



The Effects of a Nutritional Education Package Titled "Eat a Rainbow Every Day" on Eating Behaviors and Physical Activity of Elementary School Children

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ABSTRACT

Background: In school age children, a healthy nutritional behavior can prevent double burden of malnutrition and chronic diseases. Nutritional education has a key role in adopting a healthy lifestyle. This study aims to evaluate the effectiveness of an educational package on the nutritional knowledge and practices, physical activity (PA), and body mass index (BMI) of elementary school children in Zahedan, southeast Iran. **Methods:** In this quasi-experimental before-after study, a total of 734 elementary school children, aged 10–14 years, recruited by census sampling method completed the survey. Each student received 8 hours of training and they were provided with a booklet that included a weekly chart for recording intake of food groups and PA by students for 3 months. A semi-structured questionnaire that included questions on the students' nutritional knowledge, eating behavior, PA performance, and BMI before and after the intervention was used for data collection. Paired t-test, McNemar's, and Friedman tests were used for data analysis. **Results:** Before the intervention, the mean score of nutritional knowledge was 7.5 and the prevalence of underweight and overweight/obesity was 17.4% and 0.4%, respectively. After the intervention, the results showed a significant increase in the nutritional knowledge scores, the number of days with 30 min PA per week, and the frequency of consumption of dairy products, animal protein, and fruits. Also, in comparison with before intervention, a significant decrease was found in the prevalence of underweight and overweight/obesity of school children after the intervention. **Conclusion:** This multifaceted nutritional education intervention was associated with improved nutritional knowledge score, PA, and being underweight in elementary school children.

Keywords: Body mass index; Eating behavior; Knowledge; Physical activity; Elementary school

Introduction

Malnutrition is considered a major public health problem especially in developing

countries (Ali *et al.*, 2022). Being underweight as well as overweight and obese in childhood

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and adolescence negatively affects physical, psychological, and social health throughout life (Murtagh and Collaboration, 2017). Globally, it is estimated that 75 million girls and 117 million boys aged 5-19 years are underweight. Correspondingly, 50 million girls and 74 million boys are obese (Murtagh and Collaboration, 2017). The overall prevalence of underweight, overweight, and obesity in school children in Iran is estimated to be 6.6%, 11.9%, and 9.7%, respectively (Azizi-Soleiman *et al.*, 2020, Khashayar *et al.*, 2018). The highest rate of food insecurity in the country has been reported in Sistan and Baluchistan Province, where 21.3% and 9.6% of elementary school children suffer from underweight and overweight/obesity, respectively (Maddah *et al.*, 2010). High prevalence of underweight in elementary school children as well as an increase in the prevalence of overweight/obesity in this age group is a major public health concern (Maddah *et al.*, 2010).

Healthy nutrition has a key role in improving and maintaining health status of the individuals. In school-aged children, a healthy eating behavior not only is associated with health and growth promotion, but also may prevent childhood malnutrition and chronic diseases (Nasreddine *et al.*, 2019). Healthy nutrition is also associated with improved mental and physical ability, leading to increased self-confidence and a positive body image. Lifestyle and many core nutritional behaviors are subject to major changes during school years. Social factors, experiencing a new environment, and peer pressure can affect dietary intake of children during school years (Scaglioni *et al.*, 2018). Independence can be manifested via increasing consumption of fast food and carbonated soft drinks, decreasing vegetables and fruit consumption during the time spent out of the home or at school (FAO 2019). Due to various psychological, social, and environmental factors affecting food preferences, school-aged children are exposed to adverse health effects of malnutrition and poor eating behavior. Therefore, targeted interventions to promote healthy nutrition should be carried out early in childhood and adolescence (Wells *et al.*, 2020).

Education is an effective way to improve nutritional behavior and physical activity (PA). Education must focus on promoting children's nutritional knowledge and subsequently correcting their attitudes towards unhealthy eating behaviors (Naqibi *et al.*, 2015). The effectiveness of education on health and nutritional promotion in children has been well established in different studies (Naqibi *et al.*, 2015, Wright *et al.*, 2012). For example, the effect of nutritional education by lecture and distributing pamphlets on breakfast consumption in school-aged children, showed beneficial effects on knowledge, attitude, and performance scores in children (Naqibi *et al.*, 2015). In another study, nutrition and PA trainings along with school health program could improve nutritional behavior and it was also associated with a reduced risk of obesity in school children (Wright *et al.*, 2012).

School-based intervention to increase knowledge, attitude, and practice with a focus on reducing malnutrition are necessary for proper growth and development of school age children (Bouchard *et al.*, 2018, Hennessy *et al.*, 2019, Shapu *et al.*, 2020). The aim of this study was to evaluate the effectiveness of an educational package on the nutritional knowledge and practices, PA, and body mass index (BMI) among school age children in Zahedan, southeast of Iran.

Materials and Methods

Participants and study setting: The current quasi-experimental before-after study was conducted between September to December 2018 and included grades 5 and 6 primary school in Zahedan city, Sistan and Baluchistan Province, southeast of Iran. To calculate the sample size, a pilot study was conducted on 20 students and the standard deviation (SD) of knowledge score was used in the formula: $n = ((Z_{1-\alpha/2} + Z_{1-\beta})^2 \times \delta^2 / \Delta^2)$, where δ is the variance of knowledge score and Δ is the differences in mean score of knowledge. Given the $Z_{1-\alpha/2} = 1.96$, $Z_{1-\beta} = 0.85$ and $\Delta = 1.08$, the sample size needed for the study was estimated at 200 participants. Considering the effects of study design and sampling method, the estimated sample

size was doubled. Therefore, the final estimated sample size was 800 students (400 girls and 400 boys). The list of all elementary schools in Zahedan district was obtained from the Zahedan Department of Education. Then according to the provided information from Zahedan Health Center and definition of marginalization given by the Iranian Ministry of Health, elementary schools were divided into two categories; those located in the outskirts of the city and those located in the central part. From each category one boys' and one girls' school, in total 4 schools were randomly selected. Finally, students at grades 5 and 6 from each school were selected to participate in the study. The inclusion criteria were no existence of any acute or chronic diseases such as diabetes, cardiovascular, hepatic, and renal diseases, cancer and no adherence to a specific diet. The failure to follow the study protocol was considered for excluding the student from the study.

Ethical considerations: Ethical approval for this study was obtained from Zahedan University of Medical Sciences Ethics Committee (code IR.ZAUMS.REC.1395. 254). All participants of the study gave written informed consent.

Development of the educational package: Each student was provided with a booklet in Persian titled "Eat a Rainbow Every Day", developed based on the booklet published by Advocating the Right of Children (ARC) (Advocating the Right of Children (ARC), 2010). The booklet introduced the food pyramid and health benefits of different food groups and each food group corresponded to one color of the rainbow, encouraging children to consume each group on a daily basis. The booklet also included weekly charts for recording the daily intake of food groups and the level of PA. The booklet was divided into 4 sections and each section was taught in a 2-hour session by trained health care professionals. Also, these nutritional educational sessions were held for parents to encourage their children to observe and improve their nutritional behaviors. The topic of each educational session was presented through the lecture and discussed by questioning and answering at the end of each session.

A star chart was included in "Eat a Rainbow Everyday" booklet to be used by parents to encourage children to record their daily food group intake and PA. A color coding system was used for recording the students daily eating behavior and PA. If the student consumed a food group according to recommended daily intake, less than the recommended amount, or did not use a food group at all during the day, they were asked to paint the star of that group with a green, yellow or red pencil, respectively. In addition to food groups, if the student did not use fast foods and/or sweetened beverages, he or she was asked to paint the star of those forbidden foodstuff with a green pencil. Similarly, if the student did at least 30 minutes of PA and sports during the day, the star was painted green. The parents kept the track of their children's eating behavior and PA by counting the number of green, yellow, and red stars at the end of each week. The parents were urged to encourage their children to improve their eating behavior. This was assessed by an increase in the total number of green stars obtained during the week, according to the food pyramid recommendations, and by a decrease in the number of yellow and red stars.

Measurements: A 69-item semi-structured questionnaire was used by a team of trained health care professionals for data collection before and after intervention. The questionnaire included four sections: 1) demographic and medical information, 2) height and weight and PA measurements, 3) nutritional knowledge, and 4) eating behavior and dietary intake of participants.

The validity of the questionnaire was estimated by calculating the validity content ratio (CVR) and content validity index using the feedback from a panel of 10 experts including nutritionists, public health professionals, maternal and child health experts, and medical doctors. The questions with a CVR less than 0.62 were either modified or removed (Lawshe, 1975). The reliability of the questionnaire was evaluated by pre-tests and post-tests conducted one month apart among a sample of 35 elementary school children. An Alpha Cronbach's coefficient of 0.902 for knowledge

scores and Kuder-Richardson20 coefficient of 0.73 for other dichotomized questions established the reliability of the questionnaire.

Weight was measured to the nearest 100 g in lightly dressed and barefoot condition using a digital scale (Seca, Germany). Height was measured using a non-elastic tape. BMI was calculated as weight (kg) divided by height squared (m^2). The WHO growth charts were used to categorize the BMI into underweight BMI z-score < -2 , normal z-score ≥ -2 to < 1 , overweight BMI z-score $\geq +1$ to $< +2$, and obese BMI z-score $> +2$ (Al-Thani *et al.*, 2018).

Nutritional knowledge was assessed with 26 questions that were designed as 'Yes' or 'No' questions. Each correct answer was scored as 1, and the sum of the scores (maximum 26) was calculated as the total nutritional knowledge score.

The dietary intake of students was determined by a standard Food Frequency Questionnaire (FFQ) adapted from the Childhood and Adolescence Surveillance and Prevention of Noncommunicable disease (CASPIAN) study (Motlagh *et al.*, 2009). The duration of the intervention was 3 months. After educational sessions, at the end of each month, students were asked to bring their booklets back and their dietary and PA performance recorded in the booklets was assessed by an expert nutritionist.

Data analysis: The continuous variables were presented as mean \pm SD. Categorical variables were presented as counts and percentages. Paired t-test was used to compare the mean scores of continuous variables. McNemar's and Friedman tests were used for comparing paired categorical variables. A p-value < 0.05 was considered as significant for all analyses. SPSS version 20 statistical software package (Chicago, IL) was used for data analysis.

Results

A total of 800 elementary school children were selected in this study, out of which 734 students

including 362 (49.3%) girls, and 372 (50.7%) boys aged 10-14 years completed the study. The mean family size was 6.35 ± 2.24 . The father's and mother's education levels in 55.7% and 65.7% of participant were less than high school, respectively. Overall, 28.1% of fathers had government job, 61% were workers or self-employed, and the rest were unemployed. Also, 68.8% of mothers were housewives.

Table 1 compares the overall knowledge score, PA and eating behaviors, before and after the intervention. Statistically significant changes in knowledge scores were observed after the intervention ($P \leq 0.001$). A significant increase was also found in the number of days with at least 30 minutes of PA per week ($P < 0.001$). Regarding having meals during school days, the number of school days having breakfast, lunch, and dinner significantly increased. Similarly, the proportion of children who had breakfast and dinner on the weekends increased significantly after the intervention ($P < 0.001$).

Table 2 describes the frequency of consumption of food groups based on times per week in elementary school children before and after intervention. The consumption of dairy products, animal proteins, and fruits significantly increased. The frequency of consumption of fast foods showed a significant reduction ($P < 0.001$). No significant effect was found on the frequency of intaking grains, vegetables, salty/fatty snacks, and sweets.

The proportion of underweight in the study population decreased from 17.4% to 11.9% after the intervention. The percentage of elementary school children with a normal BMI also changed from 82.2% to 88.0% after the intervention. The fraction of overweight and obesity in the participants decreased from 0.4% to 0.1%. All differences observed in the BMI after intervention were statistically significant.

Table 1. Knowledge score, physical activity (PA), and eating behaviors in elementary school children, aged 10–14 years, before and after the intervention.

Variables	Before	After	P-value
Knowledge score	7.5±5.6 ^c	17.1±6.4	<0.001 ^a
Days with 30 min PA per week	2.6±2.0	3.4±2.2	<0.001 ^a
No. of school days having breakfast	5.9±1.9	6.1±1.8	0.009 ^a
No. of school days having lunch	6.4±1.3	6.6±1.1	0.002 ^a
No. of school days having dinner	6.3±1.4	6.6±1.1	<0.001 ^a
Having breakfast on the weekends			
Yes	651 (88.7) ^d	698 (95.1)	<0.001 ^b
No	83 (11.3)	36 (4.9)	
Having lunch on the weekends			
Yes	710 (96.7)	717 (97.7)	0.324 ^b
No	24 (3.3)	17 (2.3)	
Having dinner on the weekends			
Yes	694 (94.6)	721 (98.2)	<0.001 ^b
No	40 (5.4)	13 (1.8)	

^a: Paired *t*-test; ^b: McNemar test; ^c: Mean±SD; ^d: N(%)

Table 2. Mean (SD) of abundance of consumption (times/week) of food groups in elementary school children, aged 10–14 years, before and after intervention.

Food groups	Before	After	P-value ^a
Grains	12.93±3.60 ^b	13.12±3.35	0.268
Dairy products	4.30±2.75	4.78±2.49	0.0001
Animal protein	8.64±4.24	9.18±4.11	0.001
Plant protein	4.09±3.32	4.93±3.46	0.0001
Vegetables	3.77±2.70	3.91±2.68	0.291
Fruits (fresh, dried, juice)	5.80±3.61	6.47±3.41	0.0001
Fast foods	1.67±2.28	1.34±2.10	0.001
Salty/fatty snacks	2.73±2.81	2.65±2.87	0.520
Sweets/candies	13.00±5.70	13.01±5.74	0.970

^a: Paired *t*-test; ^b: Mean±SD

Table 3. Weight status in elementary school children aged 10–14 years, before and after the intervention.

Weight status	Before	After	P-value ^a
Underweight	128 (17.4) ^b	87 (11.9)	0.0001
Normal	603 (82.2)	646 (88.0)	
Overweight/Obese	3 (0.4)	1(0.1)	

^a: Friedman test; ^b: N(%)

Discussion

In this study, the effects of a nutritional educational intervention on the nutritional knowledge and performance, physical activity, and BMI status of elementary school children were evaluated. Results indicated that this 3-month intervention improved the nutritional knowledge

and physical performance of the participants. In line with these findings, a study conducted in Qom, Iran reported that a 3-month nutritional education program via lecture and an educational booklet improved the nutritional knowledge, attitude, and performance of junior high school students (Vahedian *et al.*, 2014). Another study showed that

two nutritional education methods (lecture with teaching aid and without teaching aid) with a focus on fast food intake among grade 5 elementary school children, increased mean score of knowledge and practice (Pourabdollah *et al.*, 2005). Other similar studies also indicated the beneficial effects of nutritional education on knowledge and attitudes of children (Hamulka *et al.*, 2018, Murimi *et al.*, 2018).

Regarding PA, the intervention improved the number of days with 30 minutes of PA. The role of PA education in improving PA level and consequently promoting health outcomes has been well established (Dudley *et al.*, 2012). Students who received PA education trainings over a six months period showed an increase in the levels of PA and the majority of subjects performed moderate and vigorous PA (Dudley *et al.*, 2012). However, PA training in high school students of deprived areas failed to reach the international recommendations after the intervention. It has been proposed that the differences in teaching method and teacher gender might affect the students' PA levels. In fact male teachers tend to teach more moderate and vigorous PAs (Sutherland *et al.*, 2016).

Meal skipping is common among children and adolescents (Azemati *et al.*, 2018). The increasing risk of chronic diseases due to meal skipping has been demonstrated in some studies (Moschiano *et al.*, 2012, Zilberter and Zilberter, 2014). In a study conducted on Iranian adolescent, the prevalence rate of breakfast, lunch, and dinner skipping was estimated 32.1%, 8.9%, and 10.9%, respectively (Kelishadi *et al.*, 2017). It was found that educational intervention could improve the number of school days having breakfast, lunch, and dinner. The intervention also improved the frequency of breakfast and dinner consumed on the weekends. A study conducted among low income adults in 14 counties of Indiana, reported that two methods of education (online and in-person education) improved most nutrition-related behaviors including breakfast consumption (Neuenschwander *et al.*, 2013). A randomized-controlled trial on 590 participants showed that nutrition education was

effective in improving breakfast-related knowledge and reducing breakfast skipping (Chaudhary *et al.*, 2016).

The findings of this study also highlighted the improving effects of the intervention on the frequency of consuming dairy product, animal and plant protein, and fruits. However, for fast food intake, an increase was observed in the consumption after the intervention. A quasi-experimental study evaluated the effectiveness of an 8-month integrated nutritional education through a peer-led approach, health promotion via school media and health clubs on dietary behaviors of 1000 school adolescents from Southwest of Ethiopia (Tamiru *et al.*, 2016). Consistent with the present study results, their findings showed improvement effects of education on animal source dietary consumption of students. In another study, dietary diversity and dietary practice of adolescent students improved after implementation of a school based nutritional education and this improvement was associated with the duration of the intervention (Tamiru *et al.*, 2016). The improving effects of a whole school nutritional education on dietary intake and attitudes of students toward fruits and vegetables have been reported in other studies (Morgan *et al.*, 2010).

The household economic status and the parents' occupation also can affect the nutritional behaviors and dietary diversity of children (Tamiru *et al.*, 2016). In the current study, parents' education and occupation were in a low status, which can result in consumption of a less diversified diet. Maternal education can affect food choices of children via shifting their attitude from unhealthy food to more healthy and nutrient-dense food (Nguyen *et al.*, 2013). Currently, most school interventions focus on preventing overweight and obesity (Abdollahi *et al.*, 2019, Niknam *et al.*, 2021), while in underprivileged areas, underweight is still a nutritional problem and the findings of this study showed that educational interventions can have a good effect on reducing the proportion of underweight school children.

The following limitations should be considered in interpreting the study findings. The duration of

this intervention was 3 months, but most studies in the field of nutritional education have indicated that longer durations of intervention can have more beneficial effects (Murimi *et al.*, 2017, Verjans-Janssen *et al.*, 2018). Therefore, conducting studies with longer duration is required to obtain more beneficial effects of nutritional education. Another limitation of the study was self-assessment conducted by students, which may lead to reporting bias. The strengths of this study included the study design (a quasi-experimental before-after study) and good compliance of the participants, using weekly schedule as a good way for recording dietary and PA of the students, and also involving parents in nutritional education and feedback.

Conclusion

This multifaceted nutrition education intervention was associated with improving the nutritional knowledge score and healthy lifestyle in elementary school children. Continued professional education and implementation of educational package to improve nutrition and health behavior in elementary school children are suggested.

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Authors' contributions

Sheikhi M and Tabatabaei SM designed and performed the study and analyses, and wrote the main paper. Eftekharinia M and Zaboli M helped performed and interpret the data. All authors read and approved the final manuscript.

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