

Evaluation of the effectiveness of an intervention program on preventing childhood obesity in Denizli, Turkey

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Aim: To determine the efficiency of 2 different intervention programs (healthy nutrition education and/or physical activity programs) for preventing the obesity of primary school students.

Materials and methods: Selected were 6 schools, making 3 groups, from all primary schools in Denizli with the half-day education system. Each group was composed of 2 schools. The groups were randomly divided into intervention group 1, intervention group 2, and the control group. The body mass index (BMI) levels of the students in all of the groups were calculated. Both the physical activity and healthy nutrition programs were applied to intervention group 1, and only the healthy nutrition program was applied to intervention group 2. BMI measurements were repeated 8 months after the interventions. The differences between the 2 BMI measurements were calculated.

Results: The increase of BMI was 0.51 in the control group and 0.35 and 0.37 in the respective intervention groups. It was found that the BMI increase in both of the intervention groups was lower than that of the control group, which means that the interventions were effective.

Conclusion: Two different intervention programs were applied (healthy nutrition program and/or physical activity) and were found to be effective in preventing obesity in children.

Key words: Childhood, obesity, preventing, intervention study, healthy nutrition, physical activity, body mass index (BMI)

Denizli’de çocukluk çağı obezitesinin önlenmesine yönelik bir müdahale programının etkinliğinin değerlendirilmesi

Amaç: Denizli’deki ilköğretim okulu öğrencilerinde obezitenin önlenmesi için geliştirilen 2 farklı müdahale programının (sağlıklı beslenme eğitimi ve/veya fiziksel aktivite programları) öğrencilerde obezitenin önlenmesindeki etkinliğini ve bu etkinliğin olası değişkenlerle ilişkisini belirlemektir.

Yöntem ve gereç: Şehirdeki tüm yarı zamanlı ilköğretim okulları arasından 3 grup oluşturmak üzere 6 okul seçilmiştir. Her bir grup 2 okuldan oluşturulmuştur. Gruplar randomize olarak müdahale 1, müdahale 2 ve kontrol grubu olarak seçilmiştir. Tüm gruplardaki öğrencilerin vücut kitle indeksi (VKİ) düzeyleri ölçülmüştür. Müdahale 1 grubuna fiziksel aktivite ve sağlıklı beslenme programı; Müdahale 2 grubuna yalnızca sağlıklı beslenme programı uygulanmıştır. Müdahalelerden 8 ay sonra yeniden VKİ ölçümü yapılmıştır. Her 2 VKİ ölçümü arasındaki fark hesaplanmıştır.

Bulgular: Kontrol grubunda 0,51 olan VKİ artışı her 2 müdahale grubunda sırasıyla 0,35 ve 0,37’ye çekilmiştir. Öğrencilerde müdahale öncesi ve sonrası 8 ay arayla yapılan 2 VKİ ölçümü arasındaki artış (fark) incelenmiş ve her 2 müdahale grubundaki VKİ artışı kontrol grubuna göre daha düşük olmuştur yani müdahaleler etkili bulunmuştur.

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Sonuç: Bu çalışmada uygulanmış olan 2 farklı müdahale programı (sağlıklı beslenme programı ve/veya fiziksel aktivite) öğrencilerde obezitenin önlenmesinde etkili bulunmuştur.

Anahtar sözcükler: Çocukluk çağı, obezite, önleme, müdahale çalışması, sağlıklı beslenme, fiziksel aktivite, vücut kitle indeksi (VKİ)

Introduction

Obesity, which is defined as “abnormal or excessive fat accumulation in fat tissues in a rate harmful for health,” has become a global epidemic (1-3). Childhood obesity has an increasing prevalence throughout the world, especially in developed countries. Aside from problems related to obesity, the increase in morbidity and mortality of adults who were obese in childhood, the obesity of 50% of obese people in adolescence, and the disregarding of obesity as an illness by families and doctors makes childhood obesity a more important and primary public health problem (4). The existing data show that the prevalence of childhood obesity is increasing in nearly all countries. It has been reported that the most effective interventions for preventing this increase are supporting physical activity and encouraging healthy nutrition habits (5-9). Nevertheless, there are still shortcomings in determining an effective standard intervention aimed at childhood obesity. To overcome this problem, interventions comparable and suitable to the situations of country and region are required (2).

Though there are many methods for measuring obesity, there are not many measurement choices for children. The most commonly used measurement method is to use the percentile curves of the body mass index (BMI) according to age and sex. Aside from this, it is proposed that BMI cut-points according to age do not have sufficient sensitivity or specificity (10,11). Consequently, it may be more useful to compare the means of the BMI before and after interventions aimed at preventing obesity in children. However, we must remember that the BMI values after the age of 5 continuously increase with age, with the increase of body weight (12). Because of this, the main aim of the interventions against preventing obesity in school-age children should be the prevention of too high of an increase of BMI, not to stop the increase.

The aim of this study was to determine the efficiency of applying both physical activity and healthy nutrition programs and only a healthy nutrition program for preventing obesity in primary school students (aged 7-13) in Denizli, to determine the relationship of this efficiency with the possible variables, and to construct an obesity control program aimed at the students.

Materials and methods

In this field-type intervention study, data were acquired from a project named “Get into motion for health,” conducted with the cooperation of the Denizli City Health Administration, the National Education Administration, and Pamukkale University.

Most of the schools in Denizli have a half-day education system; therefore, all of the schools with the half-day education system were included in this study. The list of schools with the half-day education system was first determined, and then these schools were rated as low or high, according to the socioeconomic status (SES) of their locations. From the low- and high-value SES regions, 3 schools each (a total of 6 schools) were selected by using a simple random sampling method. These schools were randomly divided into 3 groups consisting of 1 school from the low and 1 school from the high SES level. Of these groups, 2 were again randomly selected as intervention groups and the remaining 1 as the control group. As a result, intervention group 1, intervention group 2, and the control group, each consisting of 2 schools, were formed. As the study would continue through the following education year, students in the highest grade were not included in the study.

The procedures applied to the intervention 1, intervention 2, and control groups are explained below.

1. **Collecting data:** The sex, grade (grades 1-3 and 4-7), and family income were collected

from the students in all of the groups. Data were collected from the parents of the students in grades 1-3, and the students in grades 4-7 gave the data themselves.

2. Body weight and height measurements:

Body weight and height of the students in all of the groups were measured. To achieve this, the same calibrated measurement devices were used. For the measurements, the students took off their outerwear and shoes. The measurements were repeated in all of the groups 8 months after the intervention.

3. Physical activity program: This was applied only in the intervention group 1. The initial weekly physical education lessons were 2 h in total, and they were increased to 3 h on different days of the week. During these lessons, standard physical activity and sport programs, specific to the age range of the children and prepared by the Pamukkale University School of Sport Science and Technology, were applied.

4. Healthy nutrition education program: This was applied in both of the intervention groups. Education on the importance of healthy nutrition and the methods of preventing obesity were given to the students, their parents, and the teachers by the personnel of the Health Training Division of the City Health Administration. Aside from this, boxed milk was distributed to the students for them to drink during meal time. Moreover, to supply healthy eating options for the students in the school canteens, water, freshly squeezed fruit juice, buttermilk, milk, and seasonal fruits were sold.

The application scheme of the study is given in Figure 1.

According to the BMI percentile curves of the National Center for Health Statistics (NCHS) for the ages of 2-20, the BMI curves of both sexes show a natural increasing trend in the target group of 7-13 years (12). Consequently, it was anticipated that the later measurements of the students would show an increase from the previous measurements. For this reason, in determining the efficiency of the

intervention programs, the difference between the 2 measurements (the initial and eighth-month BMI values) were taken as the main criteria and these differences constituted the dependent variable of the analysis.

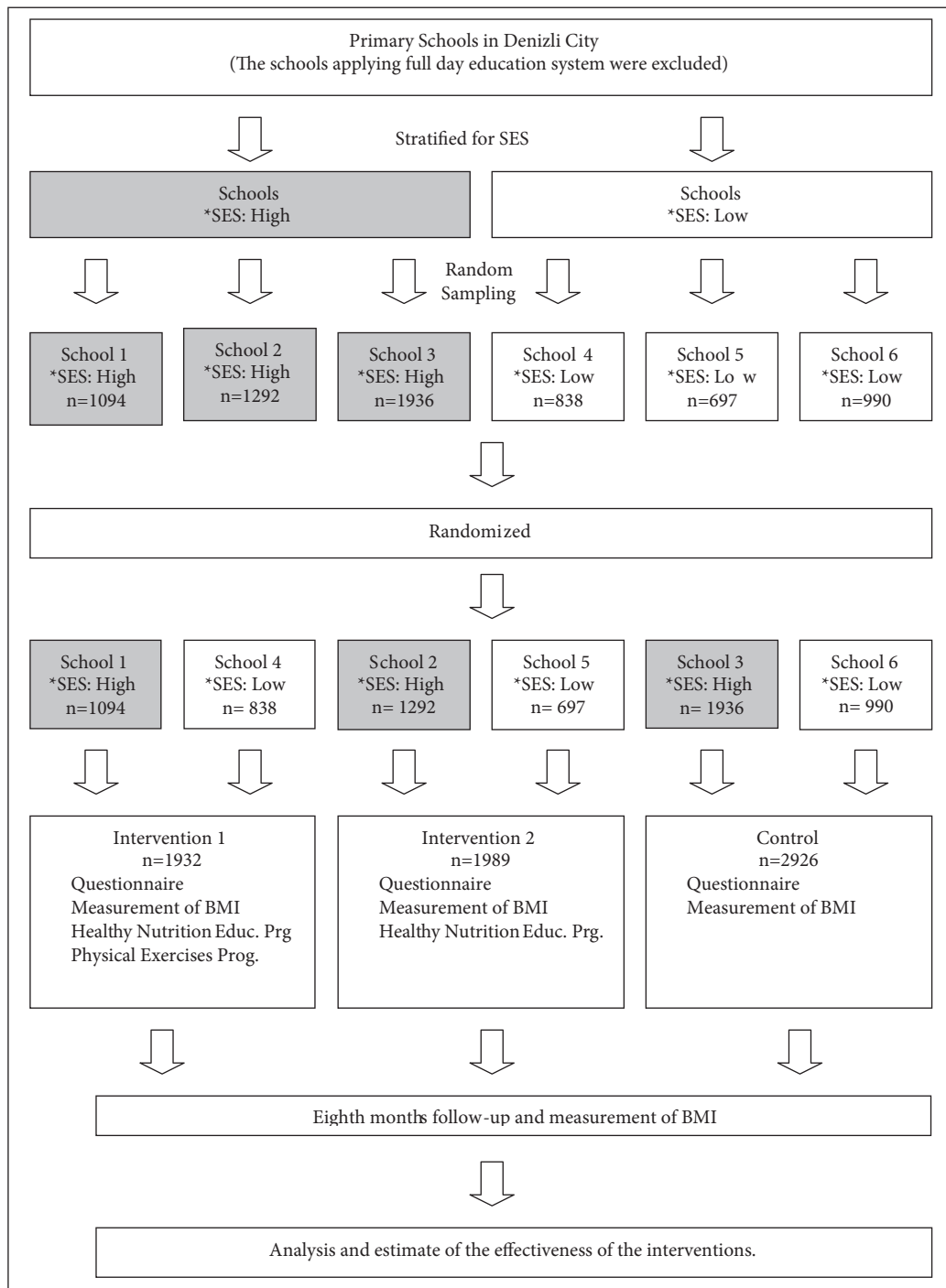
The independent variables were the students' sexes, grades, and monthly family incomes. In the analyses, the grades were grouped as 1-3 and 4-7. Socioeconomic status was analyzed in 3 groups, namely low, middle, and high. This classification was formed according to the total monthly income of the students' families in the ranges of \$0-999, \$1000-1999, and \$2000 and over (USD). SPSS 17.0 was used in the data analysis. In these analyses, the chi-square, Student's t, one-way ANOVA, and Tukey's post hoc tests were applied.

Results

Of the 6847 students, 6771 (98.9%) in all 3 groups were reached. Of the reached students, 3363 (49.7%) were female and 3408 (50.3%) were male; 2855 (42.2%) of them were in grades 1-3 while 3916 (57.8%) were in grades 4-7; and 3132 (50.8%) of them were the children of low-income families, 1812 (29.4%) were from middle-income families, and 1220 (19.8%) of them were from high-income families. Sex, grade, and income status showed similar distributions in each group (Table 1).

Baseline and eighth-month BMI means of the students according to the groups are shown in Table 2. There was no significant difference between the primary BMI measurements of the 3 groups ($P = 0.501$). Similar results were obtained for the eighth-month BMI measurements of the 3 groups ($P = 0.755$). The differences between the secondary (eighth-month) and primary measurements of BMI are also shown in Table 2.

When we evaluated the difference between the means of the BMI measurements made at an 8-month interval, we found that the BMI increase between the 2 measurements in the control group was 0.51 ± 0.98 , which was found to be significantly ($P = 0.000$) higher than that of both the intervention 1 (0.37 ± 1.08) and intervention 2 (0.35 ± 1.13) groups. However, there was no significant difference between the intervention groups ($P = 0.847$) (Table 3).



*SES: Socio -economical status
Figure 1. The application scheme of the study.

It is clearly seen in Figure 2 that the difference between the 2 measurements made at an 8-month interval was higher in the control group than in the

other 2 intervention groups, and, consequently, the BMI increase was limited in the intervention groups.

Table 1. Distribution features of the students.

Features		Total	Intervention 1		Intervention 2		Control		P*
		N	n	%	n	%	n	%	
Sex	Female	3363	1012	50.3	966	49.8	1385	49.1	0.700
	Male	3408	1000	49.7	972	50.2	1436	50.9	
Grade	Grades 1-3	2855	840	41.7	827	42.7	1188	42.1	0.839
	Grades 4-7	3916	1172	58.3	1111	57.3	1633	57.9	
Income	Low	3132	981	52.2	852	48.9	1299	51.1	0.126
	Middle	1812	537	28.6	513	29.4	762	30.0	
	High	1220	360	19.2	378	21.7	482	18.9	

*Chi-square test

Table 2. BMI means of the groups.

Groups	BMI - Before		BMI - After		Difference of means	
	Mean	SD	Mean	SD	Mean	SD
Intervention 1	18.42	3.45	18.79	3.54	0.37	1.08
Intervention 2	18.46	3.42	18.81	3.50	0.35	1.13
Control	18.35	3.52	18.86	3.70	0.51	0.98
P*	0.501		0.755		0.000	

*One-way ANOVA test

Table 3. Comparison of the difference of BMI means between the eighth-month and initial measurements of the groups.

Groups	N	Mean	SD	P*	P (1-2)**	P (1-3)***	P (2-3)****
Intervention 1	1897	0.37	1.08	0.000	0.847	0.000	0.000
Intervention 2	1815	0.35	1.13				
Control	2654	0.51	0.98				
Total	6366	0.42	1.05				

*One-way ANOVA test

**Tukey's post hoc test for intervention 1 and intervention 2

***Tukey's post hoc test for intervention 1 and the control group

****Tukey's post hoc test for intervention 2 and the control group

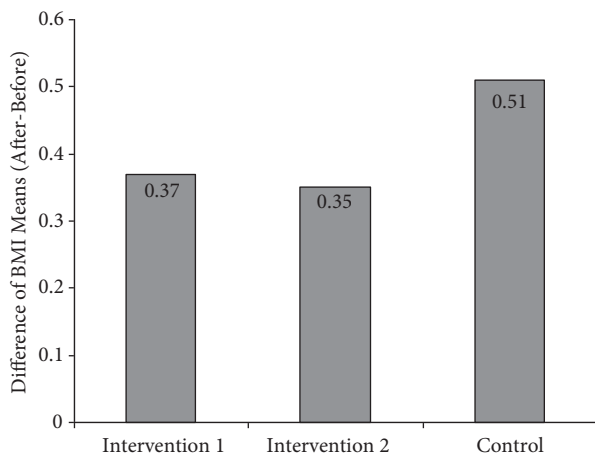


Figure 2. Distribution of the groups for the difference of BMI means between the eighth-month and the initial measurements.

When compared according to sex, there was a lower BMI increase in female students in the intervention groups compared to the control group, but no significant difference was found in the analysis ($P = 0.097$) (Table 4). However, a significantly lower BMI increase was observed in male students in both of the intervention groups compared to the control group ($P = 0.000$). The increase level in males in intervention group 1 (0.25 ± 0.90) was 50% that of the control group (0.50 ± 0.99).

When each group was compared, there was a significantly lower BMI increase in males (0.25 ± 0.90) compared to females (0.48 ± 1.21) in intervention group 1 ($P = 0.000$) (Table 4).

When compared according to the grade levels of the students, intervention group 1 was significantly

effective in students in grades 1-3 ($P = 0.002$), and both intervention groups 1 and 2 were significantly effective in students in grades 4-7 ($P = 0.000$).

When each group was compared, in all 3 groups, the BMI increase was significantly higher in grades 4-7 compared to grades 1-3 ($P = 0.000$; $P = 0.031$, $P = 0.000$) (Table 5).

Comparisons according to income levels indicated that the BMI increase in both of the intervention groups of the children from low-income families was significantly lower compared to those in the control group ($P = 0.000$). Similarly, in students from high-income families, the BMI increase was at a lower level ($P = 0.001$) in both of the intervention groups compared to the control group. However, while a decrease of 20% was observed in the middle-income group, no significant difference between the groups was observed ($P = 0.143$).

Data from the control group show that the BMI increase of the students (0.46 ± 0.84 ; 0.51 ± 1.22 , 0.63 ± 0.86) had a linear relationship with the income level of the family ($P = 0.005$). It was seen that this relationship was lost in both of the intervention groups, and the increase in BMI became equal in the children of the families with middle and high incomes (Table 6).

Discussion

Though it is proposed that physical activity and healthy nutrition are the most important factors in the prevention of childhood obesity (5-9), the efficiency of these interventions cannot be fully demonstrated

Table 4. Comparison of the difference of BMI means between the eighth-month and initial measurements of the groups by sex.

Sex	Intervention 1			Intervention 2			Control			P**
	n	Mean	SD	n	Mean	SD	n	Mean	SD	
Female	956	0.48	1.21	912	0.41	1.16	1297	0.51	0.95	0.097
Male	941	0.25	0.90	903	0.28	1.09	1357	0.50	0.99	0.000
P*		0.000			0.120			0.706		

*Column comparison; Student's t-test

**Row comparison; one-way ANOVA test

Table 5. Comparison of the difference of BMI means between the eighth-month and initial measurements of the groups by grades.

Grades	Intervention 1			Intervention 2			Control			p**
	n	Mean	SD	n	Mean	SD	n	Mean	SD	
Grades 1-3	806	0.16	0.82	783	0.32	1.10	1125	0.30	0.95	0.002
Grades 4-7	1091	0.51	1.21	1032	0.37	1.16	1529	0.66	0.97	0.000
P*		0.000			0.031			0.000		

*Column comparison; Student's t-test

**Row comparison; one-way ANOVA test

Table 6. Comparison of the differences of BMI means between the eighth-month and initial measurements of the groups by income.

Income	Intervention 1			Intervention 2			Control			p**
	n	Mean	SD	n	Mean	SD	n	Mean	SD	
Low	936	0.35	1.05	808	0.29	1.06	1249	0.46	0.84	0.000
Middle	513	0.39	1.01	485	0.40	1.38	714	0.51	1.22	0.143
High	338	0.40	1.32	366	0.39	1.0	444	0.63	0.86	0.001
P*		0.659			0.141			0.005		

*Column comparison; one-way ANOVA test

**Row comparison; one-way ANOVA test

in some studies and it is reported that stronger evidence is required for proving the efficiency of physical activity (13,14). In the existing studies, the differences between the results of the interventions might be caused by not only the application style of the intervention, but also the properties of the community to which the intervention is applied.

In our study, it was shown that both of the intervention groups were efficient. However, no significant difference was detected between intervention group 1 and intervention group 2 (P = 0.85). The above finding makes us think that the actual effective intervention might be the healthy nutrition educational program.

The efficiency of the interventions was evaluated according to students' sex, grade, and family income

level. In the comparisons made according to sex, it was seen that the interventions were much more effective in male students (P = 0.000). Some studies show that the prevalence of obesity and the cardiovascular disease risk caused by obesity is higher in males than in females (15,16). The finding that the interventions were more effective in males bears importance in this respect. However, it was seen that the application of both the physical activity and healthy nutrition educational programs together was more effective in males (0.25 ± 0.90) than in females (0.48 ± 1.21) (P = 0.000). This shows that the physical activity program supplies additional activity, especially for the male students. On the other hand, research must be done to find other interventions for female obesity.

When the findings were compared according to grade levels, it was thought that the application

of both the physical activity and healthy nutrition educational programs together was more efficient in students in grades 1-3, and the healthy nutrition educational program alone was more efficient in students in grades 4-7. This might be due to the younger students thinking that the physical activities were games and thus adapting to them more easily. In light of these findings, if childhood obesity is to be prevented, we should focus on the lower grades and apply the combined program.

Obesity has shown a rapid increase in developed countries, especially after the 1980s (15), and it has become a problem in middle- and low-income families, not just high-income families (17). However, in developing countries, obesity is still more frequent in families with higher incomes (18). Similar results were obtained in a study made in the city of Denizli (19), and in Turkey, which is a developing country (20,21). In our study, the differences of the BMI means had a linear relationship with the income level of the family. This finding led us to conclude that the other important risk group is children of high-income families. We found that both interventions were effective for this risk group.

Strengths and limitations of the study

A large sample volume and the high rate (98.9%) of access to the students in the set, randomized and controlled design, standardization in the anthropometric measurements, and physical activity

applications and education may be counted among the strong aspects of the study. In one of the schools in intervention group 1, some of the equipment required for the physical activity program could not be obtained, and an insufficiency in directing the school canteens to supply healthy food instead of fast food and carbonated drinks might be counted among the limitations of the study.

Conclusions and policy implications

It was shown here that childhood obesity may be prevented by supplying sufficient physical activity to school-aged children and/or giving effective education aimed at instilling healthy nutrition habits.

For this purpose, education aimed at gaining healthy nutrition habits should primarily be included in the formal education model, and this education should be supported by the training of teachers and the parents. As in our study, the physical activity lessons, which were originally 2 h a week, should be increased at least 1 h more. These lessons should be offered on different days, and physical activity programs suitable for the ages of the students should be applied during this time.

We plan to continue this study for 1 additional year; a childhood obesity control program that can be applied throughout the city is also planned after obtaining and considering the results of the additional year.

References

1. Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. *Obes Rev* 2004; 5: 4-85.
2. Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. *Int J Pediatr Obes* 2006; 1: 11-25.
3. Lissau I, Overpeck MD, Ruan WJ, Due P, Holstein BE, Hediger ML et al. Body mass index and overweight in adolescents in 13 European countries, Israel and the United States. *Arch Pediatr Adolesc Med* 2004; 158: 27-33.
4. Gürel S, İnan G. Çocukluk çağı obezitesi tanı yöntemleri, prevalansı ve etyolojisi. *ADÜ Tıp Fakültesi Dergisi* 2001; 2: 39-46.
5. American Academy of Pediatrics, Committee on Nutrition. Prevention of pediatric overweight and obesity. *Pediatrics* 2003; 112: 424-30.
6. Gulbrandsson K, Wennerstad KM, Rasmussen F. Municipal policies and plans of action aiming to promote physical activity and healthy eating habits among schoolchildren in Stockholm, Sweden: a cross-sectional study. *Implement Sci* 2009; 4: 47.
7. Singh AS, Chin A Paw MJ, Brug J, Van Mechelen W. Short-term effects of school-based weight gain prevention among adolescents. *Arch Pediatr Adolesc Med* 2007; 161: 565-71.
8. Zahner L, Puder JJ, Roth R, Schmid M, Guldemann R, Pühse U et al. A school-based physical activity program to improve health and fitness in children aged 6-13 years (Kinder-Sportstudie KISS): study design of a randomized controlled trial. *BMC Public Health* 2006; 6: 147.
9. Austin SB, Kim J, Wiecha J, Troped PJ, Feldman HA, Peterson KE. School-based overweight preventive intervention lowers incidence of disordered weight-control behaviors in early adolescent girls. *Arch Pediatr Adolesc Med* 2007; 161: 865-9.

10. Whitlock EP, Williams SB, Gold R, Smith PR, Shipman SA. Screening and interventions for childhood overweight: a summary of evidence for the US Preventive Services Task Force. *Pediatrics* 2005; 116: 125-44.
11. Westwood M, Fayer D, Hartley S, Rithalia A, Butler G, Glasziou P et al. Childhood obesity: should primary school children be routinely screened? A systematic review and discussion of the evidence. *Arch Dis Child* 2007; 92: 416-22.
12. National Center for Health Statistics in Collaboration with the National Center for Chronic Disease Prevention and Health Promotion. Growth Charts. 2000. Available from: URL: <http://www.cdc.gov/growthcharts>.
13. Molnar D, Livingstone B. Physical activity in relation to overweight and obesity in children and adolescents. *Eur J Pediatr* 2000; 159: 45-55.
14. Reilly JJ, Kelly L, Montgomery C, Williamson A, Fisher A, McColl JH et al. Physical activity to prevent obesity in young children: cluster randomised controlled trial. *BMJ* 2006; 333: 1041.
15. Flynn MA, McNeil DA, Maloff B, Mutasingwa D, Wu M, Ford C et al. Reducing obesity and related chronic disease risk in children and youth: a synthesis of evidence with "best practice" recommendations. *Obes Rev* 2006; 7: 7-66.
16. Livingstone B. Epidemiology of childhood obesity in Europe. *Eur J Pediatr* 2000; 159: 14-34.
17. WHO. Physical Status: The Use And Interpretation Of Anthropometry. Geneva, WHO Technical Report Series; 1995.
18. Trinh OT, Nguyen ND, Phongsavan P, Dibley MJ, Bauman AE. Prevalence and risk factors with overweight and obesity among Vietnamese adults: Caucasian and Asian cut-offs. *Asia Pac J Clin Nutr* 2009; 18: 226-33.
19. Semiz S, Özdemir ÖMA, Özdemir AS. The prevalence of obesity in childhood 6-15 years of age in Denizli. *Pamukkale Tıp Dergisi* 2008; 1: 1-4.
20. Dündar Y, Evliyaoğlu O, Hatun Ş. Short stature and obesity in school children: a neglected problem. *T Klin J Pediatr* 200; 9: 19-22.
21. Atamtürk D. The prevalence of obesity and overweight among children from lower socioeconomic status. *Gaziantep Tıp Dergisi* 2009; 15: 10-14.