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Comparison of the Effect of School-Based Game and Training Intervention on Overweight and Obese Students on Weight Loss: A Randomized Controlled Trial

Fazla Kilolu ve Obez Öğrencilere Okul Temelli Oyun ve Eğitim Müdahalesinin Kilo Vermeye Etkisinin Karşılaştırılması: Randomize Kontrollü Deneysel Bir Çalışma

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ABSTRACT

Objective: The aim of this study was to compare the effects of the Kaledo game and the nutrition training designed according to the health belief model on weight loss, nutritional self-efficacy, attitude and behaviour in overweight and obese students.

Methods: This study was a randomized controlled trial. There were three groups in the study: game (n=38), training (n=35), and control (n=53). At the beginning and end of the study, the height and weight of the participants were measured in all three groups, and body mass index values were calculated and scales were applied.

Results: The BMI z-score values were found to be lower in the training group after the training than before (*P*<.05). While there was no significant difference in nutritional attitude scores between the groups, in the in-group evaluations, the students in the game group were found to display a more positive nutrition attitude after the game intervention than before (*P*<.05).

Conclusion: The BMI z scores of the students decreased after the training. The students had a more positive nutrition attitude after the game. There is a need for experimental studies with a longer duration, larger sample, which can more clearly reveal the effect of the Kaledo game, and the difference between it and the nutrition training prepared according to Health Belief Model.

Keywords: Childhood obesity, Kaledo game, Health Belief Model, nutrition, school nurse

ÖZ

Amaç: Fazla kilolu ve obez çocuklarda Kaledo oyununun ve sağlık inanç modeline göre hazırlanmış beslenme eğitiminin kilo vermeye beslenme özyeterliğine, tutumuna ve davranışına etkisini karşılaştırmaktır.

Yöntemler: Bu araştırma randomize kontrollü deneysel çalışmadır. Araştırmada oyun (n=38), eğitim (n=35) ve kontrol (n=53) olmak üzere üç grup yer aldı. Araştırma başlangıcında, oyun ve eğitim müdahalelerin sonunda her üç grupta boy ve kilo ölçümleri yapılarak beden kitle indeksi değerleri hesaplandı ve ölçekler uygulandı.

Bulgular: Beden kitle indeksi z skoru değerlerinin eğitim grubunda eğitim sonrasında öncesine göre daha düşük olduğu tespit edildi (*P*<,05). Beslenme tutum puanları gruplar arası farklılık göstermezken, grup içi değerlendirmelerde oyun grubundaki öğrencilerin oyun müdahalesi sonrası öncesine göre daha olumlu beslenme tutumu sergilediği tespit edildi (*P*<,05).

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Sonuç : Eğitim sonrasında öğrencilerin BKİ z puanlarında düşüş gözlendi. Oyun sonrası öğrenciler daha olumlu beslenme tutumuna sahip olmuştur. Kaledo oyununun etkisini ve Sağlık İnanç Modeli'ne göre hazırlanan beslenme eğitimi ile arasındaki farkı daha net ortaya koyabilecek daha uzun süreli, daha geniş örneklemli deneysel çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Çocukluk çağı obezitesi, Kaledo oyunu, Sağlık İnanç Modeli, beslenme, okul hemşiresi

INTRODUCTION

Obesity is a condition characterized by an increased accumulation of fat in the body. Fat accumulation occurs when energy intake is greater than energy consumption.[1] Obesity is increasing rapidly worldwide, not only in adults but also in childhood. About one in six children and adolescents, or 12.7 million young people aged 2 to 19, is currently overweight or obese worldwide.[2]

Nutrition, exercise and behavioral change form the basis of the treatment approach for childhood obesity. The basis of behavioral training is to transform the nutrition behaviour that causes obesity and negative health behaviors leading to physical inactivity into positive health behaviors.[3,4] Belief-based approaches are important in creating behavior change. The Health Belief Model,[5] developed by Rosenstock in 1966 and later expanded by Becker et al., is a model with an aim to explain and predict health behaviors by focusing on individuals' attitudes and beliefs. This model argues that personal beliefs or perceptions of an individual about a disease/health condition determine the health behavior. In line with this model, in order for an obese child to perceive obesity as a problem, to take it seriously, and create a positive behavioral change for nutrition as a result, the children should be taught the right way of nutrition. However, teaching a child the right way of nutrition and creating positive behavior change is a very difficult process. In this process, the child's ability to assimilate the correct form of nutrition and make it a habit is directly proportional to success. Therefore, there is a need for education methods in which the correct nutrition can be taught to the child in the fight against obesity and the child can continue consistently without getting bored. In parallel with technological developments, new educational methods are also developing. Gamification in education is one of these methods. In education with the gamification method, the child acquires both the necessary knowledge and the skills, beliefs and habits change.[6] Games also have an effect on developing positive health behavior.[7] These effects of games on children have been used in many scientific studies to develop positive health behavior. It can be seen that many games have been developed in the literature to change the nutrition style. One of these games is the Kaledo. The development study for this game was carried out in three schools in Naples, Italy. Both in this study and the subsequent study concluded that it is a suitable method for school-age children.[8,9,10] Kaledo game, which has been used in several scientific studies, is a game that aims to provide healthy nutrition and physical activity education to children and provide behavioral change in the treatment of obesity, teaches calorie balance over the calorie values of nutrients. Kaledo game has been reported to be an effective tool to teach children about healthy nutrition in a study carried out using it.[8] In two different studies conducted by Viggiano et al.[9,10] a significant decrease in BMI z-score values and a significant increase in healthy nutrition knowledge was found after the Kaledo game intervention. In the study conducted by Şen et al.[11] on obese children whose parents were taken to family-based group therapy, a significant decrease was found in the BMI and BMI z-score values of the Kaledo game group. As can be seen, the effect of the Kaledo game on BMI has been investigated in several studies. The difference of our study from these studies is that it has been conducted in obese and overweight students, compares the game with nutrition training prepared according to Health Belief Model (HBM), and evaluates nutritional self-efficacy, attitude, behavior, and BMI together no study of this design has been found in the literature.

Proper nutrition knowledge is an important factor in maintaining weight control in overweight and obese children. School is the most suitable educational environment the correct way of nutrition can be learned and permanent behavior change can be created. The fight against obesity in schools of our country cannot go beyond nutrition education and the arrangement in school canteens. However, it is not possible for obese children to be able to fight obesity without individual intervention. School health nurses are in a position to play an active role in this individual fight. The aim of this study was to compare

the effects of the Kaledo game and the nutrition training designed according to the health belief model on weight loss, nutritional self-efficacy, attitude and behavior in overweight and obese students. Therefore, our hypothesis was that the students who receive nutrition training by playing the Kaledo game have higher nutritional self-efficacy, more positive nutrition attitudes, healthier nutrition habits and lose more weight after the training compared to those who receive nutrition training according to HBM.

METHODS

Study Design and Setting

This study was a randomized controlled trial (ClinicalTrials.gov ID: NCT04620044). The population of the study consisted of 321 overweight and 222 obese students of grades 5-6-7 of three secondary schools in the 2019-2020 academic year. These three schools were chosen because of their similarity in terms of sociodemographic characteristics.

Participants

Power analysis (Gpower version 3.1) was performed to determine the sample size of the study. Number of participants in each group was determined to be 57 (significance level 0.05 for type 1 error, effect size 0.53 and power 0.80). In line with this, the study was carried out with 64 participants in each group, considering the missing and erroneous data and absenteeism from the study. At the end of the study, the power obtained after the power analysis with the same effect size (0.53) was found to be 0.99.

The height and weight of the students in each school were measured, and the status of being overweight and obese of the students was determined by using the child body mass index calculation tool of the Department of Healthy Nutrition and Active Life, General Directorate of Public Health, Ministry of Health. Weight measurements were made using school uniforms, and clothes that would increase weight, such as cardigans and vests, were removed. The same electronics weighing machine was used for weight measurements. In all groups, both measurements were made in the morning. For height measurements, the students' shoes were removed, their feet were brought together, and their heels and back were leaned against the wall. In this position, measurements were made using a height meter attached to the wall. The BMI z-score values of the students were calculated using the formula Z=[(measurement/M)L-1]/LS in accordance with the BMI z–score classification table published by the WHO.[12,13] These students have been stratified according to their status of being overweight and obese (Figure 1). A total of 32 overweight students and 32 obese students were selected through lots for each group to form the sample size (n=64) determined by power analysis. Throughout various weeks of the game sessions, a total of 26 students, expressing their desire not to continue with the game, left the group. The game sessions were completed with 38 students. Throughout various weeks of the education sessions, a total of 29 students expressed their unwillingness to continue with the education and left the group. The education sessions were completed with a total of 35 students. In the control group, however, 11 students did not wish to participate in the repeat height and weight measurements and scale application. The control group was completed with 53 students.

Inclusion criteria were:

- 5,6 and 7th grade education
- Having a BMI percentile value over 85
- Volunteering to participate for the research
- Student parent's consent

Exclusion criteria were:

- Presence of visual and hearing impairment
- Using a language other than Turkish
- Being on a diet under the control of any specialist or using medication for weight control

Removal criteria from the sample

- Not participating in all of the 12-week game and training sessions

Data Collection Tools

Personal Information Form: Questions of age, gender, grade, presence of an overweight member in the family, frequency of meals, fast-food eating habits, snacking habits, frequency of physical activity were included in this form prepared by the researchers.

Child Dietary Self-efficacy Scale: The scale was developed within the scope of Child and Adolescent Trial for Cardiovascular Health (CATCH), a research project in the United States (US).[14,15] The Child

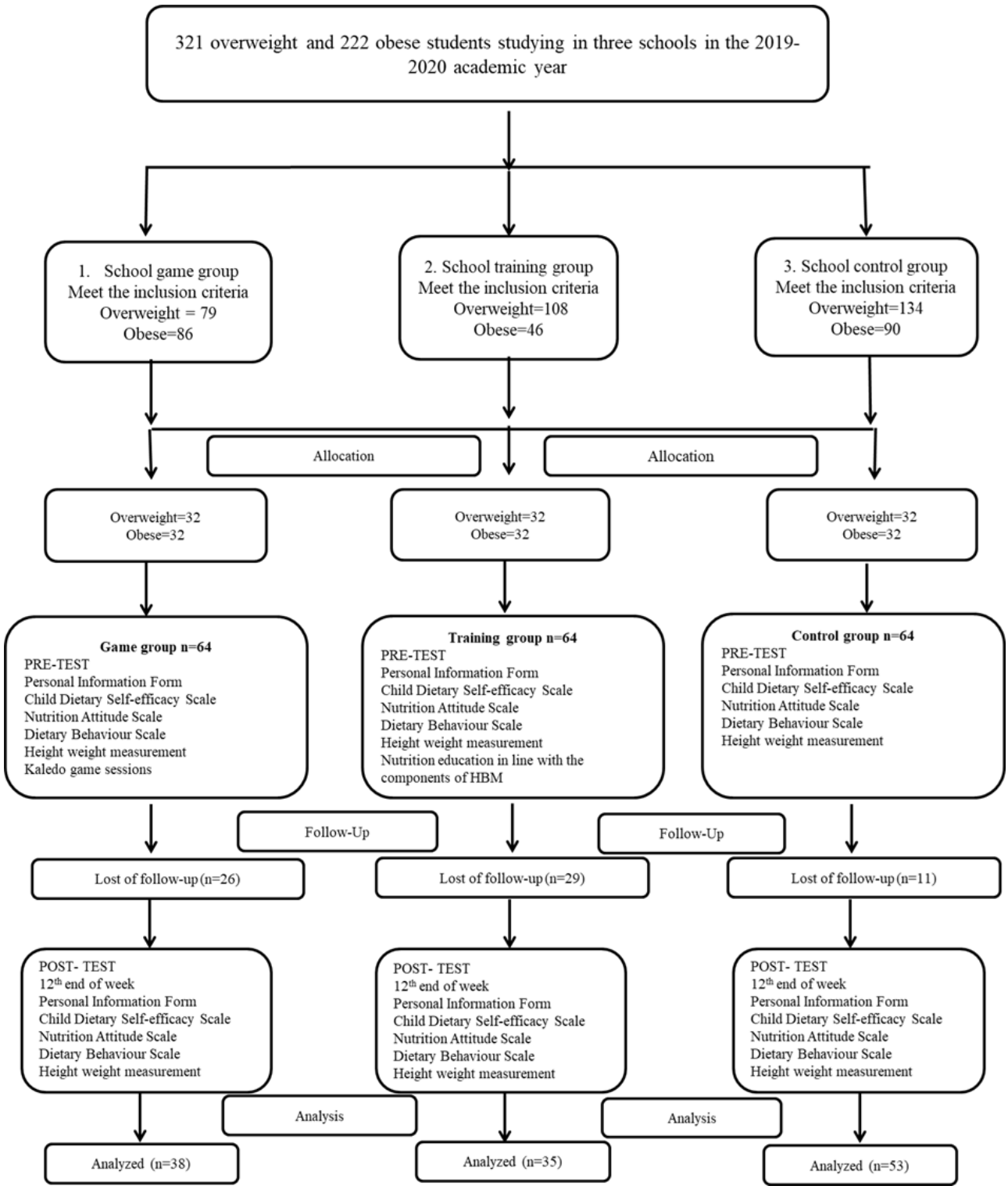

Figure 1. Randomized Controlled Study Flowchart

Detary Self-Efficacy Scale measures self-efficacy ensuring children eat low-fat and low-salt food items. Scale items were formed from various food items containing fat and salt. The scale, a 3-point Likert type, has a single factor structure consisting of 15 items. The total score ranges from -15 to +15. A high total score obtained from the scale indicates a high level of self-efficacy. The Turkish validity and reliability study of the scale has been performed and shown that it can be used on Turkish children.[16] The Cronbach alpha value of the scale in this study was 0.75.

Nutrition Attitude Scale: Nutrition Attitude Scale is the "Nutrition" subscale of "The Children's Cardiovascular Health Promotion Attitude Scale." The Children's Cardiovascular Health Promotion Attitude Scale, developed by Arvidson (1990) 17 to evaluate children's attitudes towards improving cardiovascular health, and consists of 16 items, was adapted to Turkish society by Öztürk Haney and Bahar.[18] The scale consists of four subscales: (1) Physical Activity - 4 items; (2) Nutrition - 4 items; (3) Smoking- 4 items (4) Stress Management- 4 items. The nutrition subscale measures the child's attitude towards activities that reduce fat intake, increase healthy food consumption, and the way of nutrition that improve cardiovascular health. The total score ranges from 4 to 16. A high total score obtained from the scale indicates a high level of positive attitude. The Cronbach alpha value of the scale in this study was found to be 0.71.

Dietary Behaviour Scale: The scale was developed within the scope of CATCH, a research project in the US.[14,15] The Dietary Behaviour Scale consists of 14 illustrated items with low fat/salty and high fat/salty food choices to determine the nutrient consumption of children. Children were shown comparable foods and asked which of the two food items they eat more. Total score ranges from -14 to +14. A high total score obtained from the scale indicates a healthy nutritional habit. The Turkish validity and reliability study of the scale has been performed and shown that it can be used on Turkish children.[16] The Cronbach alpha value of the scale in this study was found to be 0.71.

Data collection and intervention

Intervention groups were determined by drawing lots among the three schools where the study would be conducted. For the groups not to be aware of each other, each school formed an intervention group. The first school formed the Kaledo game group, the second school formed the nutrition training group according to HBM, and the third school formed the control group. After the samples were selected, height-weight measurements were conducted in all groups, and the scales were administered. Students were taken to meeting rooms and empty classrooms to fill out the surveys. The completion of the scales took an average of 15 minutes.

Intervention groups

First, the height and weight of the game group students were measured and the scales were applied to them. The plan for game sessions was developed in collaboration with the students selected for the game group and their parents. Over the course of 12 weeks, one day per week, with a total of 64 students in the game group; a total of 3 game sessions were held, 2 during lunch and 1 after school dismissal. Each game session lasted about 15-20 minutes. Each student was informed about which game session they would participate in. Game sessions were tracked using an attendance chart, and students who were absent were accommodated in another session to ensure the completion of 12 sessions.

The first step involved conducting height and weight measurements again for the students selected for the training group, and scales were applied. The 64 students in the training group were included in a 20-minute education session once a week for 12 weeks during lunchtime. The educational content was prepared in line with the components of the HBM. Education sessions took place in the school's training room and were conducted in the form of a PowerPoint presentation. Additionally, interactive participation of students in the education was ensured through a question-answer method during the sessions. The attendance of education sessions was monitored with an attendance chart, and for students who were absent, the topic of the week they missed was re-explained on another day.

Control group

First, the height and weight of the control group students were measured and the scales were applied to them. The control group students did not have any intervention. At the end of the 12th week, the height and weight of all students were measured again and the scales were applied to them.

Outcomes

Primary outcomes

The primary outcomes of this study were the BMI and the BMI z-score value calculated by height and weight measurements at baseline and 3rd month.

Secondary outcomes

The secondary outcomes of this study were dietary self-efficacy, nutrition attitude, dietary behaviour. The details of the measurement tools are explained under data collection tools.

Ethical considerations

In order to conduct the research;

Ethics committee approval (Date/number: 27 June 2019/12) was obtained from Eskişehir Osmangazi University Clinical Research Ethics Committee.

Informed consent was obtained from the students and their parents. In accordance with the permission obtained from the School Principal, a meeting with the parents of the students identified for all groups has been planned. Although most of the game group parents attended the meeting, the most of the training and control group parents did not attend the meeting. The parents of the students who did not attend the meeting were informed through teachers, and consent was sought by sending them an informational text. In cases where consent could not be obtained, other students were selected as replacements.

Statistical analysis

Data were analyzed with IBM SPSS V23. Normal distribution was evaluated with Shapiro-Wilk Test and Skewness-Kurtosis values. Since the kurtosis and skewness coefficients were between -2, +2, the normality assumption was accepted. Data for categorical variables were shown with frequency and percentage. One Way ANOVA was used in the independent group comparisons of students' nutrition self-efficacy, attitude and behavior scores, BMI, BMI z score values. The posthoc Bonferroni test was used to define the differences between the groups for the significant findings detected. The significance of the difference between pre-test and post-test scores was analyzed with Paired t test. Significance level was taken as $P<.05$.

RESULTS

The sociodemographic characteristics findings of the students who participated in all of the game and training sessions of the intervention groups are given in Table 1.

The BMI and BMI z-scores of the students in the game group were observed to be lower than the training group students both before and after the intervention ($P<.05$; Table 2). While the BMI values in all groups did not show any difference after the intervention compared to the pre-intervention ($P>.05$; Table 3), it was determined that the BMI z-score values in the training group were found to decrease after the intervention ($P=.031$; Table 3).

Table 1. The Sociodemographic Characteristics of the Students

	Game group		Training group		Control group		Total	
Variable	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Age								
9	2	5.3	1	2.9	1	1.9	4	3.2
10	22	57.9	17	48.6	20	37.7	59	46.8
11	9	23.7	13	37.1	17	32.1	39	31.0
12	5	13.2	4	11.4	15	28.3	24	19.0
Gender								
Girl	24	63.2	17	48.6	24	45.3	65	51.6
Boy	14	36.8	18	51.4	29	54.7	61	48.4
BMI status								
Normal	20	52.6	12	34.3	25	47.2	57	45.2
Overweight	17	44.7	22	62.9	26	49.1	65	51.6
Obese	1	2.6	1	2.9	2	3.8	4	3.2
Presence of overweight members in the family								
Yes	13	35.1	13	40.6	20	40.0	46	38.7
No	24	64.9	19	59.4	30	60.0	73	61.3

When the nutritional self-efficacy and behavior scores of the students in the intervention and control groups were compared, both pre-test and post-test scores were determined not to show differences between the groups ($P>.05$; Table 2).

Table 2. Comparison of the BMI, BMI Z Score, Self-Efficacy, Behavior and Attitude Scores of the Students in the Experimental and Control Groups

		Game group	Training group	Control group	F/*P*
Variable	**Time**	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	
Nutrition Self-efficacy	Pre-test	5.68 ± 4.80	6.91 ± 4.51	5.77 ± 4.76	0.796/.453
	Post-test	7.21 ± 4.72	7.51 ± 5.92	6.40 ± 4.85	0.570/.567
Nutrition Attitude	Pre-test	12.82 ± 2.29	13.66 ± 1.92	12.6 ± 3.05	1.880/.157
	Post-test	13.53 ± 2[ab]	13.83 ± 2[b]	12.53 ± 2.7[a]	**3.883/.023**
Nutrition Behaviour	Pre-test	3.71 ± 5.71	4.54 ± 5.44	2.45 ± 6.15	1.426/.244
	Post-test	4.61 ± 6.53	5.31 ± 6.12	3.13 ± 5.67	1.496/.228
BMI	Pre-test	22.96 ± 2.46[a]	24.91 ± 3.33[b]	23.83 ± 3.41[ab]	**3.552/.032**
	Post-test	23.14 ± 2.57[a]	24.99 ± 3.33[b]	24.01 ± 3.43[ab]	**3.109/.048**
BMI z-score	Pre-test	1.96 ± 0.56[a]	2.32 ± 0.55[b]	2.04 ± 0.57[a]	**4.093/.019**
	Post-test	1.93 ± 0.56[a]	2.27 ± 0.56[b]	2.02 ± 0.59[ab]	**3.371/.038**

F: Analysis of Variance, [a,b,c] Means of groups followed by different letters differ

In all the groups, the nutritional self-efficacy and nutritional behavior scores of the students after the intervention were found not to change compared to pre-intervention scores (*P*>.05; Table 3). There were between the groups differences in the post-test nutritional attitude scores. Nutrition attitude scores of the training group were higher than the control group (*P* =.023; Table 2). But it was similar with the game group. In addition the nutritional attitude scores of the game group were determined to increase after the intervention compared to the pre-intervention (*P*=.035; Table 3).

DISCUSSION

In the fight against childhood obesity, the child needs to learn the right way of nutrition and make this way of nutrition permanent. At this point, the question comes up, which method would be more effective to teach the correct nutrition style to the child. There is a need for different methods to teach the correct form of nutrition. In this study, it was aimed to compare the effects of the Kaledo game and the nutrition training designed according to the Health Belief Model on weight loss, nutritional self-efficacy, attitude and behavior in overweight and obese students. Since there were no studies on the effects of game and training on BMI, nutritional self-efficacy, nutritional attitude and nutritional behaviour levels of overweight and obese students, discussion of our findings was performed in line with the literature findings, obtained without any specific distinction between overweight and obese.

Gamification is the use of game-like design elements in a non-game context.[19] The use of games in health education to enhance and protect health is becoming increasingly popular. Through gamification, more information than traditional education can be obtained and expanded upon. The use of gamification in education can not only change knowledge but also other aspects of life such as skills, beliefs, and habits.[6] In this context, we anticipated that providing education to students through games would contribute to weight loss by creating behavior change, especially in terms of nutrition. However, the BMI values did not change after the intervention compared to the pre-intervention values in all the groups. Neither the game nor the training led to any change in the BMI values of the students. While no change was found in the BMI z-score values in the game and control groups after the intervention, the post-intervention BMI z-score values in the training group were determined to be lower compared to the pre-intervention. This result indicates that although training did not lead to a change in BMI values, it led to a change in the BMI z-score. In terms of the effect of the game on the BMI z-score values, Amaro et al. achieved a similar result.[8] In their study, Moore et al. reported no change in BMI values after a total of 6 courses of online nutrition training in 3 months. Although the training in their study was prepared in line with Orem's Self-Care Deficit Theory, the effect of training on the BMI values has been similar to our study.[20] However, in two different studies conducted by Viggiano et al.[9,10], they reported achieving a significant decrease in BMI z-score values after the Kaledo game intervention. The post-intervention evaluation was performed at the 6th month in one of these studies and the 8th month in the other one.[9,10] The fact that, in our study, the evaluation was performed at the 3rd month and the participants were overweight and obese students might be the reason for this difference. In their study with obese

children, in which different findings were obtained than ours, Şen et al.[11] found a significant decrease in the BMI and BMI z-score values of the Kaledo game group. The reason for this difference may be attributed to the fact that their study was carried out in the clinic and the parents of the children in the game group were involved in family-based group therapy. In the comparisons between the groups, the BMI values of the game group were found to be lower than the training group. There were also similar findings in the pre-test results. The assignment to the groups was performed according to being overweight and obese in order to achieve homogenization. Therefore, not being able to achieve homogenization of BMI in the sample was believed to be the reason for this low level.

Table 3. Comparison of in-Group Pre-Test Post-Test Scale Scores of the Students in the Experimental and Control Groups

		Game group	Training group	Control group
Variable	**Time**	$\overline{X}$ **±SD**	$\overline{X}$ **±SD**	$\overline{X}$ **±SD**
Nutrition Self-efficacy	Pre-test	5.68 ± 4.80	6.91 ± 4.51	5.77 ± 4.76
	Post-test	7.21 ± 4.72	7.51 ± 5.92	6.40 ± 4.85
	T/*P*	-1.906/.064	-0.683/.499	-1.170/.247
Nutrition Attitude	Pre-test	12.82 ± 2.29	13.66 ± 1.92	12.6 ± 3.05
	Post-test	13.53 ± 2	13.83 ± 2	12.53 ± 2.7
	T/*P*	**-2.191/.035**	-0.649/.521	0.167/.868
Nutrition Behaviour	Pre-test	3.71 ± 5.71	4.54 ± 5.44	2.45 ± 6.15
	Post-test	4.61 ± 6.53	5.31 ± 6.12	3.13 ± 5.67
	T/*P*	-1.247/.220	-0.593/.557	-1.041/.303
BMI	Pre-test	22.96 ± 2.46	24.91 ± 3.33	23.83 ± 3.41
	Post-test	23.14 ± 2.57	24.99 ± 3.33	24.01 ± 3.43
	T/*P*	-1.316/.196	-0.640/.527	-1.837/.072
BMI Z-Score	Pre-test	1.96 ± 0.56	2.32 ± 0.55	2.04 ± 0.57
	Post-test	1.93 ± 0.56	2.27 ± 0.56	2.02 ± 0.59
	T/*P*	0.770/.446	**-2.252/.031**	1007/.319

T; Paired-Sample T-Test

Gamification is the use of game-like design elements in a non-game context.[19] The use of games in health education to enhance and protect health is becoming increasingly popular. Through gamification, more information than traditional education can be obtained and expanded upon. The use of gamification in education can not only change knowledge but also other aspects of life such as skills, beliefs, and habits.[6] In this context, we anticipated that providing education to students through games would contribute to weight loss by creating behavior change, especially in terms of nutrition. However, the BMI values did not change after the intervention compared to the pre-intervention values in all the groups. Neither the game nor the training led to any change in the BMI values of the students. While no change was found in the BMI z-score values in the game and control groups after the intervention, the post-intervention BMI z-score values in the training group were determined to be lower compared to the pre-intervention. This result indicates that although training did not lead to a change in BMI values, it led to a change in the BMI z-score. In terms of the effect of the game on the BMI z-score values, Amaro et al.[8] achieved a similar result. In their study, Moore et al.[20] reported no change in BMI values after a total of 6 courses of online nutrition training in 3 months. Although the training in their study was prepared in line with Orem's Self-Care Deficit Theory, the effect of training on the BMI values has been similar to our study.[20] However, in two different studies conducted by Viggiano et al.[9,10], they reported achieving a significant decrease in BMI z-score values after the Kaledo game intervention. The post-intervention evaluation was performed at the 6th month in one of these studies and the 8th month in the other one.[9,10] The fact that, in our study, the evaluation was performed at the 3rd month and the participants were overweight and obese students might be the reason for this difference. In their study with obese children, in which different findings were obtained than ours, Şen et al.[11] found a significant decrease in the BMI and

BMI z-score values of the Kaledo game group. The reason for this difference may be attributed to the fact that their study was carried out in the clinic and the parents of the children in the game group were involved in family-based group therapy. In the comparisons between the groups, the BMI values of the game group were found to be lower than the training group. There were also similar findings in the pre-test results. The assignment to the groups was performed according to being overweight and obese in order to achieve homogenization. Therefore, not being able to achieve homogenization of BMI in the sample was believed to be the reason for this low level.

Gamification aims to motivate individuals and achieve positive behavior change in individuals.[21] The individual's ability to control their own behavior is associated with self-efficacy.[22] In this study, there was no difference between the groups in terms of nutritional self-efficacy. To determine the effect of the interventions on nutritional self-efficacy, it was evaluated whether the students' nutritional self-efficacy scores changed after the intervention compared to the pre-intervention. According to the results, no significant difference was found in the nutritional self-efficacy scores of the students in all the groups after the intervention compared to the pre-intervention. This indicates that both game and training do not have an effect on students' nutritional self-efficacy. The post-intervention evaluations of the students were carried out at the end of 3rd month which was the end of the game and training sessions. Given that building competence for nutrition is a process, it may be concluded that this process may not be completed in 3 months, therefore the effect of game and training on self-efficacy could not be observed, or it has an acute effect and the change that may occur due to the disappearance of the acute effect in the 3rd month could not be detected. In the study of Viggiano et al.[9] conducted similarly with the Kaledo game, no difference was found between the game group and the control group in terms of self-efficacy. In the study of Sharma et al.[23], students aged 9-11 played a computer-based educational game including nutrition and physical activity for 6 weeks. In the evaluation after the intervention, the nutritional self-efficacy was determined not to show differences from the pre-intervention. Although the game used in their study was different from the one in our study, the results on nutritional self-efficacy were similar to our study.[23] In another study conducted with 5th- grade students, the participants played a computer game, based on healthy nutrition and healthy living, for 52 minutes a day for 4 days, and the nutritional self-efficacy of the participants after the game was determined to increase significantly compared to the pre-game. The fact that different games and the study population, as well as the evaluation made after a short time like 4 days, may have revealed different results contrary to our study results, due to the possible acute effect of their study.[24]

The nutritional attitude that includes beliefs, thoughts, and feelings about food is a mental tendency that affects individuals' food choices and preferences.[25] Positive or negative attitudes towards any object, event or person are important in terms of having an influence on the behavior.[26] Turning a negative health behavior into a positive one in terms of nutrition is primarily possible by turning attitudes into positive ones. In educational interventions aimed at developing positive attitudes toward nutrition in children, it is crucial that the educational method is liked and found enjoyable by the child. This way, children can become more motivated to learn by gaining positive attitudes.[27] In this study, no difference was found in terms of students' nutrition attitudes between game-based education and education given in accordance with the HBM. While there was no difference observed in the training and control groups in the in-group evaluations, the post-intervention nutrition attitudes of the game group students were determined to be more positive compared to pre-intervention. This suggests that the Kaledo game is effective on the students' nutritional attitude, however, it does not have enough effect to make a difference between the groups. In the study of Yien et al.[28], the intervention group participants played computer-based nutrition information games while the control group had training with a PowerPoint presentation. After four weeks, the nutrition attitudes of both groups were found to be similar.[28] Although the game and the population used in this study are different, this result is similar to our study. In the study of Schneider et al., the students played a computer game for 52 minutes every day for 4 days, and the students were determined to have a more positive nutrition attitude in the evaluation made at the end of the 4th day.[24] The difference between the game used in the study and the study population and the acute effect might be the reason for the difference in the results.

In a gamified system, the fundamental elements of games direct players towards activities intended to encourage and motivate behavior change.[29] Game elements such as scoring systems, badges, multiple game levels, and scoreboards can lead to intrinsic motivation due to their interesting or enjoyable nature.[29] As a result, behavior change may occur. However, in our study, the game and education did not have an impact on nutrition behavior. Additionally, in the in-group evaluations, no difference was

observed also in nutritional behavior after the intervention compared to the pre-intervention in the groups. However, the nutritional attitudes of the game group students after the intervention were determined to be more positive than before the intervention. The acquisition of new knowledge has been reported to lead to changes in attitude and these changes will also lead to better nutrition behavior.[30] Considering that the transformation of attitude into behavior is a process, it can be stated that the positive attitude that emerged in the game group has not been reflected in the nutrition behavior yet.

In conclusion, the students had a more positive nutrition attitude after the game. But The Kaledo game did not affect the nutritional self-efficacy and behavior of the students, as well as the z-score values of body mass index and body mass index. Nutrition training prepared in line with the Health Belief Model did not lead to a change in nutritional self-efficacy, attitude and behavior, as well as body mass index values, but the BMI z score of the students decreased after the training. In line with these results, there is a need for including the parents in the interventions to be made with the Kaledo game in future interventional studies, including the cooperation of the school nurse to be planned with a longer duration and larger sample, which can more clearly reveal the effect of the Kaledo game and the difference between it and the nutrition training prepared according to HBM.

Limitations of the Study

This study had some limitations. Before starting the study, the assignment to the groups was performed according to being overweight and obese in order to achieve homogenization. Due to some of the students and parents not giving their consent to participate in the study, homogenization in regards to BMI value could not be achieved in order to reach the sample number determined by power analysis. Furthermore, the study could not be completed with the determined sample number because some of the students ended their participation in the study voluntarily. Besides, due to the possibility of students being in different intervention groups in the same school and aware of each other, assignment to groups was not performed among all schools, therefore the schools were determined by lots as a research group and each school formed an intervention group. Another limitation was that parents were not included in the study.

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Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir- CÇ, ÖÖ, SA; Tasarım- CÇ, ÖÖ, SA; Denetleme- ÖÖ; Kaynaklar-CÇ; Veri Toplanması ve/veya İşlemesi CÇ; Analiz ve/ veya Yorum- CÇ, ÖÖ; Literatür Taraması-CÇ; Yazıyı Yazan- CÇ; Eleştirel İnceleme-ÖÖ.
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REFERENCES

1. Albataineh SR, Badran EF, Tayyem RF. Overweight and obesity in childhood: dietary, biochemical, inflammatory and lifestyle risk factors. *Obesity Medicine.* 2019; 15: 100112. https://doi.org/10.1016/j.obmed.2019.100112
2. Moxley E, Habtzghi D, Klinkhamer N, et al. Prevention and treatment of pediatric obesity: a strategy involving children, adolescents and the family for improved body composition. ediatric *J Pediatr Nurs.* 2019; 45: 13–19. https://doi.org/10.1016/j.pedn.2018.12.010.
3. Güngör NK. Overweight and obesity in children and adolescents. *J Clin Res Pediatr Endocrinol*. 2014; 6(3): 129-143. DOI:10.4274/jcrpe.1471
4. Kumar S, Kelly AS. Review of childhood obesity: from epidemiology, etiology, and comorbidities to clinical assessment and treatment. *Mayo Clin Proc*. 2017; 92(2): 251-265 http://dx.doi.org/10.1016/j.mayocp.2016.09.017
5. Gözüm S, Çapık C. Sağlık davranışlarının geliştirilmesinde bir rehber: Sağlık İnanç Modeli. *DEUHYO ED*. 2014; 7(3): 230-237.
6. Kusuma GP, Wigati EK, Utomo Y, et al. Analysis of gamification models in education using MDA framework. *Procedia Computer Science.* 2018; 135: 385-392. DOI: 10.1016/j.procs.2018.08.187
7. Alsaleh N, Alnanih R. Gamification-based behavioral change in children with diabetes mellitus. *Procedia Computer Science.* 2020; 170: 442-449. DOI: 10.1016/j.procs.2020.03.087.
8. Amaro S, Viggiano A. Costanzo AD, et al. Kalèdo, a new educational board-game, gives nutritional rudiments and encourages healthy eating in children: A pilot cluster randomized trial. *Eur J Pediatr.* 2006; 165: 630-635. DOI:10.1007/s00431-006-0153-9
9. Viggiano A, Viggiano A, Andreozzi E, et al. Kaledo, a board game for nutrition education of children and adolescents at

school: cluster randomized controlled trial of healthy lifestyle promotion. *Eur J Pediatr.* 2015; 174: 217–228. DOI 10.1007/s00431-014-2381-8
10. Viggiano E, Viggiano A, Costanzo AD. et al. Healthy lifestyle promotion in primary schools through the board game Kaledo: a pilot cluster randomized trial. *Eur J Pediatr*. 2018; 177: 1371–1375. DOI:10.1007/s00431-018-3091-4.
11. Şen M, Uzuner A, Akman M. Examination of a board game approach to children's involvement in family-based weight management vs. traditional family-based behavioral counseling in primary care. *Eur J Pediatr*. 2018; 177: 1231–1238.
12. World Health Organization: https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age Date of access: 13.01.2021.
13. Neyzi O, Günöz H, Furman A. et al. Body weight, height, head circumference and body mass index reference values in Turkish children. *Çocuk Sağlığı ve Hastalıkları Dergisi*. 2008; 51: 1-14.
14. Parcel GS, Edmundson E, Perry CL. Measurement of self-efficacy for diet-related behaviors among elemantary school children. *J Sch Health.* 1995; 65(1): 23-27. doi: 10.1111/j.1746-1561.1995.tb03335.x.
15. Edmundson E, Parcel GS, Perry CL. et al. The effect of the child and adolescent trial for cardiovascular health intervention on psychosocial determinants of cardiovascular disease risk behavior among third- grade students. *Am J Health Promot.* 1996; 10 (3): 217-225. doi: 10.1006/pmed.1996.0076
16. Öztürk Haney M, Erdoğan S. Factors related to dietary habits and body mass index among Turkish school children: a cox's ınteraction model-based study. *J Adv Nurs.* 2013; 69(6): 1346-1356. doi:10.1111/j.1365-2648.2012.06126.x
17. Arvidson C. Children's cardiovascular health promotion attitude scale: an ınstrument development. Unpublished Doctoral Dissertation, Texas Woman's University, Denton, TX, USA.1990.
18. Öztürk Haney M, Bahar Z. Childrens' cardiovascular health promotion attitude scale's validity and reliability. DEUHF ED. 2014;7(2): 92-97. e-ISSN: 2149-0333.
19. Huang B, Hew KF. Implementing a theory-driven gamification model in higher education flipped courses: effects on out-of-class activity completion and quality of Artifacts. *Comput Educ*. 2018; 125: 254-272. https://doi.org/10.1016/j.compedu.2018.06.018
20. Moore-Burley J, Pawloski-Renee L, Goldberg P, et al. Childhood obesity study: A pilot study of the effect of the nutrition education program color my pyramid. *J Sch Nurs*. 2009; 25(3): 230-239. https://doi.org/10.1177/1059840509333325
21. Karataş E. Eğitimde oyunlaştırma: araştırma eğilimleri. *KEFAD*. 2014; 15(2): 315-333.
22. Kansu AF, Hızlı Sayar G. Öz yeterlik, yaşam anlamı ve yaşam bağlılığı kavramları üzerine bir inceleme. *Etkileşim.* 2018; 1(1): 78-89.
23. Sharma SV, Shegog R, Chow J, et al. Effects of the quest to lava mountain computer game on dietary and physical activity behaviors of elementary school children: A pilot group-randomized controlled trial. *J Acad Nutr Diet.* 2015; 115(8): 1261-1271. http://dx.doi.org/10.1016/j.jand. 2015.02.022.
24. Schneider KL, Ferrara J, Lance B, et al. Acceptability of an online health videogame to improve diet and physical activity in elementary school students: ''fitter critters'' games. *Games Health J.* 2012; 1(4): 262-268. DOI: 10.1089/g4h.2012.0009
25. Scott CL, Haycraft E, Plateau CR. Teammate influences on the eating attitudes and behaviours of athletes: A systematic review. *Psychology of Sport & Exercise*. 2019; 43: 183–194. https://doi.org/10.1016/j.psychsport.2019.02.006.
26. Rucker DD. Attitudes and attitude strength as precursors to object attachment. *Curr Opin Psychol.* 2021; 39: 38–42. https://doi.org/10.1016/j.copsyc. 2020.07.009.
27. Kaplan Laço S, Aytekin Özdemir A. Çocuklarda bilgisayar destekli eğitimin kalp sağlığını geliştirme tutumlarına etkisi. *JICAH.* 2023; 3(3): 176-187. DOI: 10.5281/zenodo.10431278
28. Yien JM, Hung CM, Hwang GJ, et al. A Game-based learning approach to ımproving students' learning achievements ın a nutrition course. *TOJET.* 2011; 10: 2. https://files.eric.ed.gov/fulltext/EJ932220.pdf.
29. Chow CY, Riantiningtyas RR, Kanstrup MB, et al. Can games change children's eating behaviour? A review of gamification and serious games. *Food Quality and Preference*. 2020; 80: 103823. https://doi.org /10.1016/j.foodqual.2019.103823
30. Orji R, Vassileva J, Mandryk RL. LunchTime: a slow-casual game for long-term dietary behavior change. *Pers Ubiquit Comput.* 2013; 17: 1211–1221. DOI 10.1007/s00779-012-0590-6.