

ORIGINAL ARTICLE

School based multifaceted nutrition intervention decreased obesity in a high school: an intervention study from Turkey

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Summary. Childhood obesity is ever-increasing, and school-based programmes are an intervention area for tackling obesity. In this interventional study, nutritional knowledge and behavior and obesity status were determined for high school students. After multifaceted nutrition and physical activity interventions, nutritional knowledge and behavior and obesity status were re-evaluated. Of the adolescents, one quarter (25.7%) were overweight. Nutritional knowledge and positive nutritional behaviors significantly improved and mean BMI and overweight prevalence significantly reduced after the interventions. Obesity status of the students must be monitored regularly. The effectiveness of interventions should be determined with advanced research, and effective interventions should be implemented to other schools.

Key words: obesity, nutrition intervention, adolescents, school health

Introduction

Obesity is the excessive accumulation of adipose tissue which deteriorates physical and psychophysical health and well-being (1). Childhood obesity is ever-increasing and prevention and control efforts for children and adolescents are an intervention area of first priority in the fight against obesity (2-6). It is reported that childhood obesity precedes adulthood obesity and chronic diseases such as cardiovascular diseases, diabetes and hypertension (3,5,7-9). Many studies have shown that the history of adult chronic diseases is related to childhood nutritional behavior (3,10,11). The prevention of obesity is easier in adolescence and childhood than in adulthood, because fat deposits can be avoided without any energy restriction since the ener-

gy requirements of children and adolescents are higher, and a continuous increase in height reduces body mass index to normal levels in time if body weight remains the same (12). Ensuring adolescents gain the habit of healthy nutrition is a highly important step for the improvement of health, and the school years are a critical period for establishing such habits (13-15). Interventions can be carried out with a far smaller budget at schools, more easily accessing for lower income families. Children may be directed towards proper behavior by the foods provided by schools that offer food service, and it is good for schools to have sports centers, playgrounds and other facilities that support physical activities (6,15). Many studies report that school-based interventions achieve success in changing nutritional knowledge and habits (16-20). Recently, the main ap-

proach has been towards the planning of integral interventions that create health-promoting schools. This approach recommends that school curricula should be modified for healthy lifestyles, that food service and sports areas should be arranged accordingly, and that families and society should be educated about and sensitive to this issue (6,13,14). Moreover, efforts should not be limited to providing nutrition education, but practices such as sports, workshops, tasting opportunities, correct purchasing practices and the use of social networking should be involved (14).

Thus, nutrition interventions with an integrated and multifaceted approach can ensure a positive change in nutrition behavior in adolescents. This study aims to improve nutritional knowledge, positively change nutrition behavior and reduce the prevalence of being overweight in students by implementing school-based multifaceted nutrition and physical activity interventions for ninth and tenth grade high school students.

Methods

Setting

The study was conducted in a medium-size city located in western Turkey with coasts both on the Aegean and Marmara Seas. Its main means of livelihood is agriculture and tourism. The high school where the study has been carried out is a free public school where students are placed by a national examination. It is a full-time school with a cafeteria, a canteen, an outdoor football field and an indoor sports hall.

Study design and participants

This study is interventional. Its theoretical basis is shown in Figure 1.

The study group is composed of ninth (n=204) and tenth grade (n=180) high school students. More senior students were not included due to exam schedules and graduation preparations. No sample was been selected since it was intended to reach the entire study group. Students who came to the school by transfer or left the school during 2014-2015 school year, and those who did not participate in the pretest or posttest were excluded.

Instruments

Obesity status: Obesity was defined by means of body mass index (BMI) percentiles according to age and sex. Those below 85.0 are defined as normal, those between 85.0 and 94.9 are defined as overweight, and those over 95.0 are defined as obese (2,21,22). BMIs of 85.0 and higher are categorized as overweight in the analyses. For BMI calculation, body weight in kilograms is divided by the square of height in meters.

Nutritional knowledge: Nutritional knowledge was evaluated using 10 multiple-choice questions. Each question has one correct answer, and the number of correct answers was the knowledge score, which ranged between 0 and 10. Items were presented in Table 1.

Nutritional behavior: To determine nutritional behavior, the frequency (more than once a day, every day, every two days, 3-4 times a week, once a week, once every fifteen days and once every month or less frequently) of drinking carbonated and/or sugary beverages, eating packaged food and fast food (hamburgers, grilled sandwiches, pizza, french fries and so forth.) was asked. The students were also asked about their habits of eating fresh fruit and vegetables, adding salt without tasting, having breakfast regularly, adding sugar to their tea or coffee, preferred bread type and eating speed. A nutrition habits score was obtained by giving 1 point for each positive behavior on a scale of 1 to 10. Positive behaviors were; drinking carbonated drinks once a week or less frequently, consuming harmful snacks once a week or less frequently, eating fast food once a week or less frequently, eating fruit

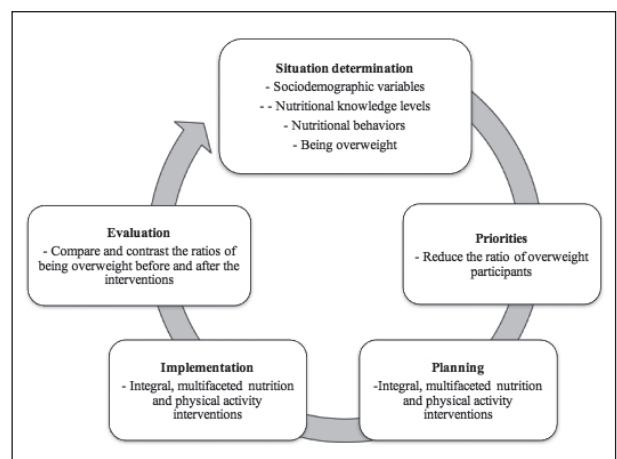


Figure 1. The theoretical basis of the study

every day, eating vegetables every day, not adding salt without tasting, having breakfast every day, not adding sugar to tea or coffee, consuming whole wheat or whole grain bread and eating slowly.

Procedure

Planning: the research team was constituted of the researchers, The school administration body, one consultant teacher, one physical education teacher and two students from these classes. School administration, teachers and students were included to ensure that this study would be accepted and embraced by the participants. The team held meetings before and during intervention phase throughout the study.

Situation determination: The stage of situation determination was planned at the school by March 2014, and information was gathered in face-to-face interviews with the students using a questionnaire. The weight and height of the students were measured while they wore light clothing without shoes. A digital scale sensitive to 100 grams was used for measurement. Height measurement was made in the Frankfurt plane position. A stadiometer supported by the wall was used for the measurement (23).

Interventions: Multifaceted nutrition and physical activity interventions were then implemented for two months (April-May). The main goal of the interventions was to improve nutritional knowledge, change nutrition-related behavior and in turn reduce the ratio of overweight participants. After the interventions, the participants were followed for 3 months (June, July and August).

Intervention in the menu: The school's monthly lunch menu was examined, and necessary recommendations were made.

Intervention in bread: The white bread served for lunch at the school was recommended to be replaced with whole wheat and whole grain bread.

Intervention in salt: It was recommended to set tables without salt shaker, which were put in a distant corner of the cafeteria.

Information posters: Seven 70X90 centimeter posters were prepared to inform the students about an adequate and balanced diet and the active lifestyle. They were hung in highly visible locations in the school. Two posters were intended to draw attention, while the re-

maining five were intended to provide information. The posters included brief colorful messages.

Movie screening: A 100-minute long movie in English (with Turkish subtitles) was selected by the researchers to describe obesity and its effects on health, and teachers screened this movie in an appropriate lesson.

Class lesson: The researchers held a discussion about the main messages of the film in classes in which the movie screening was completed. Information sharing and awareness raising about the following topics were the goals of this discussion: the correlation of obesity and fast food, the short and long term health effects of this nutrition style and the social and economic determinants of unhealthy nutrition. After the movie screening, the researchers gave computer-supported visual training about: the core concepts in nutrition, my diet, energy balance, BMI calculation, the definitions of obesity and being overweight, the causes and consequences of obesity and the benefits of physical activity. The class lesson was given to each class separately.

Nutrition and Sports Festival: The messages of the festival, its activities and scheduling were planned in meetings with the school administration, teachers and students. The distribution of tasks and support groups for them, were determined. The event was planned to involve the entire school for one school day. The festival was announced with banners in advance. The topics in scope of the festival are as follows: 1. Sports competitions (football and volleyball) 2. Nutrition-related competitions (recognize the yoghurt's friend and win, squeeze the oranges, the most delicious lemonade is mine), 3. Serving healthy food: Healthy food (fruit salad, lettuce, carrot and cucumber slices, mint yogurt-drink, fresh fruit, bulgur, potato salad and so forth) was served to the students. In the competition called "Recognize yoghurt's friend and win," vegetables such as cucumbers, roasted eggplant and pumpkin were added to yoghurt, and students were asked to identify the vegetables in the yoghurt by tasting it. In the competition called "Squeeze the oranges," students were given equal quantities of oranges, and the team that made the most orange juice won. In the competition called "The most delicious lemonade is mine," students were given lemon juice and sugar and asked to prepare some lemonade,

the team with the most delicious lemonade was selected by a jury. The healthy foods were prepared at home by students and served to their friends at the festival.

T-shirt Design Competition: This competition was announced approximately one month before the festival. The students were asked to prepare visual images and a motto to be printed on a t-shirt. A selection committee composed of researchers and teachers selected the best visual image, which was printed on t-shirts given to the students as prizes for the competitions in the nutrition and sports festival.

Final test and measurements: After the end of the summer holiday, in September, the final test was applied using the same questionnaire as the preliminary test. The weight and height of students were re-measured in the same way.

Evaluation and feedback:

The research results were analyzed, put into report and submitted to the school.

Data analysis

SPSS 15.0 was used for statistical analysis. Continuous variables were presented as means \pm 1 standard deviation, and categorical variables were summarized as percentages. Independent samples t-test and chi-square test (Yates corrected) was used in univariate analysis. Mean BMI percentiles, nutrition knowledge and behavior scores before and after the interventions were compared using the dependent samples t-test and overweight prevalence by McNemar chi-square test. A p-value of <0.05 was considered significant.

Results

All ninth and tenth grade students in the 2013-2014 school year ($n=384$) were invited to participate in the study. Of them, the 349 students who participated in the preliminary test and final test (access rate 90.9%) were included in the evaluation (Figure 2). The mean age of the students is 14.94 ± 0.70 . The youngest is 14, and the oldest is 17 years old. Slightly more than half of the students were girls (55.6%) in ninth grade (55.6%).

The nutritional knowledge score average was 6.49 ± 1.45 . The question most often answered correctly was: "Which substance does not give energy to

the body?" Of the students, 93.1% correctly answered water. The least often correctly answered question was: "Which of the following is not included in meat and meat products?" Only 10.3% of the students correctly answered milk.

Then nutritional behavior score average was 4.21 ± 1.76 . Of the students, 13.5% drink carbonated drinks every day, 11.2% eat fast food every day, and 19.8% add salt without tasting their food. Of them, 59.0% eat fruit every day as, and 49.9% eat vegetables every day. Finally, 65.3% consume white bread, and 76.8% add sugar to their tea or coffee.

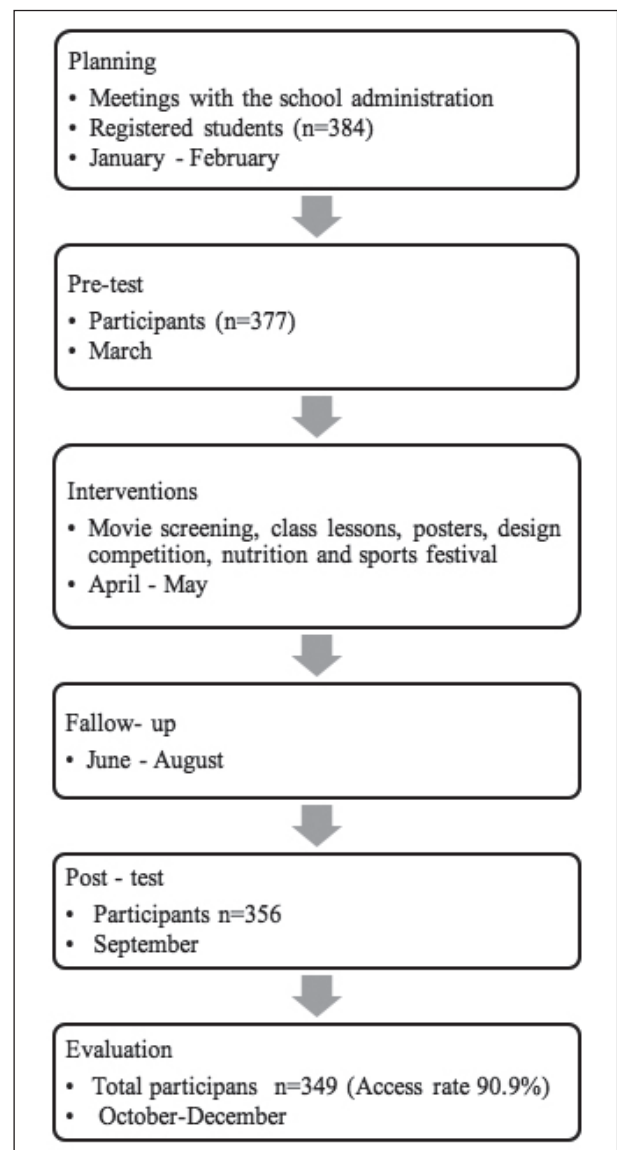


Figure 1. The theoretical basis of the study

Of the students, 11.7% are obese, and 14.0% are slightly obese. Approximately one-fourth of them (n=90, 25.7%) are overweight. Being slightly obese is almost equal for both genders (females, 13.4%; males, 14.8%), while the prevalence of obesity is higher for girls than boys (respectively 13.3%, 9.7%). The mean BMI is 22.12 ± 3.76 , and the average values of the girls and the boys are similar (21.98 ± 3.64 and 22.30 ± 3.90 , respectively).

The effects of the interventions on nutrition-related knowledge, nutritional behavior and being overweight

After the interventions, the frequency of correct responses increased significantly for four questions about nutrition-related knowledge, raising the average from 6.49 ± 1.45 to 6.77 ± 1.63 after the interventions ($p=0.004$) (Table 1).

The changes in nutritional behavior are shown in Table 2.

Table 2 shows that nutritional behavior generally shifted in a positive direction. The most distinctively improved behavior is the significant rise in eating fruit every day from 59.0% to 72.5% ($p<0.001$). The ratio of students who consume carbonated drinks once a week or less rose significantly from 50.1% to 61.0% ($p<0.001$). In addition, the ratio of students who do not add sugar to their tea or coffee rose significantly from 23.2% to 30.9% ($p<0.001$). Thus, nutritional behavior score average rose significantly after the interventions ($p=0.002$).

Change in average BMI values for all age groups and the ratio of overweight participants after the interventions is shown in Table 3.

Mean BMI significantly decreased for all students and every age group, and the ratio of overweight students decreased significantly after the interventions.

Discussion

Approximately one-fourth (25.7%) of the adolescents (n=349) who participated in this study are overweight. The prevalence of being obese is higher in girls than boys. Nutritional knowledge significantly improved, positive behavior related with nutrition significantly increased, and average BMI for all age groups

and the ratio of overweight participants significantly decreased after the interventions.

The prevalence of being overweight

This study found that 14.2% of the adolescents are slightly obese (BMI between 85 and 94 percentile), and 18.6% are obese (BMI ≥ 95 percentile). Studies in Turkey indicate that prevalence of being overweight is similar for similar age groups, but the prevalence of being obese is distinctively higher in this study. The results of studies held in different cities are reported in an article published by Bereket et al. (24) in 2012. The prevalence of being overweight is between 10 and 15%, while the prevalence of being obese ranges between 2 and 8%. There may be several reasons why the prevalence of obesity is higher in this study than others. One reason is that the prevalence of obesity may have increased in recent years. A study of children and adolescents by enol et al. (2014) in Kayseri found that the prevalence of obesity had increased in the last three years (25). The study was held in an urban area with prepubescents, which may also have affected its prevalence. In addition, there are differences with respect to percentile curves. In some studies the percentile limit for obesity is taken as .97, while it was .95 in this study (26). Moreover, the World Health Organization's software program and thus its percentile curves are used in some studies, while percentile curves developed by Neyzi et al. are also be used in studies in Turkey (27). This may also have led to the higher prevalence of obesity in this study.

The effect of the multifaceted interventions on nutrition-related knowledge, nutritional behavior and being overweight

The multifaceted nutrition interventions for the students in the study (evaluation of the school menu, serving whole wheat or whole grain bread at the school, information posters, movie screenings, lessons, the t-shirt design competition and the nutrition and sports festival) increased the nutritional knowledge score average significantly ($p=0.004$). School-based nutrition interventions may differ. Some may only focus on education, while others may be more multifaceted. These latter may include: changing food services, reorganizing food sales, including nutritional education in curricula,

Table 1. Survey items and response choices for nutritional knowledge

		Correct answers (%)		
		Before	After	p*
Healthy choices				
Which one is the healthiest option for dinner	a. Meatballs with bulgur and yogurt b. Meatballs with french fries and yogurt drink c. Light cookies with yogurt and salad d. Salad and rice	72.5	79.1	0.023
Which one is the healthiest option for drink	a. Gaseous drinks b. Yogurt drink c. Fruit juice d. Coke	80.2	86.5	0.010
Which one can be considered as a healthy snack	a. Dried fruits and nuts b. Packed biscuits/cookies c. Coke d. Packed cake	84.2	88.3	0.103
Which one is the healthiest way to consume potato	a. As a baked potato b. As french fries c. As potato puree d. As a potato salad	61.3	63.6	0.539
Which one is not appropriate for coke	a. Coke may cause calcium deposition from bones b. A can of coke (330 ml) may contain energy equal to 16-18 cubes of sugar c. Light cokes are harmless d. Coke contains caffeine	80.5	89.7	0.001
Food groups				
Which one cannot be considered under "dairy and dairy products" group	a. Cheese b. Yogurt c. Eggs d. Kefir (fermented yogurt drink)	92.6	90.0	0.243
Which one cannot be considered under "meat, meat products and legumes" group	a. Eggs b. Fish c. Chickpeas d. Milk	10.3	8.9	0.568
Recommendations				
Which one cannot be considered as a healthy nutrition recommendation	a. Don't add salt to your meal b. Be active c. Don't skip breakfast d. Eat fruits and vegetables every other day	41.0	39.8	0.810
Energy balance				
Which one has the highest energy load per gram	a. Mayonnaise b. Bagel c. Eggs d. Pasta	33.0	40.4	0.013
Which one does not supply energy to the body	a. Proteins b. Carbohydrates c. Water d. Fats	93.1	90.3	0.183
Total scores		6.49±1.45	6.77±1.63	0.004**

Table 2. Changes in nutrition behaviors

	% of Those Exercising the Behaviors		
	Before	After	p*
Drinking carbonated drinks once a week or less frequently	50.1	61.0	<0.001
Eating fast food once a week or less frequently	71.1	71.3	1.000
Eating harmful snack foods once a week or less frequently	31.8	34.4	0.426
Having breakfast everyday	60.2	58.5	0.539
Eating slowly	28.1	30.4	0.445
Eating fruit everyday	59.0	72.5	<0.001
Eating vegetables everyday	49.9	49.6	1.000
Not adding salt before tasting	80.2	79.4	0.798
Consuming whole wheat or whole grain bread	34.7	34.1	1.000
Not adding sugar to tea and coffee	23.2	30.9	<0.001
Mean score	4.88±1.94	5.21±1.93	0.002**

Table 3. Change in mean BMI values for all age groups and the ratio of overweight participants after the interventions

	Pre-intervention	Post-intervention	p
	BMI (Mean±SD)	BMI (Mean±SD)	
All students	22.12±3.76	21.55±3.45	<0.001*
Age 14	22.75±4.12	22.07±3.80	<0.001*
Age 15	21.89±3.82	21.36±3.54	0.002*
Age 16	21.88±2.98	21.33±2.60	0.037*
	Being overweight (%)	Being overweight (%)	
All students	25.8	18.9	<0.001**

(*)Dependent sample *t*-test; (**)X²_{McNemar}

Since there was only one 17 year-old student, age 17 was excluded

reorganizing sports areas and increasing the time allocated for physical activity and ensuring the participation of society, primarily the family. Moreover, the fine points of interventions may also differ. Some examine knowledge levels, some monitor changes in obesity levels, and others examine nutritional behavior and attitude changes. However, it may be said in general that nutrition interventions positively affect nutrition-related knowledge and behavior (14). Another current study that evaluates the effect of nutrition education using the health belief model reported that it positively improved knowledge, attitudes and behavior (28).

Fahlman et al. held a study in urban secondary schools and found that nutrition education significantly increased nutritional knowledge scores (18). School-based nutrition programs were evaluated in a 2001 review by Perez-Rodrigo et al. They determined

that nutrition education interventions significantly increased nutrition knowledge in all these programs (14). All these results support those of this study.

A 1996 article by Harrell et al. presented the results of the CHIC study, which determined that adolescents' physical activity levels and nutritional knowledge improved, while their cholesterol and body fat fell, after an eight-week physical activity and nutrition program (16).

The nutritional habits adopted during childhood are continued in youth and adulthood, implying that individuals who make a habit of consuming such food at early ages may continue to so in the future (29,30). The issue of adding salt without tasting one's food is another problem with salt consumption that was not improved by the interventions. A study of sixth to eighth grade students in the United States of America

determined that 14% of the students usually add salt without tasting their foods, while do so 48.3% sometimes (31). This resistance determined regarding the issue of salt in our study parallels current salt consumption habits in the society at large, and stronger efforts are required to change them.

The fall in the consumption frequency of carbonated drinks is a highly important improvement. Such drinks are a significant source of energy for adolescents, and it has been reported that a feeling of satiation may not be provided by these drinks. This is highly important for obesity in adolescence. It is also reported that such drinks are usually accompanied with salty foods. This means that reducing the salt content of foods may also reduce the consumption of carbonated drinks and thus significantly reduce childhood obesity (32-34). Reducing the consumption of such drinks in this study is a significant step toward lowering caloric intake, salt consumption and thus obesogenic nutritional behavior.

The increase in daily fruit consumption is also a highly important result of our study. The national data for the fruit and vegetable consumption of young people shows that the ratio of girls who consume an adequate level of vegetables (37%) and fruit (31%) is higher than that of boys (23% and 31%), but this ratio is low for both genders (35). However, insufficiency of fruit and vegetable consumption has been identified as the sixth most important cause of mortality(54). Studies report that 38,734 deaths (21,668 male and 17,066 female)—34% of ischemic heart diseases and 22% of strokes—could be prevented by everyday consumption of fruit and vegetables (36). The fact that this study's interventions motivated young people to consume greater amounts of fruit indicates that they usefully and effectively encouraged fruit consumption.

The habit of having breakfast regularly was not improved by this study. Studies of adolescent nutrition in Turkey have found that skipping breakfast is common (37,38). Nutrition research in the United States of America also found that one-fifth of young people between 15 and 18 years of age skip breakfast (39). The issue of skipping breakfast seems to be resistant to accurate information or motivational strategies as our study found. Skipping meals is related to other social and economic dynamics (40). Thus, National Action Programs in this field are advised to raise the question

of local support for healthy and free breakfast facilities at schools. This could ensure that students have a vigorous and healthy start to their day.

Mean BMI fell significantly in every age group, and the ratio of overweight students also significantly declined after the interventions. In a study of 1,295 sixth and seventh grade students in the U.S., interventions regarding four primary nutrition and physical activity topics reduced the girls' prevalence of obesity significantly (41). In another study in Chile, students and parents were given education on nutrition, healthy canteens were opened and 90 minutes of physical education per week was included in the curriculum. As a result, BMI values significantly fell in boys, and physical health criteria significantly improved in both boys and girls (42). A 2008 review by Kropfski et al. emphasizes the difficulty of drawing conclusions due to the scarcity of published school-based nutrition intervention studies and procedural differences and suggests that the evidence is still weak in spite of the existence of some positive changes in obesity (43). Another study indicates that healthy eating habits may be improved, and BMI may be decreased by means of multifaceted nutrition interventions with disadvantaged groups (44). This study's interventions significantly reduced the average BMI value of the school by encouraging physical activity and better nutritional habits. This positive change affected not only high risk children, but also the entire school population. Studies report that ensuring both change in nutrition and increased physical activity is crucial for long term benefits, and they emphasize the importance of combining both these components. School environments give access to large populations for such interventions and may play a crucial role in their institutionalization as social events (41). However, school interventions are scarcely leading to the reduction of obesity among adolescents in our country. Since school age youth are greatly influenced by their environments, teaching accurate health knowledge and healthy behavior to them in this period will ensure that society's health consciousness continues to develop and grow.

Strengths and limitations

The Ministry of Health has had the "Obesity Prevention and Control Program" since 2010, the draft-

ing of which began in 2008. Its first action plan covers 2010 to 2014, and its primary aim is to inform society about the benefits of healthy nutrition and physical activity. Updated for 2014 to 2017, the Action Plan for Healthy Nutrition and Active Living Program includes the strategy of getting students to adopt the habit of adequate and balanced nutrition and regular physical activity to fight obesity in schools. The Efforts for Obesity Prevention program assigns schools this task. In this context, the strengths of this study may be listed as follows. This is the first example in our country of a study that involved the cooperation of a university, a school administration and students in an effort to motivate healthy energy consumption, to changing perceptions of physical activity, to rectify key nutritional information, to disseminate healthy practices widespread and to create positive health outcomes. Its goals were achieved as a result of its interventions, which addressed the subject of obesity prevention, one of the most important items on the agenda of the Ministry of Health. Adolescents are informed about its subject, and some behavioral change was achieved. The 90% access rate and the support and participation of the students and school administration also improve the strength of this study.

The lack of a control group may be considered a significant limitation of this study; however, the school where it was conducted did not approve the inclusion of another school for this purpose. Using another school as a control group may be recommended for future research in order to determine the effectiveness of interventions accurately.

Conclusion

The weight and height of students should be measured every year, and the condition of being overweight should be monitored. Physical activities should be supported with some events such as sports festivals and sports competitions at schools, and some healthy nutrition practices should be adopted like setting tables without a salt shaker and serving whole wheat bread at school. Nations should provide healthy nutrition education in compliance with the cultural characteristics of schools, ensure access to healthy food and encour-

age physical activities as priorities. The effectiveness of interventions should be determined by advanced research, and interventions with proven effectiveness should be made widespread in other schools.

Ethical Concerns: The study was approved by an independent ethics committee (Decision number:15-1/48), and written informed consent was obtained from the participants.

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