

RESEARCH ARTICLE

Effectiveness of a nutrition education intervention using simulation videos and encouragement of parental involvement for elementary school students

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Abstract

This study aims to develop a nutrition education intervention to promote healthy eating, and to evaluate the effectiveness of this intervention on healthy eating knowledge, attitude and behaviour among elementary students. A quasi-experimental study was conducted in two elementary schools in Taiwan. The intervention course design included simulation videos, lectures, and the after-school learning worksheet designed for parental involvement. A total of 4 courses along with 4 simulation videos were given to the intervention group. The four course themes were Sugar patrol, Balanced Diet during the Mid-Autumn Festival, Rainbow Fruit and Vegetables, and Smart Dine Out. The study recruited 35 3rd grade students for the intervention group and 30 for the control group. Data were collected from the pre- and post-test questionnaires. The nutrition intervention had significant effects on improving participants' knowledge about tips for making healthy choices and the necessity of balanced diet, and on attitude toward healthy eating. There was no significant improvement in participants' healthy eating behaviours. This nutrition education intervention, which utilized simulation videos and encouraged parental involvement, could be recommended for teaching practice in elementary schools to improve healthy eating knowledge and attitude among students.

Key words: Healthy eating; Nutrition education intervention; Parental involvement; Simulation videos

Introduction

Based on the results of Nutrition and Health Surveys in Taiwan, the consumption of sugar-sweetened beverages, insufficient consumption of vegetables and fruits, and insufficient intake of dairy products among schoolchildren constitute pressing nutritional issues. Dietary intake has a profound impact on children's development and health and may further affect their health conditions in adulthood.⁽¹⁾ Imbalanced nutrition intake is considered to be closely related to childhood obesity which can lead to an increased incidence of CVD, diabetes, asthma, and sleep apnoea.^(2–6) The necessity and benefits of preventing and controlling childhood obesity has been suggested in literatures.⁽⁷⁾ A survey study in Taiwan revealed that the frequency of vegetable consumption in overweight schoolchildren was lower than that of students with normal body weight.⁽⁸⁾ Excessive consumption of sugar-sweetened beverages^(9–11) and skipping

breakfast in schoolchildren are also unhealthy lifestyles which have been linked to increased risk of obesity and CVD.^(12–14)

The school-based health interventions have demonstrated results of developing healthy behaviours among elementary students.⁽¹⁵⁾ A systematic literature review indicated that childhood obesity and subsequent health problems could be improved through nutrition education.⁽¹⁶⁾ Nutrition education courses can improve participants' nutritional knowledge and help improve badly balanced eating habits.⁽¹⁷⁾ Those with better nutritional knowledge tended to demonstrate healthy dietary behaviours, such as increased consumption of vegetables and fruits, and decreased consumption of sugar.⁽¹⁸⁾ In the childhood obesity prevention guideline compiled by the Taiwan Pediatric Association, it was strongly recommended that nutrition education be incorporated into the core curriculum of schools.⁽¹⁹⁾ Presently, nutrition-related topics are included in

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health education curriculum for schoolchildren in Taiwan. However, in practice, health education teachers in elementary schools do not necessarily have expertise in health education, and they often face challenges when guiding students in obtaining health-related knowledge and skills.⁽²⁰⁾ Consequently, elementary school children may not be able to acquire knowledge on healthy eating in schools, which may affect the development of healthy dietary behaviour.

To promote nutrition education on campus and improve the dietary habits of schoolchildren, the WHO has put forward specific teaching recommendations based on empirical research. Selected recommendations were adopted to develop intervention materials of this study: (1) Designing professional nutrition courses; (2) Parental participation; (3) Experiential learning such as cooking and food preparation activities; (4) Using media for teaching; (5) Establishing a learning community to provide resources and feedback.⁽²¹⁾ These teaching strategies should be implemented and evaluated by empirical research. Scholars have proposed the concept of parental influences on shaping the children's preferences and eating behaviours.⁽²²⁾ In addition to nutrition educators working in schools, parents may also play a similar and active role in teaching their children about nutrition.^(23–25) Increasing nutrition interventions attempted to incorporate family involvement and take-home activities to encourage good nutrition practices at home^(26,27); however, a systematic review of nutrition interventions with parental involvement showed the inconclusive effectiveness.⁽²⁸⁾ The possible explanations for the inconclusive results might be that ensuring parental involvement in school-based interventions was challenging, and the information on parental attendance was often lacking.⁽²⁹⁾ Further approaches to encourage parental engagement need to be explored and tested. The present study referred to the above recommendations, considered common dietary problems of Taiwanese schoolchildren, and designed a nutrition education course module that combined simulation teaching videos and parental involvement. Simulation is considered an effective educational technique in nursing education. Either virtual patients or scenarios are commonly created for nursing students to practice and acquire skills.^(30–32) Simulation video is also recommended as a teaching media to enhance student engagement in the learning process.⁽³³⁾ Its possible application in nutritional education should also be examined. The objective of the study was to evaluate the effectiveness of the intervention and to observe whether this curriculum could improve schoolchildren's knowledge, positive attitudes, and behavioural practices about healthy eating.

Methods

Study participants

This study adopted a quasi-experimental design. The experimental group and the control group were recruited from two elementary schools located in different districts in Taipei City in Taiwan. Study participants were third-grade students aged 9–10. The experimental group consisted of 35 students who received

nutrition education module instruction. The control group consisted of 30 students who received health courses that were not related to nutrition education (e.g. physical activity and personal hygiene) during the intervention period. Before the participants were recruited, the school teachers confirmed that neither of the two groups had taken relevant nutrition courses. This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving study participants were approved by the Tri-Service General Hospital in Taiwan (#1-106-05-065). Written informed consent was obtained from the guardians of all participants and their parents.

Course module planning and preparation

The course module consisted of four lessons of 40 minutes each, which were implemented from September to October 2018. The four lessons conducted weekly for four weeks. Course topics were formulated based on schoolchildren's nutritional issues as identified in the literature review, prior understanding of learners' needs, and taking into the consideration the folk festivals occurring during the semester. The four themes were Sugar patrol, Balanced Diet during the Mid-Autumn Festival, Rainbow Fruit and Vegetables, and Smart Dine Out. Table 1 presents details about the topic contents and course flow.

The course began with a five-minute simulation video depicting the daily life and dietary experience of a fictional character 'Student Nutritionist Mimiko', such as going to the market with family to buy groceries and hanging out with classmates for a meal in a restaurant. Teachers used these simulation videos to stimulate students' learning motivation and guide students to connect the scenario in the video with life experiences. After watching the videos, the teaching was then extended to guide students to realize the importance of healthy eating and to discuss how to implement healthy eating behaviours in daily life. Each lesson ended with a specially designed homework assignment, 'Little Nutritionist Learning Worksheet', allowing students to assume the role of nutritionists at home and fill out the worksheet with their parents, thereby extending the effectiveness of classroom learning. To encourage parental participation, the instructor prepared a 'letter to parents' before the intervention started, explaining course objectives and establishing an online communication group to provide resources and feedback.

Evaluation of intervention effectiveness

Intervention effectiveness was evaluated using a self-administered questionnaire which was compiled according to the study objectives and with reference to the questionnaires used in the Nutrition and Health Survey in Taiwan (NAHSIT) which was a series of surveys conducted by the government. The target population of the surveys included elementary school students, and the specialized questionnaires were planned.⁽³⁴⁾ A total of 43 questions were used to assess 'Healthy Eating Knowledge', including the functions of foods, nutrients and disease, nutritional contents in food, tips for making healthy food choices, the necessity of balanced diet, and the concept of healthy eating. A higher score indicates better knowledge about



Table 1. Content of the nutrition education course modules for the experimental group

Lesson topic	Learning objective	Course flow
Sugar patrol	Raising self-awareness of healthy body weight and understanding the health problems caused by foods high in sugar	<ol style="list-style-type: none"> 1. Watch a video: Student Nutritionist Mimiko's Journey Through Space and Time 2. Explain the course content and conduct prize Q&A 3. Explain the homework assignment
Balanced diet over the mid-autumn festival	Understanding the concept of food classification and balanced dietary intake	<ol style="list-style-type: none"> 1. Watch a video: Mimiko's Market Mission 2. Explain the course content and conduct prize Q&A 3. Explain the homework assignment
Rainbow fruit and vegetables	Knowing the recommended amount of fruit and vegetables the schoolchildren need.	<ol style="list-style-type: none"> 1. Watch a video: Mimiko's Dinner Table Password 2. Explain the course content and conduct prize Q&A 3. Explain the homework assignment
Smart dine out	Choosing healthy meals when dining out	<ol style="list-style-type: none"> 1. Watch a video: Mimiko's Gathering with Her Classmates 2. Explain the course content and conduct prize Q&A 3. Explain the homework assignment

healthy eating (Cronbach $\alpha = 0.72$). Fifteen questions were used to assess 'Healthy Eating Attitudes', referring to the attitude towards making healthy eating choices. A five-point scale was used for scoring, with a higher score indicating a more positive attitude towards healthy eating (Cronbach $\alpha = 0.68$). Finally, 16 questions were used to evaluate 'Healthy Eating Behaviour', concerning the recommended daily intake of six food groups, healthy breakfast intake, sugar-sweetened beverage consumption, fried food consumption, and low-nutrient-density food consumption. A higher score in this question set indicated a better implementation of healthy eating behaviours (Cronbach $\alpha = 0.63$).

Data collection and statistical analysis

Both the experimental group and the control group took a questionnaire survey before and after the nutrition education course. The collected data were analysed using SPSS 23 (SPSS, IBM, Armonk, NY). Generalized Estimating Equations (GEE) were used to assess the effectiveness of curriculum intervention on healthy eating knowledge, attitude, and behaviour. The GEE method can be used to analyse repeated measures with non-normal response variables, and it can take into account the correlation of within-subject data.

Results

The pre- and post-test questionnaires

All the participants of two groups completed the intervention and the pre- and post-test questionnaires. There were no statistically significant differences between the experimental and control groups in terms of gender distribution, self-perceived body size satisfaction, and BMI (Table 2). The two-sample *t*-test showed that there was also no significant difference in the pre-test scores of healthy eating knowledge, attitude, and behaviour between the two groups (Table 3). The results of the GEE analysis showed that the intervention had no significant effect on the mean overall score for healthy eating knowledge ($\beta = 2.452$, $P = 0.147$). However, there was a significant improvement in 'tips for making healthy choices' and 'the necessity of balanced diet' after intervention ($\beta = 0.81$, $P = 0.06$; $\beta = 1.257$, $P = 0.007$) (Table 4). The intervention also had a significant effect on the attitude towards healthy eating ($\beta = 4.705$, $P = 0.048$) (Table 5), but not on healthy eating behaviour (Table 6).

After-school learning worksheets and online group interactions

Besides questionnaire data, the review of after-school learning worksheets showed that those distributed in the first lesson had the highest completion rate, with 34 copies returned. As the course progressed, only 28 worksheets filled out fully by both parents and students and signed by parents were returned for the fourth lesson. In addition, the online group interactions among parents and intervention instructor were limited. During the intervention process, only four parents frequently and consecutively interacted in the online group to discuss the course content and after-school learning worksheets.

Discussion

The features of this intervention study were to utilize simulation videos as the primary teaching medium in designing the curriculum and to use after-school learning worksheets as assignments to encourage parental involvement. The intervention helped participants make significant improvements in their scores on the knowledge and attitude question sets, which could be attributed to the use of simulation videos in the curriculum which raised participants' learning motives and concentration. However, there was no significant change in participants' healthy eating behaviour. Changes in nutrition behaviours might not be observed after a short-term intervention, which emphasizes the need to conduct long-term interventions measuring effects on nutrition behaviour outcomes.⁽²⁰⁾ Besides, although previous studies suggested that parental involvement and take-home activities should be effective strategies to help children develop healthy eating practices,^(21,26) it was observed in the present study that the level of parental involvement was unable to sustained during the entire intervention, which might be associated to the unsatisfied outcomes in changing schoolchildren's eating behaviour.

**Table 2.** Study participant characteristics, BMI, and pre-test scores

Variable	Experimental group (n = 35)		Control group (n = 30)		P value	
	n	%	n	%		
Gender					0.900	
	Male	11	31.4	9	30	
	Female	24	68.6	21	70	
Semester grade					0.909	
	A or A+	18	51.4	15	50	
	Below A	17	48.6	15	50	
Satisfaction with body size					0.128	
	Satisfied	11	31.4	15	50	
	Dissatisfied	24	68.6	15	50	
BMI(kg/m ²)		Mean	Standard deviation	Mean	Standard deviation	
	Boys	16.2	2.8	16.9	3.0	0.393
	Girls	16.0	3.0	17.4	3.2	0.147

Table 3. Mean scores of healthy eating knowledge, attitude and behaviour before and after the intervention

Variable	Experimental group (n = 35)		Control group (n = 30)		P value ^a
	pre-test	post-test	pre-test	post-test	
Mean overall knowledge score	32.1 ± 5.1	33.5 ± 5.8	29.6 ± 7.4	27 ± 7.6	0.109
Function of foods	3.2 ± 1.0	3.5 ± 1.1	2.6 ± 1.5	2.3 ± 1.4	
Nutrients and disease	3.5 ± 1.2	3.7 ± 1.4	2.7 ± 1.4	2.5 ± 1.5	
Nutritional contents in food	10.1 ± 2.0	9.6 ± 2.7	9.3 ± 3.6	7.6 ± 2.9	
Tips for making healthy food choices	4.6 ± 1.5	4.9 ± 1.4	4.7 ± 1.6	4.2 ± 1.4	
Necessity of balanced diet	5.1 ± 1.4	6.5 ± 1.5	5.6 ± 1.3	5.8 ± 1.5	
Concept of healthy eating	5.7 ± 0.5	5.4 ± 1.7	4.63 ± 1.4	4.56 ± 1.5	
Mean attitude score	61.3 ± 13.2	65.5 ± 8.2	61.8 ± 6.8	61.3 ± 11.6	0.839
Mean behaviour score	34.7 ± 3.4	35.0 ± 3.7	33.4 ± 3.1	33.2 ± 3.0	0.687

^aComparison of pre-test scores between the two groups using the two-sample *t*-test.

Simulation video has been widely used in nursing education because of its advantages in creating real-life situations for students to engage in the learning process.^(35,36) This study extended its application to nutrition education for elementary students, and found its effectiveness in improving participants' knowledge and attitude regarding healthy eating. In order to motivate participants' learning interests and guide them to reflect real-life experiences, the short simulation videos showed the daily life of a fictional character who is at the same age as the study participants. Participants watched the simulation video and learned how the fictional character completed various dietary-related missions. After watching the video, participants were asked to imitate the fictional character's missions and complete homework assignments. The use of simulation videos allows for the demonstrations of situations that learners are yet to experience and provides them with a contextualized opportunity for learning.⁽³⁷⁾

Based on observing students' reactions in class and analysing the learning worksheets, it was found that some students and parents had difficulties in grasping numerical concepts such as the daily 'recommended upper limit of added sugar' and 'calories contained in snacks'. Teaching nutritional knowledge often involves computational skills. For future intervention material design, it is suggested that numerical concepts be

translated into specific food types and servings to facilitate comprehension. For example, if a schoolchild eats one slice of red bean bread for breakfast, sugar-free beverages shall be recommended when choosing paired drinks. Additionally, instructors might illustrate the abstract concept by analogy with concrete cases, for example, by using the traffic light system to help students identify foods with high energy density and learn to be cautious about intaking these foods.

Several limitations of this study and suggestions for future research are addressed. This intervention was implemented for small sample size. In terms of implementation process, an issue should be mentioned was about the imperfect completion of 'Little Nutritionist' after-school learning worksheets designed to increase parental involvement. The worksheets were designed to be completed by children and parents jointly, but the handwriting on some returned worksheets appeared to be completed by children alone. Future intervention should consider improving the after-school worksheet design or planning other parents-child activities to encourage parental engagement. Moreover, the intervention period coincided with the Mid-Autumn Festival in Taiwan, and the topic of choosing healthy festival foods was purposely integrated into the curriculum to conform participants' real-life experience. However, during actual implementation, it was found that schoolchildren's dietary

**Table 4.** GEE analysis results of the effectiveness of nutrition education intervention on healthy eating knowledge

Variable		β	SE	P
Overall score	Intercept	29.567	1.3364	0.000
	Group	2.548	1.5839	0.108
	Pre- and post-test	-2.567	1.2389	0.038
	Pre- and post-test \times Group	2.452	1.6912	0.147
Functions of foods	Intercept	3.000	0.4738	0.000
	Group	-0.086	0.5741	0.881
	Pre- and post-test	-0.367	0.2728	0.811
	Pre- and post-test \times Group	0.652	0.3384	0.054
Nutrients and disease	Intercept	2.933	0.4495	0.000
	Group	0.381	0.6028	0.527
	Pre- and post-test	-0.200	0.2724	1.000
	Pre- and post-test \times Group	0.400	0.3731	0.284
Nutritional contents in food	Intercept	10.967	1.1338	0.000
	Group	-0.395	1.3599	0.771
	Pre- and post-test	-1.667	0.5988	0.007
	Pre- and post-test \times Group	1.181	0.7959	0.138
Tips for making healthy food choices	Intercept	5.167	0.4271	0.000
	Group	-0.938	0.5811	0.106
	Pre- and post-test	-0.467	0.2094	0.673
	Pre- and post-test \times Group	0.810	0.2936	0.006
Necessity of balanced diet	Intercept	5.367	0.5153	0.000
	Group	-1.738	0.7236	0.016
	Pre- and post-test	0.200	0.3347	0.000
	Pre- and post-test \times Group	1.257	0.4641	0.007
Concept of healthy eating	Intercept	4.700	0.5167	0.000
	Group	1.243	0.5503	0.024
	Pre- and post-test	-0.067	0.3298	0.333
	Pre- and post-test \times Group	-0.219	0.3640	0.547

Note: $Y = \beta_0 + \beta_1$ (pre- and post-test) + β_2 (group) + β_3 (pre- and post-test \times group); Pre- and post-test: post-test = 1, pre-test = 0, Group: experimental group = 1, control group = 0.

Table 5. GEE analysis of the effectiveness of nutrition education intervention on healthy eating attitude

Variable		β	SE	P
Healthy eating attitude	Intercept	61.833	1.2303	0.000
	Group	-0.548	2.5203	0.828
	Pre- and post-test	-0.533	1.9042	0.770
	Pre- and post-test \times Group	4.705	2.3834	0.048

Note: $Y = \beta_0 + \beta_1$ (pre- and post-test) + β_2 (group) + β_3 (pre- and post-test \times group); pre- and post-test: post-test = 1, pre-test = 0, group: experimental group = 1, control group = 0.

Table 6. GEE Analysis of the effectiveness of nutrition education intervention on healthy eating behaviour

Variable		β	SE	P
Healthy eating behaviour	Intercept	33.367	0.5587	0.000
	Group	1.376	0.7955	0.084
	Pre- and post-test	-0.167	0.1639	0.309
	Pre- and post-test \times Group	0.424	0.7579	0.576

Note: $Y = \beta_0 + \beta_1$ (pre- and post-test) + β_2 (group) + β_3 (pre- and post-test \times group); Pre- and post-test: post-test = 1, pre-test = 0, Group: experimental group = 1, control group = 0.

preferences in cultural festivals tend to be shaped by sociocultural environment, rather than being easily altered through a short-term intervention. Furthermore, peer influences on schoolchildren's eating behaviours were not included in this intervention. Peer effects on children's eating behaviour were observed to link with the consumption of energy-dense and low-nutrition value foods,^(38,39) which should be taken into account in future nutrition interventions for schoolchildren.

Abbreviations

GEE: Generalized Estimating Equations

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Conflict of interest

None.

Authorship

SR and YC designed the study, and SR implemented the intervention. Both SR and YC contributed to data analysis and manuscript writing. Both authors read and approved the final manuscript.

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