8%) and 97 female (54.2%)). The average age of the experiment groups was 12.5 years (females 12.28 years and males 12.76 years). Average height of the experiment groups was 151.65 cm and the average weight was 60.55 kg (males 151.48 cm and 60.045 kg, and females 151.79 cm and 60.992 kg). For the diet group, the average height was 151.67 cm, and the average weight was 60.51 kg. For the diet+exercise group, the average height was 151.62 cm, and the average weight was 60.60 kg. The BMI of the research group was 26.27 kg/m². The BMI of the diet group was 26.21 kg/m². The BMI of the diet+exercise group was 26.32 kg/m².

At the end of the study, a 3.69 kg weight difference was observed in the research group (diet and diet+exercise combined) compared to the control group. The average weight of the diet group was 58.154 kg, while the difference observed in their average weight was 2.36 kg. The average weight of the diet+exercise group was 55.561 kg, while the difference observed in their average weight was 5.04 kg. The average weight of the male subjects was found to be 56.082 kg, while the difference observed in their average weight was 3.92 kg. The average weight of the female subjects was 57.528 kg, while the difference observed was 3.38 kg.

The comparative results of the first and last BMIs of diet and diet+exercise methods are given in Table 1.

The most important reason for the obesity is the positive deterioration in the energy balance of the body. Therefore, when one of the physical exercise methods or diet programs, or both, is applied, there will be negative changes in this energy balance. Thereby, the person who is overweight will lose weight and the BMI value will decrease.

As a result of the present study, it was found that there were significant changes between the first and last BMI values ($.000 < 0.05$) of both groups (diet and diet+exercise group).

As a result of the study carried out by Yaman on the effects of diet, diet+exercise, and exercise on obese university students on weight loss, it was found that there were significant differences at the level of $P < 0.05$ between the first and second measurements of the subjects' weights (31,33,34), which is in line with the results of our current study.

Saçaklı found statistically significant changes in BMIs of İstanbul Technical University students after diet and exercise application (34), which also supports our results.

Comparative results of weight change (the decrease in the BMI) between diet and diet+exercise are given in Table 2.

In order to prevent obesity either the energy taken should be reduced, which is called diet, or the energy should be consumed through exercise.

In the present study, it was found that significant weight losses, and thus BMI changes, occurred in both groups. Regarding the changes between the groups, it was found that the weight loss and BMI difference that occurred in the diet+exercise group ($.001 < 0.05$) were more significant than in the diet group ($.000 < 0.05$). In the study carried out by Karakaş et al. (2005) involving 36 male and 37 female subjects, it was found that, when the individuals taking exercise regularly and the ones not doing so were compared to each other, there were statistically significant differences in terms of body fat rate (BFR) and other data between the 2 groups for both sexes (35).

The comparative results of weight change resulting from diet and diet+exercise between genders are given in Table 3.

Table 1. The differences between the first and last BMIs.

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 ^{FirstBMI - LastBMI}	1,60895	0,86974	0,06501	1,48066	1,73723	24,750	178	0,000

Table 2. The weight change (the decrease in the BMI) between diet and diet+exercise.

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig.(2-tailed)
First BMI	5.262	.023	Equal variances assumed	177	.717
Equal variances not assumed			156.464	.716	
Last BMI	5.261	.023	Equal variances assumed	177	.001
Equal variances not assumed			153.925	.001	
Difference in kg	15.982	.000	Equal variances assumed	177	.000
Equal variances not assumed			144.419	.000	

Table 3. The differences in diet and diet+exercise between genders.

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig.(2-tailed)
First BMI	1.247	.266	Equal variances assumed	177	.413
Equal variances not assumed			175.944	.403	
Last BMI	.711	.400	Equal variances assumed	177	.159
Equal variances not assumed			176.193	.151	
Difference in kg	2.458	.119	Equal variances assumed	177	.047
Equal variances not assumed			157.337	.051	

The factor that males have more active life styles should be taken into consideration when the differences are examined in terms of gender.

As a result of the study, weight losses were found in both groups. When genders were compared to each other, it was found that the male subjects (.047 < 0.05) had lost more weight than the female subjects (.051 < 0.05). The results obtained in the present study are in parallel with the results obtained from the study carried out by Karakaş et al. (35).

Discussion

According to the findings of the present study, there was a significant (P < 0.05) difference between the first and last BMIs of the subjects.

When the diet and diet+exercise groups were compared to each other, it was found that weight loss and the decrease in BMI were higher in the diet+exercise group. Regarding the difference between genders, it was found that weight loss of the male subjects was higher than that of the female subjects. Consequently, when diet

and diet+exercise were compared, although weight loss was observed in both groups, diet+exercise was observed to be more effective.

School administrators should assume the responsibility of informing students about weight related issues during adolescence. Professional support should be provided regarding nutrition and related matters; physical education teachers should encourage students to do more

physical activities and equipment should be provided to help attain this goal. The number of physical education classes should also be increased. Once students are introduced to a healthier lifestyle, they may maintain the same lifestyle throughout their life. Such precautions are necessary to create a healthy society in which the obesity rate is low. To ensure a healthy next generation, families should be educated in this matter as well.

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