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SHORT COMMUNICATION

Effect of Game-Based Nutrition Education on Nutritional Knowledge of Preschool Children

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ABSTRACT

Background: Nutrition education during childhood plays a substantial role in promotion of healthy eating habits throughout the life. We aimed to assess the effect of a newly designed game-based nutrition education program on nutritional knowledge of preschool children.

Methods: An experimental study was conducted at eight kindergartens from various socioeconomic levels in Shiraz, Iran. Forty-eight children aged 5 to 6 years old were recruited to the study. We developed a computer-game containing health improving nutritional messages, based on snake and ladder game. The intervention period of game playing was 20 minutes per day for a week. All children were asked to complete a questionnaire, including 9 questions designed for their age group, before and after playing the game. Also, we assessed the acceptance of the game among the experimental group.

Results: Forty-seven children including 27 boys and 20 girls completed the study (23 in the experiment and 24 in the control groups). The mean age of participants was 5.71±0.41 years. Baseline scores of nutritional knowledge were significantly more in high socioeconomic regions. The mean score of nutritional knowledge in experimental and control groups improved significantly (0.73±1.62 and 0.52±1.78, respectively). Considering the baseline mean score as covariate, the mean score of nutritional knowledge significantly increased in the experiment group. The results showed that all children preferred to select more healthy foods after playing game. Moreover, the experimental group was interested in playing the game in 3 levels; low (8.7%), high (52.2%), and very high (39.1%).

Conclusion: This new game-based educational approach may simplify the education in preschool children and enhance their nutritional knowledge.

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Introduction

Childhood is a vulnerable life stage that may be threatened by several factors (1). Nowadays, children like other age groups are facing a two tailed nutritional inequalities that developed both under- and over-nutrition in communities (1, 2).

Recent literatures in Iranian children demonstrated unhealthy food habits including breakfast skipping, and lower intake of dairy products, fruits, and vegetables. On the other hand, foods lacking vitamins and minerals, and full of sugar, fat, and salt are more accessible, especially as snacks (3-5). This food pattern make children prone to higher incidence of cardiovascular disease, cancer, and diabetes in adult years (5, 6). Since, the most food patterns, lifestyles, and social behaviors develop from childhood, it should be more important to prevent chronic disease and improve quality of life from early years of life. Also, preschool children start to select foods independently, thus early improvement of nutritional knowledge could create healthy adult years (2, 7).

It is more important to effectively educate subjects, considering the age adjusted education tools and approaches. Technology development and producing attractive electronical games takes children attracted in this field of entertainment. Thus, health education based on personal computer, laptop, tablet, and cell phone may be more applicable to develop nutritional knowledge (2, 7). Up to our knowledge, designing and assessment of game-based educations were mostly conducted in children higher than 7 years of age and preschool children were less studied. Thereby, we aimed to assess the effect of a newly designed game-based nutrition education program, based on snake and ladder game on nutritional knowledge of children aged 5 to 6 years old.

Materials and Methods

In an experimental study, 48 children aged 5 to 6 years old were enrolled from regions with different levels of socioeconomic status in Shiraz, Iran. Sample size was determined as 24 in each group with power of 80 using sampling formula. Subjects were selected by multistage random sampling. At first level, we divided Shiraz into 4 regions according to different socioeconomic levels. Then, we selected 2 kindergartens in each region as experimental and control groups. Thereby, four kindergartens from four different socioeconomic levels were allocated as experimental groups and four others as control groups.

The control group was matched for socioeconomic level with the experiment group. Finally, we randomly selected six children in each kindergarten. Inclusion criteria were children aged 5-6 years old and who registered in one of selected kindergartens. We did not include children who had any congenital disorders. Children were excluded if did not complete the intervention duration. This study was approved by Ethics Committee of Shiraz University of Medical Sciences, Shiraz, Iran. Verbal consents were obtained from children' parents or caregivers.

A computer-based game was developed to provide preschool children with nutritional recommendation. This electronical game was based on snake and ladder game (Figure 1) and contain voice nutritional messages. Originally, snake and ladder is a game on paper with 100 chambers. The players throw dice and move through chambers accordingly. By playing the game, they may expose snakes or ladders that punish or encourage the player, respectively. In this electronic-based version, we designed two groups of messages. Children were punished by snakes as they stepped in chambers containing unhealthy foods, and encouraged with climbing ladders as they

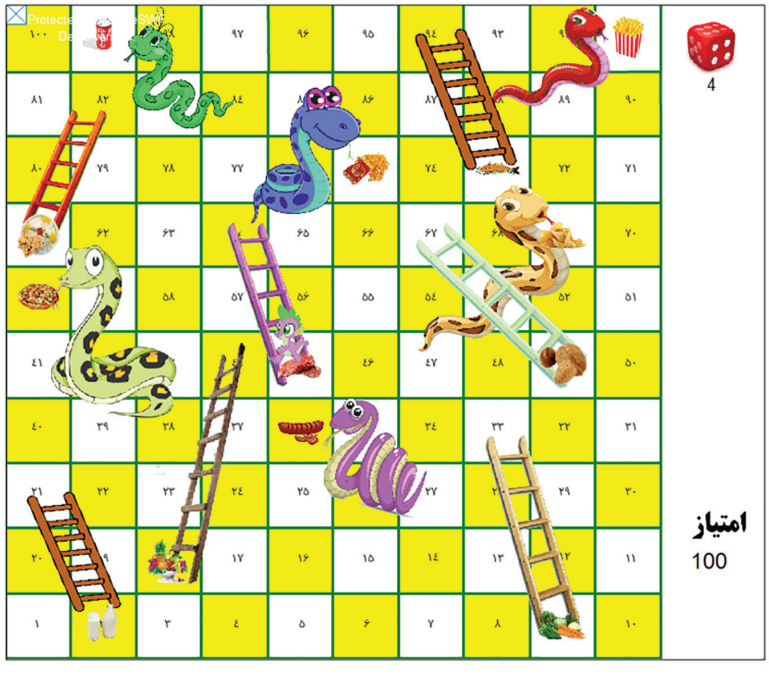

Figure 1: The newly designed computer-based Snake and Ladder game.

stepped in chambers containing healthy foods, and at the same time heard a verbal nutritional message related to that chamber picture.

A questionnaire was designed to evaluate nutritional knowledge of children in both groups at the beginning of the study and after intervention. The questionnaire contained nine questions and answers were food drawing pictures. Interviewers read the questions and asked children to paint correct answer. Questions tested the knowledge of participants as follow: "which food is healthy for heart"; "which foods bring enough energy"; "which snacks are not healthy"; "which foods cannot help you grow"; "which foods help you grow"; "which foods improve your health"; "which food strengthen the bones"; "which food is harmful for the heart"; and "which foods are needed every day to improve health".

Then, their nutritional knowledge were scored from zero to 9. The experimental group played the game through a week, 30 minutes per day. On the other hand, children in control group took no intervention. Moreover, we asked experimental group two other questions to evaluate acceptance and effectiveness of the game, at the end of 67 interventions. Following asking questions; "How much do you like this game and was it exciting? Low, High, Very high"; "Did you prefer to choose most healthy foods after playing this game? Yes, No".

Data were analyzed using SPSS software (version 22 for Windows; SPSS Inc., Chicago, IL, USA). We used Kolmogorov-Smirnov and Shapiro-Wilk tests to check normality of data. Data was normal, thus we used parametric tests. Between-groups, analyses were done using Independent t-test, and paired t-test was used for within-group analysis. Also, we used One Way ANOVA test to compare mean score of nutritional knowledge between different socioeconomic levels at baseline. ANOVA was used to test the differences between experimental and control groups in score of nutritional knowledge at post-intervention, using the baseline measure as covariate. P values <0.05 were considered statistically significant.

Results

Of 47 participants, 27 were boys and 20 were girls. One child in experiment group was excluded from study because of incomplete intervention. Distribution of participants in study groups were 23 in the experimental and 24 in the control group. Mean age of participants was 5.71±0.41 years. As shown in Table 1, there were no significant differences in terms of mean score of nutritional knowledge between boys and girls at the beginning of the study. However, the mean score showed significant differences between regions with different levels of socioeconomic status.

Paired sample T-Test showed that the mean score of nutritional knowledge increased significantly in experimental group [6.34±1.84 to 7.08±1.53; P=0.04], though it did not change significantly in the controls [5.04±2.15 to 5.56±1.82; P=0.15]. Moreover, independent t-test showed significant differences in mean score of nutritional knowledge between experimental and control groups after intervention (P=0.003), that was also remained statistically significant after adjustment for baseline scores (P=0.04). Table 2 represents the comparison of each question between study groups, and within each group. Participants in experimental group rated their interest in playing the game as follows; low (8.7%), high (52.2%), and very high (39.1%). Besides, all participants preferred to select more healthy foods after playing the game.

Discussion

This study indicated that the snake and ladder computer-game increased nutrition knowledge of preschool children. In this regard, several studies demonstrated different game-based educational

Table 1: Baseline characteristics of participants.

Variable		Mean score	*p*-value
Sex	Boys	5.75±1.73	0.74*
	Girls	5.55±2.56	
Socioeconomic level	1st level (n=12)	7.00±1.53[a]	0.001**
	2nd level (n=12)	6.58±1.72	
	3rd level (n=11)	4.63±1.68	
	4th level (n=13)	4.46±2.18[b]	
Study groups	Experiments	6.34±1.84	0.02***
	Control	5.04±2.15	

Data are presented as mean±SD; *P value is resulted from Pearson Chi-Square test; ** P value is resulted from One-way ANOVA test; *** P value is resulted from Independent t-test; Multiple comparisons using Post-Hoc test showed significancy, a) higher mean score in 1st level of socioeconomic level compared to 3rd and 4th levels, b) lower mean score in 4th level of socioeconomic level compared to 1st and 2nd levels.

Table 2: Comparison of each question between the study groups.

Questions	Experiments (n=23)		Control (n=24)		*p*-value*
	Baseline	Endpoint	Baseline	Endpoint	
1- "which food is heart healthy"	14§	21	17	18	0.08
p-value**	0.06		1.00		
2- "which foods bring enough energy"	15	19	11	13	0.02
p-value**	0.21		0.68		
3- "which snacks are not healthy"	21	22	18	17	0.01
p-value**	1.00		1.00		
4- "which foods cannot help you to grow"	20	21	12	15	0.01
p-value**	1.00		0.50		
5- "which foods help you to grow"	16	17	15	15	0.30
p-value**	1.00		1.00		
6- "which foods improve health"	12	17	16	16	0.45
p-value**	0.18		1.00		
7- "which food strengthen the bones"	16	19	7	12	0.01
p-value**	0.45		0.18		
8- "which food is harmful to the heart"	14	11	17	15	0.39
p-value**	0.50		0.75		
9- "which foods are needed every day to improve health"	18	16	13	18	0.85
p-value**	0.68		0.26		

§Number of participants answered questions correctly; * *p*-value was resulted from Pearson Chi-Square test to compare endpoint values between groups; ** *p*-value were resulted from Mc-Nemar test to compare within group values.

methods enhancing the knowledge of children (8-10). Also, electronic health education programs were introduced as a new and interested educational approaches (11, 12). Yien et al. found that game-based education could improve the learning achievement of the students regarding nutrition knowledge, attitudes, and food habits, more than traditional methods (10).

Moreover, Amaro et al. developed a new educational board-game (Kalèdo) and evaluated the nutritional knowledge and performance in 11-14 years old children. After24 weeks of playing Kalèdo, nutritional knowledge and weekly intake of vegetables were higher compared to the controls (8). Moreover, another study reported higher intake of fruits and vegetables after using Diab and Nano, two types of computer games (12). Similar to our results, a review article, on 9 articles and 11 computer games, demonstrated that computer games improved dietary knowledge, exercise, and blood sugar monitoring in children with type 1 diabetes mellitus (11).

Literature revealed that unhealthy eating habits during childhood were associated with occurrence of diabetes, hypertension, cardiovascular disease, etc. in adulthood (13). Establishment of a healthy eating behavior from early childhood was shown to be able to construct healthy eating habits, later in life (14, 15). An updated systematic review demonstrated nutrition education as an important intervention strategy contributed to obesity prevention in preschool children (16). Moreover, recent studies mostly addressed parent or child caregivers in educational interventions with aim of child health improvement (17, 18).

However, as preschool children are starting to select foods based on their preference and sometimes independent of their parents (19), involving children themselves in interesting and amusing types of education programs may be more effective to promote eating habits. On the other hand, we found that more than 90% of children in experimental group enjoyed playing the snake and ladder game at levels of high and very high. Similarly, Calderaro et al. reported that children who played videogames were more motivated and concentrated on learning (20). The same results were also reported by Yien et al. that showed game-based education is more interesting to learn (10).

Furthermore, our results showed that baseline nutritional knowledge of children was related to their family socioeconomic level. Many studies also reported higher socioeconomic status which was defined by educational level, income, resident area, etc. related to higher knowledge of nutrition and health improving concepts (21-23). A limitation of the present study was lack of a designed game for control group which was same as snake and ladder game in experiment group, just different in voice messages.

We concluded that snake and ladder game could be introduced as a novel approach to educate young children and enhance their nutritional knowledge through a one-week enjoyable intervention.

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Conflict of Interest

None declared.

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