

Original Article

The Effectiveness of School-based Interventions in Preventing Childhood Obesity and Depression in Turkey

ZE ERÇELİK, S ÇAĞLAR

Abstract

Purpose: The study was conducted in order to determine the effect of the Nintendo Wii game and Colour MyPyramid Nutrition Education Programme in overweight and obese school-age children's Body-Mass Index, percentile values, healthy food consumption behaviours at school and depression levels. **Methods:** Overweight and obese students aged between 10 and 13 years were included in the randomised-controlled intervention study (N=78). After the participants participated in Colour MyPyramid Nutrition Programme and played Nintendo Wii game, their pre-intervention and post-intervention Body-Mass Index (BMI), and percentile values, healthy food consumption behaviours at school and depression levels were evaluated. **Findings:** It was determined that there was a significant decrease on the BMI and percentile values of the children in the experimental group ($p<0.05$), and they developed a healthier consumption behaviours at school and their depression levels decreased after the intervention ($p<0.001$). **Conclusions:** Active video games applied together with nutrition education within the scope of school health programmes make positive contribution due to the effects on weight loss, healthy food consumption behaviours at school and depression levels among overweight and obese school age children. Nutrition education applied with active video games in preventing childhood obesity is an important opportunity to increase the motivation of children.

Key words

Active video games; Childhood obesity; Depression; Nutrition education program

Introduction

Childhood obesity has become one of the most important global health problems in the last decade.¹ According to the report of the World Health Organisation,

340 million children and adolescents in the age range of 5-19 years were obese and overweight in 2016.² It is reported that 19.6% of children aged between 10 and 14 years in Turkey were overweight and 10.5% were obese.³ Environmental factors play a role in obesity developing as a result of the imbalance between calorie intake and physical activity in childhood. Childhood obesity causes many chronic diseases such as diabetes, hypertension, and cardiovascular diseases and continues in adulthood and may result in death.^{1,4}

Bandırma Onyedi Eylül University, Faculty of Health Sciences, Nursing Department, Department of Pediatric Nursing, Balıkesir/Bandırma, Turkey

ZE ERÇELİK RN, PhD

Istanbul University-Cerrahpaşa, Florence Nightingale Faculty of Nursing, Pediatric Nursing Department; and Abide-i Hürriyet Cad. İstanbul Üniversitesi Hemşirelik Fakültesi 34381 Şişli, İstanbul, Turkey

S ÇAĞLAR RN, PhD

Unhealthy eating habits, insufficient level of physical activity is an important factor leading to childhood obesity.⁵ In addition, obese adolescents are exposed to peer bullying and stigma in the school environment and social media and this situation also paves the way for the development of depression.⁶ It is reported in the literature that the increase in the frequency of physical activity is effective in decreasing depressive symptoms.^{5,7}

It is known that since today's children live together with technology continuously, the education methods applied to previous generations remain insufficient to meet

Correspondence to: Asst. Prof. ZE ERÇELİK

Email: zezgizgenn5@gmail.com

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the expectations of today's generation and the education programmes should be supported with advanced technologies.⁸ Simulation methods such as active video games increase children's interest and motivation by providing fun environments and support physical activity.⁹

Since children spend most of their time at school, school environment has a critical role in developing healthy lifestyle behaviours and preventing childhood obesity.^{10,11} However, today obesity prevention programmes have been still not conducted effectively in schools. In line with this information, this study was conducted to determine the effect of Nintendo Wii (NW) game and the Colour MyPyramid Nutrition Education Programme (CMNEP) on Body Mass Index (BMI) and percentile values, healthy food consumption behaviours at school and depression levels of overweight and obese children aged between 10-13 years.

Methods

Type of the Study

The study was conducted between February and April 2018 in experimental design type with pretest-posttest control group.

Hypotheses of the Study

Hypothesis 1 (H1): Post-intervention BMI averages of children in the experimental group are lower than the control group

Hypothesis 2 (H2): Post-intervention percentile values of children in the experimental group are lower than the control group.

Hypothesis 3 (H3): Post-intervention healthy food consumption behaviours of children in the experimental group are better than the control group.

Hypothesis 4 (H4): Post-intervention depression values of children in the experimental group are lower than the control group.

Population and Sample

The population of the study was composed of students (n=1380) aged between 10-13 years studying in a primary school and the sample of the study was composed of students (n=219) who (1) were aged between 10-13 years, had no mental and/or physical disability; (2) who agreed to participate in the study and whose parents gave consents; (3) overweight ($85 \leq <95$ percentile) and obese (95% and above percentile).

Based on a similar study's power analysis in the literature,¹² the minimum sample size required for obtaining $d=0.6$ effect size with, 80% power ($p=0.80$) within the limits of 95% confidence interval ($\alpha=0.05$) was calculated as 72 with the power analysis. By considering that there would be students who would like to leave the programme, 84 overweight and obese adolescents were included in the Programme. During the study, 5 students from the experimental group and 1 student from the control group left and the study was completed with 78 students.

Simple computer randomisation method was used to determine the groups.¹³ Randomisation was performed in a 1:1 ratio using a computerised random number generator. As a result of randomisation, adolescents were assigned to the experimental (n=42) and control (n=42) groups.

Prevention of Stigma and Interaction

In order to prevent stigma, students with normal weights were included in both groups (n=10). However, these students were not included in the data analysis. In order to prevent interaction between the groups, students coming to the school before noon were assigned to the experimental group and the students coming to the school in the afternoon were assigned to the control group. While the students in the experimental group attends morning session, students in the control group attends afternoon so students did not interact with each other.

Data Collection Tools

Data collection form: The form was prepared by the researcher in the light of the literature. The question form comprised questions evaluating the sociodemographic characteristics and a food diary chart in which the student wrote down the foods they consumed in the last day (5 meals).^{14,15}

Depression scale for children: Depression Scale developed by Kovaks in 1981, is a self-rating scale prepared to evaluate the depressive symptoms of children. The scale anticipated to be applied to the children aged between 9 and 13 years is composed of 27 items and there are 3 different options for each item. There are 3 options (ranked as 0, 1, 2) in each item of the scale questioning the presence and severity of the symptoms associated with depression within the last two weeks. 0 refers to no symptom, 1 indicates mild symptom and 2 refers to evident symptom. Children who get a score of ≥ 19 are evaluated in terms of depressive disorders. The maximum score of the scale is 54. This scale was adapted to Turkish by Öy.¹⁶

Scale and height meter: Weight of the children included in the study group was measured with Arzum brand scale and their heights were measured with a Mesitas brand height meter.

Body mass index table: According to height-weight measurements of the children, BMI and percentile values were calculated. In order to calculate BMI and percentile values, BMI calculation method developed for children and adolescents included in the web page of the Centres for Disease Control and Prevention (CDC) was used.¹⁷ BMI value was evaluated as <18.5 (underweight = <5 Percentile), between 18.5-24.9 (normal = between 5 <<85 Percentile), 25-29.9 (overweight = between 85 ≤ <95 Percentile) and 30 and higher (obese = ≥95 Percentile).

Colour MyPyramid guide: It is a consumer-friendly guide prepared by the United States Department of Agriculture in 2005 in order to help all healthy people aged over 2 years to make healthy food choices and revised in 2011.¹⁸ CMNEP includes the topics of "Definition, general nutritional concept, function of nutrients in body work, cereal, vegetable and fruit food groups, milk, meat-legume and fatty food groups, healthy lifestyle behaviour, portion size, exercise and physical activity". The students in the experimental group were trained with this programme.

Nintendo Wii game console: Wii is a simulation device that can detect simple movements with motion sensitive sensors, developed in November 2006 by Nintendo.¹⁹ The students in the experimental group played Wii Fit, Wii Just Dance 4 and Wii Sports Resort games projected on the screen.

Data Collection

At the beginning of the study, height-weight measurements of all children (n=1380) aged between 10 and 13 years in the school were taken and overweight and obese children were determined (n=219). It was determined that 84 students should be included in the study. The students were assigned to the experimental (n=42) and control (n=42) groups via randomisation.

The measurements were performed in the morning. All measurements were performed after the adolescents removed their shoes. After weight and height measurements of the students in the experimental and control groups by the researcher, BMI and percentile values were calculated again. The students were asked to fill out the "data collection form" and "Depression Scale for Children". While filling out the food diary chart in the data collection form, the students were asked to write down what they ate at school and at home in all meals the day

before. The food diary chart was filled out one-on-one with the student under the guidance of the researcher.

The researcher provided "Colour MyPyramid Nutrition Education" to the students in the experimental group for 20 minutes, once a week for a total of 10 weeks and they were informed about the portions in company with an expert dietician. Along with the education, video games were played under the control of the researcher with the support of the physical education teacher 2 times a week for a total of 10 weeks and for 40 minutes in the first 6 weeks and 45 minutes for last 4 weeks. Students were moderate intensity physical activity. If students did not feel well during the game, we checked heart rate. When heart rate >185 beats/min we took he/she from video game.

No intervention was applied to the students in the control group. Only 4 hour/semester nutrition education included in the MEB (Ministry of National Education) curriculum was given. In addition, students in control and experimental group engage in physical activities for 2 hours a week within the scope of the physical education curriculum.

At the end of the Programme, height – weight measurements of the adolescents in the experimental (n=37) and control groups (n=41) were obtained again by the researcher and their BMI and percentile values were calculated and they were asked to fill out the "data collection form", "Depression Scale for Children" and food diary chart again (Figure 1).

Data Analysis

Statistical analyses were performed using IBM SPSS Statistic 23 (IBM Corporation, Armonk, NY). Descriptive statistics were conducted for the baseline information of the students.

For the homogeneity of the descriptive characteristics of the groups, Pearson's chi-square and Fisher's Exact test in categorical variables and independent samples t-test in the numerical variables were used. In the comparison of the distribution of BMI group, McNemar test for the pretest and posttest within-group difference, Yates corrected chi-square test and Fisher Exact test for between-group difference were used. Independent samples t-test for the mean score difference of the depressive symptoms of the groups and dependent samples t-test for the mean score difference of the within-group pretest-posttest depressive symptoms were used. The status of having normal distribution for the numeric data was evaluated with Kolmogorov-Smirnov test and Skewness and Kurtosis. The significance level was accepted as $p < 0.05$.

Results

It was determined that the mean age of the children was 12.08±0.83 in the experimental group and 11.93±0.85 years in the control group; 54.1% of the children in the experimental group and 53.7% of the children in the control group were girl. The majority of children (37.9%) in the experimental group were 6th grade students while the majority of the children in the control group (36.6%)

were 5th grade students. Most of the children (experimental group=89.2%; control group=82.9%) had nuclear family. 75.7% of children in the experimental group and 90.2% of children in the control group had equal income – expense levels; 35.1% of the experimental group and 29.3% of the control group had an obese individual in their family and there was no statistically significant difference between the groups in terms of descriptive characteristics ($p>0.05$) (Table 1).

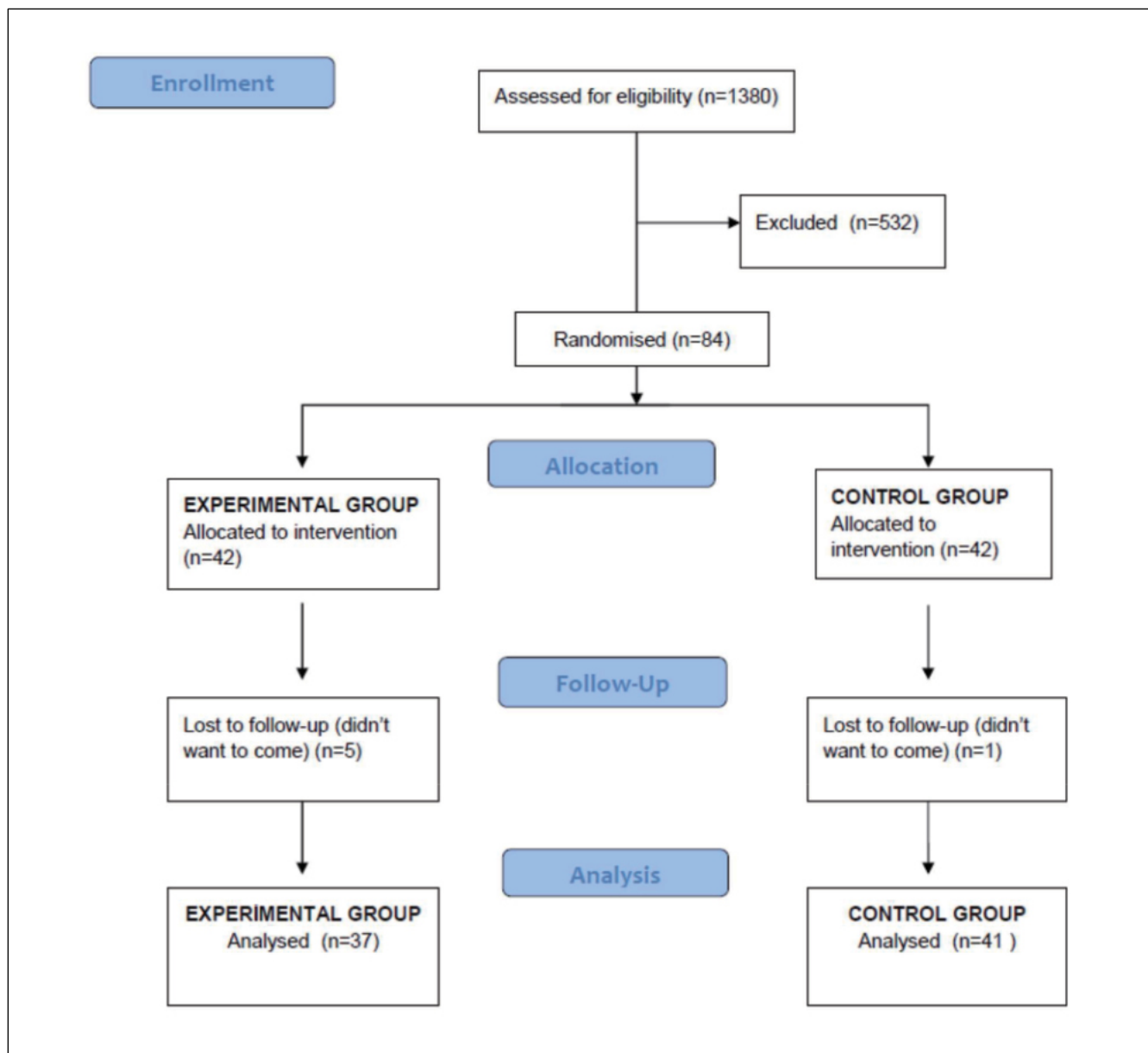


Figure 1 Consort diagram.

When BMI values of the children were evaluated; it was determined that BMI averages of the children in the experimental group were 23.71±2.00 pre-intervention and 23.24±2.07 post-intervention and difference is statistically significant (p=0.000), there is no significant difference (p>0.05) between BMI averages of the children in the control group pre-intervention (24.54±3.22) and post-intervention (24.45±3.06), after intervention difference between post-intervention BMI averages of the

experimental and the control groups is statistically significant in favour of the experimental group (p=0,047) (Table 2).

When percentile values of the children were examined, it was found that the rate of overweight children in the experimental group was 91.9% (n=34) before the intervention and this rate decreased to 78.4% (n=29) after the intervention, and 8.1% of obese children (n=3) did not change before and after the intervention. While there was

Table 1 Comparison of introductory characteristics of children

Characteristics	Experimental Group (n=37)		Control Group (n= 41)		χ^2 / t	p
	n	%	n	%		
Age						
10-11 age	9	24.3	14	34.1	0.492	0.483 ^Y
12-13 age	28	75.7	27	65.9	(sd: 1)	
Average of age (min-max / \bar{X} ±SS)	10-13	12.08±0.83	10-13	11.93±0.85	t: 0.811	0.420
Gender						
Male	17	45.9	19	46.3	0.000	1.00 ^Y
Female	20	54.1	22	53.7	(sd: 1)	
Class						
5th class	10	27.0	15	36.6		
6th class	14	37.9	14	34.1	0.837	0.658
7th class	13	35.1	12	29.3	(sd: 2)	
Type of family						
Extended family	4	10.8	4	9.8		
Elementary family ^a	33	89.2	34	82.9		1.00 ^F
Broken family ^a	-	-	3	7.3		
Family's level of income						
Equivalence of income and expense	28	75.7	37	90.2	2.016	0.156 ^Y
More income than expense	9	24.3	4	9.8	(sd: 1)	
Presence of obese persons in family						
None	24	64.9	29	70.7	0.097	0.755 ^Y
Yes	13	35.1	12	29.3	(sd: 1)	

a: Since the number of samples was small, the analysis was performed by combining the groups; Y: Yates correction; F: Fisher exact test
 χ^2 : Pearson chi-square test

Table 2 Comparison of body mass index (BMI) values of children (N=78)

BMI average	Pre intervention	Post intervention	t*	p
	\bar{X} ±SS	\bar{X} ±SS		
Experimental Group (n=37)	23.71±2.00	23.24±2.07	4.196	0.000
Control Group (n=41)	24.54±3.22	24.45±3.06	1.384	0.174
t**	1.343	2.018		
P	0.183	0.047		

*t test in dependent groups (sd: 76)

**t test in independent groups (sd: 76)

no children having normal weight before intervention, 13.5% (n=5) children reached to normal weight after the intervention and the difference was statistically significant (p=0.008). It was found that the rate of overweight children in the control group was 78% (n=32) before and after the intervention, while the rate of obese children was 22% (n=9) and there was no difference between them before and after the intervention (p>0.05). The difference between the post-intervention percentile values of the experimental and control groups was found to be statistically significant in favour of the experimental group (p=0.019). In the advance chi-square analysis conducted by excluding the group having normal body weights with high row chi-square to determine the difference, it was found that there was no difference between the groups (p>0.05) and the difference was caused by the experimental group (Table 3).

When the foods consumed by children in one day (morning, mid-morning, noon, afternoon, evening) according to the nutrition diary chart were examined, it was found that the rates of consuming milk (p=0.013), fruit-vegetable (p=0.001), oilseed group (nuts) (p=0.001) and water consumption (p=0.002) of the children in the experimental group increased after intervention; there was no significant change in the healthy food consumption behaviours of the children in the control group compared to the pre-intervention but there was a significant increase in their coffee/soda consumption (p=0.031) compared to pre-intervention, there was no change in the rates of consuming unhealthy foods (such as toast, fast food, chips)

in both groups after the intervention (p>0.05). When the post-intervention food consumption of the children in the experimental and control groups was compared, it was determined that the rates of consuming fruit-vegetable (p=0.001), oilseed (p=0.043) and water (p=0.016) were more significant in favour of children in the experimental group (Table 4).

When the depression levels of the children were examined, it was determined that the depression scale mean scores of children in the experimental group were 12.78±7.37 before the intervention and 7.35±4.33 after the intervention (p=0.000); there was no difference between the depression levels of children in the control group before and after the intervention (p>0.05); depression mean scores between the experimental and control groups were more significant after the intervention in favour of the experimental group (p=0.000) (Table 5).

Discussion

It is stated that physical activity is very important in preventing obesity.²⁰ Many global action plans have been prepared in fighting against childhood obesity. "Multi-stakeholder Action Plan on Non-communicable Diseases 2017-2025" and "Action Plan for Preventing Childhood Obesity 2019-2023" are among the projects conducted in Turkey. In the developed strategies, it is aimed to increase sensitivity and practices in active life.^{21,22} The literature

Table 3 Comparison for percentile values of children (N=78)

Percentile value	Experimental Group (n=37)				Control Group (n=41)				Experimental – Control Group		Experimental – Control Group	
	Pre intervention		Post intervention		Pre intervention		Post intervention		Pre intervention difference		Post intervention difference	
	n	%	n	%	n	%	n	%	χ ²	p	χ ²	p
Normal (5-84.9%)	-	-	5	13.5	-	-	-	-				
Overweight (85-94.9%) ^a	34	91.9	29	78.4	32	78.0	32	78.0	1.898	0.168 ^Y	7.963	0.019
Obese (95% and more) ^a	3	8.1	3	8.1	9	22.0	9	22.0	(sd:1)		(sd: 2)	
p (McNemar*)	p: 0.008				p: 1.000							

a: Since the number of samples was small, the analysis was performed by combining the groups; Y: Yates corrected chi-square test (Observed values <25)

χ²: Pearson chi-square test

*McNemar test, binomial distribution was used

Table 4 Comparison of daily food consumption of children (N=78)

Nutrition type (Daily consumption)	Experimental Group (n=37)				Control Group (n=41)				Experimental – Control Group		Experimental – Control Group	
	Pre intervention		Post intervention		Pre intervention		Post intervention		Pre intervention difference		Post intervention difference	
	n	%	n	%	n	%	n	%	χ^2	p	χ^2	p
Milk												
Yes	11	29.7	22	59.5	13	31.7	18	43.9	0.000	1.00	1.313	0.252
No	26	70.3	15	40.5	28	68.5	23	56.1				
p (McNemar*)	0.013				0.063							
Fruit and vegetable												
Yes	7	18.9	21	56.8	2	4.9	7	17.1	0.077 ^F	11.641	0.001	
No	30	81.1	16	43.2	39	95.1	34	82.9				
p (McNemar*)	0.001				0.063							
Oilseed												
Yes	4	10.8	16	43.2	3	7.3	8	19.5	0.702 ^F	4.088	0.043	
No	33	89.2	21	56.8	38	92.7	33	80.5				
p (McNemar*)	0.001				0.063							
Water												
Yes	15	40.5	28	75.7	15	36.6	19	46.3	0.016	0.900	5.817	0.016
No	22	59.5	9	24.3	26	63.4	22	53.7				
p (McNemar*)	0.002				0.125							
Coffee/soda												
Yes	3	8.1	2	5.4	3	7.3	9	22.0	1.00 ^F	3.136	0.077	
No	34	91.9	35	94.6	38	92.7	32	78.0				
p (McNemar*)	1.000				0.031							
Unhealthy food												
Yes	23	62.2	29	78.4	33	80.5	36	87.8	2.384	0.123	0.658	0.417
No	14	37.8	8	21.6	8	19.5	5	12.2				
p (McNemar*)	0.210				0.250							

 χ^2 Pearson chi-square test

F: Fisher exact test (Expected number <5)

* McNemar test, binomial distribution was used

Table 5 Comparison of point average for depression scale of children (N=78)

Group	Pre intervention		Post intervention		t*	p
	$\bar{X} \pm SS$		$\bar{X} \pm SS$			
Experimental Group (n=37)	12.78±7.37		7.35±4.33		4.915	0.000
Control Group (n=41)	12.29±6.31		13.02±6.11		1.317	0.195
t**	0.317		4.766			
P	0.752		0.000			

*t test in dependent groups (sd D: 36, K: 40)

**t test in independent groups (sd: 76)

shows that active video games are an important strategy that can be used to provide social support, increase motivation and family interaction, as well as daily calorie expenditure.²³

In the study, BMI averages and percentile values of the experimental group were seen to decrease after the programme applied. When the literature was examined, it was observed that the physical activity conducted at school reduced BMI and percentile values.²⁴ In the study by Staiano et al,²⁵ 74 overweight and obese children played NW Clup game for 20 weeks and they observed that there was weight loss and their self-efficacy and peer interaction increased. Moore et al²⁶ applied Colour Pyramid Nutrition Programme to 126 children and they were asked to play NW game and they found as a result of the study that their nutrition information and physical activity times increased but their BMI averages did not change. This difference was believed to be caused by the fact that the physical activity was not performed by the practitioner in the study but left to the free-will of children in the study. In the systematic review and meta-analysis study by Ameryoun et al,²⁷ it was stated that AVG had a small effect on lowering BMI values. In the meta-analysis study conducted by Bochner et al,²⁸ it was stated that there was no difference between the pre-post test results of AVG, and it was reported that the duration of the analysed studies was short, the biases were high, and that better quality studies should be conducted in order to understand the effect of AVG.

It was seen in the study that there was an increase in the healthy food groups (milk, fruit-vegetable, water consumption) consumed by students from the experimental group after the programme. When the studies were examined, it was determined that there was an increase in the rates of milk;^{29,30} fruit-vegetable^{10,24} and water consumption^{31,32} as a result of nutrition educations and programmes. Based on the existing literature it is stated that not only physical activity, but also programs applied together with other methods are effective in controlling obesity.^{33,34} For this reason, we expected our study to be more effective not only with active video game but also with nutrition program. The control group was doing a certain level of physical exercise within the scope of the education curriculum and was given nutrition education. However, it was observed that the curriculum was not sufficient in this study.

It has been reported that obesity and depression seen in adolescent period are two factors triggering each other and mental problems such as low academic performance, low

self-esteem, anxiety and depression are more common in overweight^{35,36} and obese adolescents.^{37,38} In the study, it was determined that there was a decrease in the post-intervention depression scale mean scores of the students in the experimental group. When the literature was examined, it was observed that physical activity programmes decreased the prevalence of depression.^{39,40} In a systematic review by Chen and Wilkosz,⁴¹ it was stated that technology-based interventions applied to obese adolescents were effective in reducing the level of depression and improving self-esteem.

Limitations

The study has some limitations. First of all, since the sample was composed of overweight and obese children from only one school, the results cannot be generalised to whole population. Secondly, it was planned to setup informative meetings with families about the importance of nutrition and physical activity during the programme at the beginning of the study but parents did not attend this meeting for various reasons. Finally, since the study was a master's thesis and the time was limited, the programme could be applied to the students for only one semester (10 weeks).

Conclusion

It was observed that the Colour MyPyramid Nutrition Education Programme and Nintendo Wii games applied in schools had positive impacts on the BMI and percentile values, health food consumption behaviours and depression levels of overweight and obese children. In fighting with obesity, it is very important for school nurses, teachers and parents to make plans for organising school environment, applying regular nutrition trainings, and developing simulation based physical activities that will attract attention of children and health lifestyle behaviours.

Implications for Practice

In line with the results of the study, it is recommended to increase nutrition trainings in schools, inform students about healthy food consumption at regular intervals, support to have healthy foods in school cafeterias and prevent unhealthy food from being sold and served in cafeterias, add dynamic, video-based physical activity

games to the curriculum of physical education courses that will attract students' interest and ensure their active participation and increase their weekly hours, organise informative seminars for families and teachers on the importance of healthy nutrition and physical activity at regular intervals, and give feedbacks by measuring heights and weights of the students at frequent intervals.

The literature on the effect of active video games on the level of depression is quite limited. Long-term (at least 3 months) randomised controlled studies are needed to understand active video games effect.

Ethical Considerations

Before starting the study, ethics committee approval from the Clinical Trials Ethics Committee and institution permission from the Directorate of National Education were obtained. By meeting with the principal and teachers of the school where the study would be conducted, they were informed about the purpose and method of the study. Written consents about the participation of the students were obtained from the parents of students who would participate in the study by informing them about the purpose and method of the study.

Conflict of Interests

The authors declare that there are no conflict of interests.

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