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The Effects of an Educational Intervention Based on Poetry, Game, and Problem-Solving Skills on Promoting Nutritional Knowledge and Behavior in Iranian Primary School Students

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ABSTRACT

Background: Current educational techniques may have a few effects on dietary habits and food preferences in adolescents, so by designing an educational attractive program, nutritional knowledge can be significantly enhanced. This study aims to investigate the effect of a structured educational intervention based on poetry, game, and problem-solving skills on promoting nutritional knowledge, and behavior in primary school students. **Methods**: This experimental study was conducted on 120 primary school students aged 10-12 years in Sabzevar, Iran, in 2019. The participants were selected through multi-stage random sampling and divided into experimental (EG, n=60) and control (CG, n=60) groups. The data collection tool was a researcher-made questionnaire consisting of three sections (demographic characteristics, nutritional knowledge section, and nutritional behavior section). The validity and reliability of the questionnaire were checked and confirmed. The educational program, including educational poems, a "road to health" game, and problem-solving skills, was designed. The EG received a self-directed educational program. Both groups completed the questionnaires before and one month after the intervention. R**esults:** After the intervention, the mean scores of nutritional knowledge and nutritional behaviors significantly improved in the EG compared to the CG ($P < 0.05$). Moreover, after the intervention, the mean score of nutritional behavior in the EG significantly improved compared to before the intervention ($P < 0.05$). The highest percentage in mean scores in the food pyramid groups was related to the consumption of vegetables (27%), consumption of milk and dairy products (26%), non-consumption of low-value snacks (13%), and non-consumption of sugar and candy (11%), respectively. **Conclusion:** The educational program based on poetry, game, and problem-solving skills can be practical, attractive, and cost-effective for promoting nutritional knowledge and behavior in adolescents.

Keywords: *Nutritional knowledge; Nutritional behavior; Educational poetry; Problem-solving, Primary students*

Introduction

Healthy diet is one of the important health goals in childhood and adolescence due to the importance of the adolescence period to achieve proper growth and ensure the health of later periods of life, so that ignoring this issue will have irreversible consequences (Babazadeh *et al.*, 2015). National surveys in most countries have indicated excessive consumption of saturated fat, trans fats, sugar, salt, and low consumption of vegetables, fruits, and whole grains, which has increased the rate of obesity. An unhealthy diet not only shortens life expectancy but also affects the

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quality of life. Consuming low nutritional value foods in childhood is the leading cause of obesity and chronic diseases in adolescence and youth. Therefore, one way to prevent non-communicable diseases is to improve childhood nutritional behaviors (Khodaveisi *et al.*, 2016, Perera *et al.*, 2015). Today, in addition to malnutrition caused by undernutrition, a new type of childhood malnutrition is emerging as overweight and obesity resulting from changes in people's lifestyles and eating habits, such as consuming fatty and energy-boosting foods and lack of adequate physical activity (Tavakoli *et al.*, 2016). The number of overweight children has increased from 10 million in 2000 to 40 million in 2019. Almost half of all overweight children live in Asia (Verbeke *et al.*, 2007). In 2016, the prevalence of overweight and obesity among Iranian children and adolescents aged 5 to 19 years reached 25.6% (United Nations Children's Fund (UNICEF) *et al.*, 2019).

Nutrition plays an essential role in efficient physical and cognitive function, especially in childhood. However, recent evidence has shown that children do not follow healthy diet recommendations properly (Krebs-Smith *et al.*, 2010, Nicklas and O'Neil, 2015). As a result of unhealthy dietary patterns, children are at risk of complications and problems, such as iron deficiency anemia, obesity, gastrointestinal disorders, and tooth decay in the short term, and also chronic and dangerous cardiovascular disease, cancer and stroke, and type 2 diabetes in the long-term (Tandon *et al.*, 2016). The benefits of a healthy diet for children have been widely recognized and include improving wellbeing and learning abilities, which can improve their school performance (de Vlieger *et al.*, 2019). Childhood is a period in which educating healthy eating behaviors is necessary to develop healthy eating habits in the later years (Nicklaus and Remy, 2013). Therefore, it seems necessary to conduct purposeful interventions to increase the consumption of fruits, vegetables, and dairy products and reduce fats, junk food, chips, and other low-value snacks, salt, soft drinks, other carbonated beverages, etc. (Dehdari *et al.*, 2012).

Proper education of health behaviors can lead to behavior change; so that proper nutritional behaviors replace inappropriate ones (Baharzadeh *et al.*, 2017, Kaveh *et al.*, 2018). Educating people to increase their level of knowledge has a very influential role in improving nutritional behaviors. The primary prevention method is nutrition education, intending to use food resources better (Dehdari *et al.*, 2014). Nutrition education in elementary schools can increase students' knowledge and skills to choose healthy foods and improve their healthy eating behaviors. On the other hand, current methods for educating nutrition and healthy eating behaviors are mostly ineffective in changing school students' dietary preferences, and it is not an appropriate and attractive education method for children (Perera *et al.*, 2015). Traditional educational methods, such as lecturing, in which the instructor is only the provider of knowledge and the learner is the passive acceptor, arise from a one-dimensional view of education that considers education only the transfer of knowledge to education learners. However, modern educational methods emphasize learners' activeness in learning and developing all aspects of their learning process. If the education is in line with children and adolescents' nutritional needs and is presented attractively and tangibly using visual and auditory techniques, it will affect their knowledge and dietary behavior patterns (Esfarjani *et al.*, 2004).

Self-directed learning is when learners identify their learning needs with others' help or on their initiative. In addition to setting learning goals and identifying human resources and other resources required for learning, learners select appropriate learning strategies and ultimately evaluate the consequences (Karimi *et al.*, 2010). Self-directed learning benefits include increased power of choice, confidence, self-efficacy, motivation, and the development of lifelong learning skills. Therefore, learners use their knowledge to discover available resources and make informed judgments to solve problems (Karimi *et al.*, 2010). In self-directed learning, the learning goals and how to carry out a task are gradually transferred from the

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instructor to the learner. This method emphasizes the motivational role of learners' greater independence in learning and a strong determination to start and continue achieving the goals (Nadi and Sadjadian, 2011).

Educating children with poems can be helpful because it plays a crucial role in memorizing texts. Children enjoy listening to poems and memorize their concepts. Therefore, this method can be used for better, more effective, and more sustainable education. Games are also an active method to cultivate creativity and thinking and improve cognitive thinking; since the level of knowledge and reminders are not enough to complete an unfinished story or create a new story. Students need to combine what they have learned with dreams (Pellegrini *et al.*, 2004). It is required to design new effective and attractive educational methods for students that are both scientific and cost-effective and do not require many human resources to educate and the possibility of using it in schools and health education programs. Therefore, this study was conducted to investigate the effect of a structured educational program based on poetry, game, and problem-solving on promoting nutritional knowledge and behaviors in adolescent students.

Materials and Methods

Participants: This experimental study was carried out among 120 boys and girls (age 10-12 years) in Sabzevar, Iran, in 2019. Based on a similar study (Rasouli and Tavafian, 2010), using the following formula (comparing the mean score of two independent populations) with a 95% confidence interval and 90% power, 55 participants were needed for each group. Taking into account a drop-out rate of 10%, it increased to 60 participants for each group.

$$n = \frac{2S_p^2(Z_{1-\alpha}+Z_{1-\beta})^2}{d^2} = \frac{2\times 2.087(1.64+1.28)^2}{(0-57)^2} \cong 110 + \%10 = 121$$

The participants were selected through a multi-stage random sampling technique and were divided into experimental (EG, n=60) and control (CG, n=60) groups. First, Sabzevar city schools were divided into two regions, and four elementary schools (for each region, one girl school, and one boy school) were randomly selected from each region. Then, two classes were randomly selected from each school. In area one, the fourth grade of girls and boys' schools were considered as CG and the fifth grade of both schools was considered as the IG. In area two, conversely, the fourth grade of two schools was considered as the IG and the fifth grade of two schools was considered as the CG. The inclusion criteria included informed consent, interest in participating in the educational program by students and parents, and completing the educational program. The exclusion criteria included malnutrition, obesity, and suffering diseases that require a special diet, reluctance to continue participating in the study, and failure to finishing the educational program.

Measurements: The measurement tool was a 3-section questionnaire (demographic characteristics, nutritional knowledge, and nutritional behaviors) containing 34 questions. The initial questionnaire with 50 questions was designed by reviewing related texts and scientific studies using two standard questionnaires, including a food frequency questionnaire (FFQ) and Dietary Screener Questionnaire (DSQ). Content Validity Index (CVI) and Content Validity Ratio (CVR) were also assessed to determine the questionnaire's face and content validity. First, the questionnaire was given to ten health and nutrition specialists, and they confirmed the face and content validity of the questionnaire. According to the CVI results (0.89), five questions were modified, and based on the CVR results (0.84), out of 50 questions, seven questions were removed. Finally, the final version of the questionnaire, including 34 questions, was prepared. Cronbach's alpha method confirmed the reliability of the questionnaires, so that the questionnaire was given to 30 people (students other than the subjects). Cronbach's alpha value was calculated, and the necessary corrections were made. Cronbach's alpha coefficient was 0.92 for nutritional knowledge questions, 0.97 for nutritional behavior questions, and 0.98 for the

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whole questionnaire. Therefore, the reliability of the questionnaire was confirmed.

Demographic characteristics included nine questions (grade, gender, age, parents' educational level, parents' occupation, weight, and height). The nutritional knowledge section included ten 3-option questions (true, false, do not know). Each correct answer was given two points; the wrong answer zero points, and the 'I do not know' answer one point. The nutritional behaviors section included 24 four-option questions, with score range of 0 to 3. In this section, questions included regular consumption of breakfast, not consuming sugar and candy, daily consumption of water and liquids, not consuming low-value prepared foods, healthy consumption of sweets, not consuming beverages, not consuming low-value snacks, consuming milk and dairy products, consuming groups meat and legumes, consumption of fruits group, consumption of vegetables group, consumption of cereals group, number of daily meals , each food group introduced in the food pyramid categories was examined separately. After confirming the questionnaire's validity and reliability, it was completed in self-reports and interviews conducted by the researcher. Both groups completed the questionnaire before and one month after the educational intervention.

Educational program: After the needs assessment stage and obtaining approval from the Ministry of Culture and Islamic Guidance, a 24-page educational book was published and distributed among the participants. The participants were then explained the steps of the study. The educational intervention consisted of a pre-test and a two-stage intervention test that was performed during 4 months. The themes of poetry, games, and problem solving were designed with the following sections.

Section 1. Composing poems related to the research objectives

In this section, diet and nutrition experts designed an appropriate scenario, and the childish poems were composed. The study aimed to introduce healthy and unhealthy foods to students, and the instructor introduced the food pyramid categories using childish poetry. Food categories were introduced to the students concisely and based on their understanding level. At the end of the poem, which introduced the miscellaneous food group, healthy alternative foods instead of unhealthy and harmful ones were introduced. To attract the students' attention, they were reminded of 14 essential points of a healthy diet in the form of a childish health message entitled "Do you know." The participants were asked to read the poem on healthy nutrition at a particular time and also read the "Do you know" section.

Section 2. Designing images and childish characters in accordance with the poems

At this stage, shapes and drawings related to the poem were designed. The drawings were related to the food group's educational theme described in the poem on the same page and introduced each food group on each page. The drawings had a happy and colorful atmosphere, suitable for the children's world. By introducing various healthy and unhealthy foods to students, they were also valuable for visual education.

Section 3. Designing assignments for problem-solving in accordance with the research objectives

At this stage, problems and assignments were designed for students related to the educational content of the program previous section. Students solved the problems, enjoyed problem-solving skills, reviewed the contents, practiced positive eating behaviors, and made decisions by playing the game and book exercises. The included assignments were as follows:

- The first assignment was designed to educate on buying healthy food in an appropriate number of different food groups for Sarah (poetry character). It aimed to assess the level of learning related to the food pyramid, the students' knowledge of each category's food units, and calculate the required number of food units during a day.

- The second assignment aimed to train students to diagnose healthy and unhealthy foods according to nutritional learnings. To this end, the student

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had to identify and approve healthy food (✓) and identify unhealthy food, and mark disapproval (×). Therefore, the student learned the usefulness and harmfulness of food through video instruction and judged whether they are healthy or unhealthy.

- The third assignment was designed to teach students how to replace unhealthy food with healthy food. The food was shown to the students with a picture, and they were asked to replace unhealthy food with healthy ones.

- The fourth assignment was designed to help students to find the right category of each food in the food pyramid. The student wrote down the food number based on the food pyramid's right category next to each food picture. This assignment aimed to measure the students' understanding and knowledge of food pyramid place.

Section 4. Designing a health-oriented game

This section included designing an appropriate and straightforward "road to health" game related to the contents. This section aimed to increase the students' knowledge to become more familiar with healthy and unhealthy foods and eating habits. The "road to health" game is a competitive and group game. The students could become more familiar with the concept of a healthy diet while walking in the health road. By distributing dice and game pieces among the students, they were asked to do the book assignments and play its game at the appointed time. To play the health road game, they were also recommended to play with friends at school or with their family members at home as a group game. A competition was held to ensure that the subjects play the games and fulfill the educational program assignments. After reviewing their answers and the final exam, three students from each class were awarded a reward.

On the health road, some yellow, green, and red houses were designed. Yellow houses had no remarkable score and were only for passing. Green houses had a message related to a healthy diet and had a positive score. Red houses also introduced harmful and unhealthy eating habits and food and had a negative score. The game procedure was as follows: First, the dice and game pieces with different colors were given. If the student rolls the dice with the six faces up, he/she starts the game. When he/she continues the game by rolling the dice, if he/she enters the green house (healthy eating habits), he/she goes forward one house as a reward, and if he/she enters the red house (unhealthy eating habits), he/she has to go back two houses. By applying the encouragement and punishment mechanism, the students realize the importance of consuming healthy food, avoiding unhealthy food, and enjoying playing in a competitive game. This self-directed educational program was designed so that students do not need an instructor presence, and education was done only indirectly (the researcher's presence was only to guide the students and start the learning process). In order to attract the control group's attention, a health storybook (designed by the research team) was prepared and distributed in connection with another subject and different from the experimental group.

Data analysis: The collected data were analyzed using SPSS 16 software. To describe the quantitative variables, the mean (standard deviation) was used for the sub-variables, and the mean (standard error) was used for the subscales. To describe the qualitative variables, frequency (percentage) was used. The Mann-Whitney test was used to compare the two groups' quantitative variables, the t-test or its non-parametric equivalent. The Chi-square test or Fisher's exact test was used to compare qualitative variables between the study groups. To examine the nutritional knowledge and nutritional behaviors, t-test, paired t-test, Chi-square, ANOVA, correlation, hierarchical regression, and Analysis of Covariance (ANCOVA) were used. P-value < 0.05 was considered statistically significant.

Ethical considerations: The required permissions were obtained from the authorities and written and informed consent from participants and their parents before entering the study. The participants had the right to withdraw from the

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study at any stage. The participants were also assured of the confidentiality of their answers. Ethical approval was granted from the Sabzevar University of Medical Sciences ethics committee under the code (1398.043.IR.MEDSAB.REC).

Results

One hundred twenty primary school students (60 girls and 60 boys) participated in the study. The mean age was 10.7 ± 0.69 year in the IG and was 10.77 ± 0.74 year in the CG. Also, the mean body mass index (BMI) was 17.26 ± 1.96 kg/m^2 in the IG and 17.7 ± 1.47 kg/m^2 in the CG, and no significant difference was observed between the two groups ($P > 0.05$).

Most fathers (41.70%) and mothers' (46.70%) educational level was a diploma. Most fathers (56.70%) were self-employed, and most mothers (71.65%) were housewives. According to **Table 1**, the results show that by examining the qualitative demographic variables in the IG and CG by Chi-square test and Fisher's exact test, between any of the qualitative demographic variables including age, educational level, education. There was no statistically significant difference between the parents and the occupation of the parents in the two groups ($P > 0.05$).

The results indicated no statistically significant difference between the mean scores of nutritional knowledge and nutritional behaviors between the groups ($P > 0.05$) before the intervention. However, after the intervention, there was a significant difference between the mean scores of nutritional knowledge and nutritional behaviors in the EG compared to the CG ($P < 0.05$) (**Table 2**). The mean scores of nutritional knowledge and nutritional behaviors in the EG significantly improved after the intervention ($P < 0.05$). However, some items, such as not intake of carbonated beverages and having breakfast regularly, did not change significantly ($P > 0.05$). The results show the frequency distribution of mean scores of eating habits before the educational intervention and after the educational intervention in the EG. Comparing the status of eating habits, according to the mean score before the educational intervention and after meditation, an improvement in the mean scores of the state of eating habits was observed in all evaluated cases. The results of examining the eating habits of students in the EG, before the intervention and one month after the intervention, showed that in terms of percentage, the mean score of the number of daily meals was 37.00% before the intervention and with more than 10% after the intervention. The improvement was average (47.66%). Percentage of mean score of bread and cereals group was 63.00% before the intervention which after the intervention increased by more than 13% (76.66%). The percentage of mean score of vegetables group was 28.66% before the intervention which increased to 55.66% by performing the intervention with a 27% increase in the mean score. The mean score of fruits group before the intervention was 55.66% which was evaluated after the intervention with an increase of about 14% (58.33%). The mean score of meat, legumes, and nuts group was 54.33% before the intervention which after the intervention, with about 15% increase in the mean score reached 69.00%. The mean score of milk and dairy products group before the intervention was 33.33% which after the intervention, increased by 26% (59.33%). The mean value of non-consumption of low value snacks before the intervention was 60.00% which after the intervention increased by more than 13% (83.66%). The mean percentage of non-alcoholic beverages before the intervention was 84.33% which increased by about 7% to 83.66% after the intervention. 77.66%) which was evaluated after the intervention, with an increase of 10% in the mean (87.33%). The mean percentage of non-consumption of ready meals and low-value sauces before the intervention was 68.33% which after the intervention, with an increase of more than 6%, reached to 75.00%. Regarding the percentage of mean score of daily consumption of healthy water and fluids before the intervention, it was (50.00%) which after the intervention increased by more than 10% (60.66%). The mean percentage of non-consumption of sugar and candy before the intervention was 71.66% which after the intervention, with an increase of about 11%

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reached 82.33%. The mean score of breakfast intake before the intervention was 82.66% which after the intervention increased by 4% (86.00%). The results of paired t-test for almost all items (except not drinking and regular breakfast), showed a significant improvement in the mean scores of eating habits of the EG after the intervention. Prior to the intervention, they found that it is a sign of the positive effect of the educational intervention using a self-directed educational package. Except for not consuming soft drinks and regular breakfast, no statistically significant difference was observed (**Table 3**).

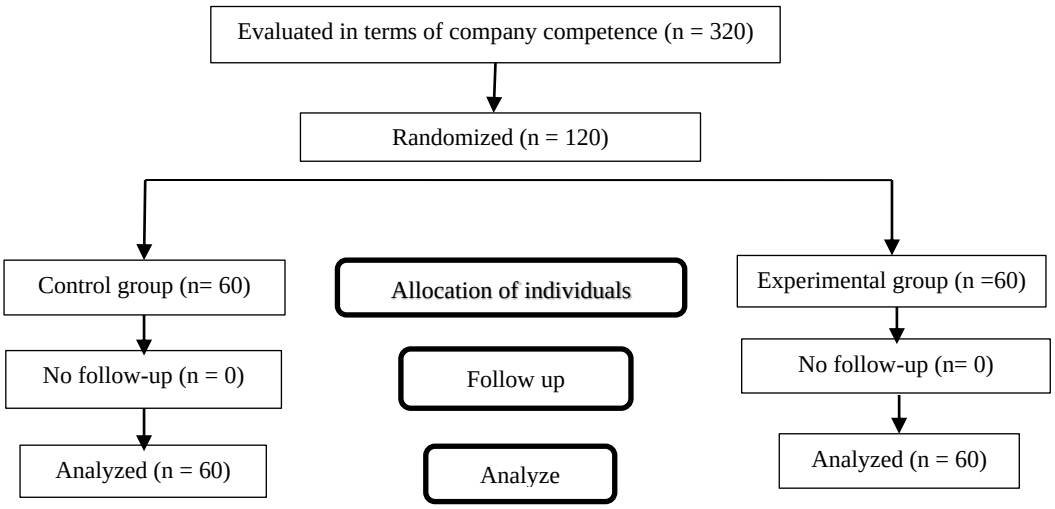


Figure 1. Study steps based on the CONSORT flow diagram.

Table 1. Comparison of the frequency distribution of qualitative demographic variables in two groups.

Variables	Intervention group		Control group		P-value[a]
	Number	Percent	Number	Percent	
Grade					< 0.001
Fourth	30	25.00	30	25.00	
Fifth	30	25.00	30	25.00	
Gender					< 0.001
Girl	30	25.00	30	25.00	
Boy	30	25.00	30	25.00	
Father's education level					0.21
Illiterate	0	0	0	0	
Elementary / Middle School	19	31.70	18	30.00	
Diploma	22	36.70	28	46.70	
M.Sc. Diploma / Bachelor	16	26.60	8	13.30	
Master's degree	3	5.00	6	10.00	
Mother's education level					0.64
Illiterate	0	0	1	1.70	
Elementary / Middle School	13	21.70	12	20.00	
Diploma	25	41.70	31	51.70	
M.Sc. Diploma / Bachelor	17	28.30	13	21.70	
Master's degree	5	8.30	3	5.00	
Father's job					0.71
Unemployed	0	0.00	0	0.00	

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Table 1. Comparison of the frequency distribution of qualitative demographic variables in two groups.

Variables	Intervention group		Control group		P-value[a]
	Number	Percent	Number	Percent	
Self-employed	43	56.70	43	56.70	
Manual worker	10	16.70	14	23.30	
Employee	14	23.30	10	16.70	
Retired	2	3.30	2	3.30	
Mother's job					0.45
Housewife	42	70.00	44	73.30	
Self-employed	8	13.30	5	8.30	
Manual worker	5	8.30	2	3.30	
Employee	5	8.30	8	13.30	
Retired	0	0.00	1	1.70	

[a]: Fisher's exact test

Table 2. The comparison of mean scores of nutritional knowledge and nutritional behaviors befor and after the intervention.

Variables	Group	Before	After	P-value[a]
Nutritional knowledge	Experimental	14.41 (0.37)[c]	18.30 (0.21)	<0.001
	Control	15.70 (0.36)	15.01 (0.28)	0.10
P-value[b]		0.02	<0.001	
Nutritional behavior	Experimental	40.25 (0.80)	50.66 (0.87)	<0.001
	Control	40.93 (0.95)	42.83 (0.91)	0.03
P-value		0.58	<0.001	

[a]: Mann-Whitney test; [b]: Independent t-test; c: mean (Standard error)

Table 3. The mean scores of eating habit status before and after the educational intervention.

Habits	Before		After		P-value[a]
	Mean (SD)	Percentage	Mean (SD)	Percentage	
Eating breakfast regularly	2.48 (0.74)	82.66	2.58 (0.74)	86.00	0.43
Not intake of sugar and candy	2.15 (0.91)	71.66	2.47 (0.65)	82.33	0.01
Daily intake of water and fluids	1.50 (0.98)	50.00	1.82 (0.89)	60.66	0.03
Not intake of low-value prepared foods	2.05 (0.62)	68.33	2.24 (0.46)	74.66	0.04
Healthy consumption of sweets	2.33 (0.85)	77.66	2.62 (0.58)	87.33	0.03
Not intake of carbonated beverages	2.53 (0.79)	84.33	2.75 (0.54)	91.66	0.07
Not intake of low-value snacks	1.80 (0.80)	60.00	2.51 (0.74)	83.66	<0.001
Intake of milk and dairy products	1.00 (0.75)	33.33	1.78 (0.64)	59.33	<0.001
Intake of meat and legumes	1.63 (0.51)	54.33	2.07 (0.42)	69.00	<0.001
Intake of fruit	1.40 (0.76)	46.66	1.75 (0.63)	58.33	<0.001
Intake of vegetables	0.86 (0.76)	28.66	1.67 (0.81)	55.66	<0.001
Intake of cereal	1.89 (0.36)	63.00	2.30 (0.36)	76.66	<0.001
Number of meals	1.11 (0.82)	37.00	1.43 (0.69)	47.66	0.03

[a]: Paired *t-test*

Discussion

The present study results revealed that educational intervention significantly improved the mean scores of nutritional knowledge and behavior in the experimental group compared to the control group. The results obtained in this study are in line

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with several other interventional studies, including studies conducted by Barati (Barati *et al.*, 2018), Ebrahimi (Ebrahimi *et al.*, 2016), and Serrano (Serrano and Karen, 2016). However, the study by Movahed (Movahed *et al.*, 2014) showed no significant difference in the mean scores of nutritional knowledge in the experimental group compared to the control group after the intervention. Movahed *et al.* used high and challenging content for their target group (Movahed *et al.*, 2014). Therefore, the significant improvement in nutritional knowledge and behavior in the present study could be attributed to easy-to-learn and understandable educational content and a self-directed educational program. Implementing an effective educational program is a necessary factor in forming a positive view of nutritional behaviors. Therefore, using convenient educational tools and engaging and age-appropriate content is a prerequisite for an educational program. In this study, the authors tried to design the educational content according to the adolescents' age and characteristics using simple, attractive, and childish language, so that students became interested and more easily learned the content of the educational program. Therefore, the educational techniques used in the present study may be adjustable to all students, particularly those who are not interested in routine educational techniques.

Furthermore, the study results showed that the educational intervention caused a significant improvement in the mean score of nutritional behaviors in the EG compared to the CG. In the control group, nutritional behaviors before the intervention (40.93 ± 0.95) had a statistically significant difference with after the intervention (42.83 ± 0.91); however, the improvement in mean scores was less than the EG. The results were in line with the other studies (Farrokhmanesh *et al.*, 2018, Shahmohammadi *et al.*, 2014). In these studies, by performing the intervention, a statistically significant difference was observed in the mean score of nutritional behaviors in the EG compared to the CG. Studies on students' nutritional behaviors have shown a low nutritional performance level in this age group. Most researchers have emphasized the need for nutrition education, especially from elementary school. Given that school age is a good time to encourage students to use healthy diets, measures are required to improve nutrition and increase nutritional security. Low level of students' nutritional behaviors is a problem with several reasons, such as unfavorable level of nutritional knowledge, inadequate economic status of families, lack of diversity and balance in the use of all food groups and the required amount of each group in the diet of families, and incorrect eating habits and incorrect dietary patterns in food selection and consumption. This issue shows the importance of providing nutrition education in this age group and in this study, healthy nutrition education using self-directed educational program, was an effective educational method to promote nutrition knowledge and improve nutritional behaviors in the subjects.

Table 3 reveals that the intervention by self-directed education improved the percentage of the mean score of all the studied eating habits in accordance with the questionnaire and based on the food pyramid in the EG. The most remarkable improvement in the food pyramid groups' mean score was the intake of vegetables (27%) and milk and dairy products (26%). Moreover, the mean score of not intake of low-value snacks (13%) and not intake of sugar and candy (11%) had the most remarkable improvement. The study results were consistent with the other studies (Lee *et al.*, 2017, Mohammadi Zeidi and Pakpour, 2013, Roozbahani *et al.*, 2021). Considering inappropriate dietary patterns of some students, they stated that it was necessary to modify dietary patterns from childhood and raise nutritional knowledge in these studies to improve self-efficacy, healthy food intake, and proper diet. However, the present study results were not in line with the study results by Khakpour (Khakpour *et al.*, 2016). They showed no significant difference in improving performance and proper nutritional behavior in the experimental group despite raising knowledge. High levels of malnutrition and inadequate dietary pattern in food

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selection and consumption, especially not having attention to intake dairy products, vegetables, and not intake of low-value snacks and sugars, are health threats and could negatively affect students' performance in their academic achievement. Therefore, paying more attention to healthy nutrition education and increasing the nutritional knowledge of students and families can improve their eating habits. The reason for the ineffectiveness of the educational intervention in the study of Khakpour *et al.* was that the knowledge factor alone was not influential, and they ignored the critical role of student's attitudes and beliefs in solving the problem of unhealthy nutrition. Khakpour *et al.* believed that changing the healthy attitude was almost impossible just by watching an educational program in a short time, in which there was no interaction between the user and the educational program (Khakpour *et al.*, 2016). Another reason was that in their study, the educational program was shown three times, and it was possible that by more repetition and knowledge, students' attitudes and behaviors could be significantly improved. This point confirms and emphasizes the importance of continuing education in interventions, especially in the age group of children and adolescents. In this study, the educational program was always available to the students and it was possible to review the content and repeat the education without the need for an instructor. Therefore, the significant improvement in nutritional behaviors of the experimental group could be due to providing appropriate access to educational resources and continuing nutritional self-directed learning by the students.

In the current study had some limitations. The data were collected using a self-report method that may lead to self-report bias. Therefore, it was tried to complete the questionnaires without haste. Interference of education or data collection times with the main course classes. To overcome this problem, it was tried to hold classes and collect data, as much as possible, at agreed times with their teachers' opinions. In measuring the demographic variables affecting the research indicators, the family income variable could not be examined due to the participants' young age.

Given that the present study was conducted on a limited population of students in Sabzevar, it is suggested that this educational program be tested in a larger population and with different cultures. Future studies can benefit from using the study procedure to design various educational programs with other health topics to promote children's nutritional health.

Conclusion

According to the results of this study and considering the low cost, availability, and effectiveness of the self-directed educational program, this effective educational method could be used in health education activities. Especially in particular circumstances (corona disease prevalence) where virtual education has replaced real education, a self-directed educational program is an appropriate solution for effective education. Finally, this study showed the effectiveness of a self-directed educational program based on poetry, game, and problem solving on promoting nutritional knowledge and its status in elementary students.

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Conflict of interest

The authors do not have any conflict of interest to declare.

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Authors' contributions

Shirin A, joveyni H, and Hashemian M designed the research; joveyni H, Hashemian M, and Rakhshani MH conducted the research;

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Rohban A, and Kooshki A analyzed the data; and Sharifi N, Shirin A, and joveyni H wrote the paper. Sharifi N, and Shirin A primary responsibility for final content. All authors read and approved the final manuscript.

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