Research article

Nutrition teaching model, "Good Nutrition - Key to Healthy Children", to improve knowledge among primary school students

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ABSTRACT

Thailand is experiencing double burden malnutrition. Improving nutrition knowledge in schools using a nutrition teaching model can potentially lead to healthier attitudes and behaviors among students. This study's objective was to test the effectiveness of the nutrition teaching model "Good Nutrition – Key to Healthy Children" for Grade 3 students in improving their nutrition knowledge. Assigned teachers from 2 public schools in peri-urban areas of Bangkok were trained using printed teaching materials during school breaks. At the beginning of the semester, Grade 3 students took a knowledge pre-test before starting the first topic. Thereafter, the trained teachers conducted the nutrition lessons according to the nutrition teaching model. After the last topic (5 and 8 months after the first topic for School 1 and School 2, respectively), students took a knowledge post-test. Results showed that the mean knowledge scores of 283 students from both schools increased significantly compared to pre-test scores (14.32±3.51 vs 13.14±3.06; $p<0.001$). Students also had significantly higher mean scores in 4 out of 8 topics ($p<0.01$), which indicates improved student knowledge. This study's results suggest advantages in using this nutrition teaching model to improve students' nutrition knowledge.

Keywords: nutrition, teaching model, primary school students

Received: 8 July 2022 Accepted: 1 December 2022 Available online: 5 December 2022

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บทความวิจัย

การใช้ชุดการเรียนการสอนโภชนาการ Good Nutrition - Key to Healthy Children เพื่อพัฒนาความรู้ของนักเรียนชั้นประถมศึกษา

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บทคัดย่อ

ประเทศไทยเผชิญกับปัญหาทั้งด้านภาวะโภชนาการเกินและภาวะขาดอาหาร การเพิ่มความรู้ด้านโภชนาการโดยใช้ชุดการเรียนการสอนโภชนาการน่าจะนำไปสู่พฤติกรรมด้านโภชนาการที่ดีขึ้น วัตถุประสงค์ของงานวิจัยนี้เพื่อทดสอบประสิทธิภาพของชุดการเรียนการสอนโภชนาการสำหรับเด็กชั้นประถมศึกษาปีที่ 3 ต่อการเพิ่มความรู้ด้านโภชนาการ ขั้นตอนการวิจัยประกอบด้วยการอบรมครูที่ได้รับมอบหมายจากโรงเรียนรัฐบาลที่เข้าร่วมงานวิจัยจำนวน 2 แห่งในเขตชานเมืองกรุงเทพฯ โดยใช้ชุดการเรียนการสอนโภชนาการ เป็นการอบรมช่วงปิดภาคเรียน เมื่อเปิดภาคเรียน นักเรียนทำแบบทดสอบความรู้ด้านโภชนาการก่อนเริ่มเรียนหัวข้อที่ 1 หลังจากนั้น ครูที่ผ่านการอบรมแล้วนำชุดการเรียนการสอนไปใช้สอนนักเรียน หลังการเรียนการสอนหัวข้อสุดท้าย (หัวข้อที่ 9) นักเรียนได้ทำแบบทดสอบความรู้ด้านโภชนาการอีกครั้ง (หลังจากเริ่มหัวข้อที่ 1 ไปแล้ว 5 และ 8 เดือน สำหรับโรงเรียนที่ 1 และ 2 ตามลำดับ) ผลการวิจัยพบว่า คะแนนความรู้เฉลี่ยของนักเรียนจำนวน 283 คนจากทั้ง 2 โรงเรียนเพิ่มขึ้นหลังจากการเรียนโดยใช้ชุดการเรียนการสอนโภชนาการ เมื่อเปรียบเทียบกับก่อนเรียน (14.32±3.51 กับ 13.14±3.06; $p<0.001$) และยังพบว่า นักเรียนได้รับคะแนนเฉลี่ยดีขึ้นใน 4 จาก 8 หัวข้อ ($p<0.01$) แสดงให้เห็นถึงความรู้ที่มากขึ้น กล่าวโดยสรุป งานวิจัยนี้แสดงให้เห็นว่า การใช้ชุดการเรียนการสอนโภชนาการมีประโยชน์ในการเพิ่มความรู้ด้านโภชนาการของนักเรียน

คำสำคัญ: โภชนาการ, ชุดการเรียนการสอน, นักเรียนชั้นประถมศึกษา

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Introduction

The prevalence of overweight and obesity among children is increasing worldwide. The prevalence of obesity rose from less than 1% (5 million girls and 6 million boys) in 1975 to nearly 6% in girls (50 million) and 8% in boys (74 million) by 2016[1]. In 2018, the World Health Organization (WHO) reported that the rates of childhood and adolescent obesity had recently accelerated in low- and middle-income countries, especially in Asia[2]. In Thailand, data from the Department of Health, Ministry of Public Health, collected from children and adolescents aged 5-14 years, showed that the prevalence of overweight and obesity in children and adolescents was 8.9% in 2013 and increased to 12.9% by 2016[3]. A study conducted in peri-urban areas of Bangkok showed a gradual increase in the prevalence of overnutrition and undernutrition in school children over the years[4]. False or lack of knowledge can lead to unawareness of the importance of health care and the onset of diseases[5]. Practical knowledge and a positive attitude toward good nutrition can help promote healthy eating and increase physically activity[6,7]. A study from Thailand tested a program on food behavior and physical activity promotion in a primary school. The results showed positive improvements in self-efficacy, outcome expectation, and consumption, as well as physical activity behaviors[8]. Furthermore, an innovative communication study targeting overweight older primary school students also showed that students had higher scores in nutrition knowledge, attitudes, and practices after an intervention using short message service (SMS)[9]. Consequently, the "Good Nutrition - Key to Healthy Children" model program was created as a tool to encourage and help teachers teach child nutrition content. This study's objective was to determine the efficacy of this nutrition teaching model to improve the nutrition knowledge of Grade 3 students.

Materials and Methods

This study was approved by the Ethical Clearance Committee on Human Rights Related to Research Involving Human Subjects, Faculty of Medicine Ramathibodi Hospital, Mahidol University (Approval No. 10-61-64). It was a quasi-experimental study conducted from October 2018 to February 2020. The study was conducted in two selected public primary schools in peri-urban areas of Bangkok that had never been exposed to any nutrition promotion program using a nutrition teaching model in the past five years.

Subjects

Sample size calculation was based on the study by Shah et al. (2010)[10] using knowledge scores of students before and after the intervention. Assuming an approximate 10% loss to follow-up, the sample size was at least 118 students with an alpha of 0.05 and power of 90% to detect a significant difference when comparing pre- to post-intervention mean scores of 13.4 for pre-test and 16.2 for post-test. The characteristics of schools, teachers, students, and their parents were collected at the beginning of the study. Characteristics of the teachers were identified using questionnaires before the start of the training session. Teachers who participated in the study were Thai nationals, aged 24-45 years, with at least a Bachelor's degree in Education, and at least two years of responsibility for teaching nutrition, health education, physical education, or

related subjects. Grade 3 students were aged 8-9 years and had no chronic illness, vision, hearing, physical disability, or learning disorders. Parents of the Grade 3 students who participated in this study had moderate Thai literacy levels. Grade 3 students whose parents did not give consent to join the study were excluded. Classes were held as part of the Health Education curriculum, so all of the students attended these classes. For students whose parents did not approve of the research, data from those students were not collected and, therefore, not included in this study. Students were interviewed by a researcher using questionnaires. For parents, questionnaires were delivered and returned to the researcher *via* students. All participants (teachers, students, and parents) gave informed consent to participate in this study. For students aged below 18 years, informed consent forms were attached with details about the research including objectives, methods, and contact information for the researchers. The forms were read, understood, signed by the parents, and returned to the researchers.

Intervention

All teaching learning materials were created in English by the Southeast Asia Public Health Nutrition (SEA-PHN) Network and were especially designed for Grade 3 students. The teaching-learning materials included a teacher's teaching guide, teaching slides (PowerPoint), a student's workbook, a parent's leaflet, and interactive activities. All of the questionnaires, the knowledge test for students, and feedback forms were developed by SEA-PHN. For Thai students, the teaching-learning materials, questionnaires, the knowledge test, and feedback forms were translated into Thai, and customized by researchers. Thai media were printed in three draft copies, sent to be validated by three nutrition experts, and edited as suggested by the researchers. The validated materials were printed in hard copies with an adequate amount for all participants.

The contents of each topic were as follows:

Topic 1 (the healthy way of eating: from pyramid to plate): the importance of healthy diet, introduction to Thai Nutrition Flag and its use, the importance of each food groups, 2-1-1 Healthy Plate, examples of healthy meals

Topic 2 (be active, be healthy): introduction to Thai Physical Activity Pyramid, examples and recommended frequency of each type of exercises and physical activity, examples of sedentary activities, advantages of regular physical activity, the results of excessive energy intake

Topic 3 (cereals, cereal products and tuber for energy): examples of cereal food group, the importance of the nutrients from this food group, comparing the benefits from fiber contents of each type of cereals and its products, recommended frequency and portion

Topic 4 (veggies and fruits for health): examples of vegetables and fruits, the importance of the vitamins and minerals, symptoms of vitamin deficiencies, recommended frequency and portion

Topic 5 (protein foods make you grow stronger): examples of animal-based and plant-based protein, the importance of protein foods, symptoms of calcium and iron deficiencies, recommended frequency and portion

Topic 6 (limit fats, sugar and salt for health): examples of foods containing high fat, sugar and sodium, the roles of fats, sugar and salt, the effects of excessive fat, sugar, and salt consumption

Topic 7 (choose safe and healthy foods especially when eating out): definition and importance of food hygiene, determination steps for safe and healthy food, examples of options of healthier food when eating out

Topic 8 (Use food labels for healthier food choices): introduction of each part of food label including brand name, food name, FDA mark, net weight or volume, manufacturing and expiry date, ingredient list, nutrition facts label, manufacturer's information, Healthier Choice logo and its meaning

Topic 9 (review: eat smart and be active): a review of topic 1 to topic 8 in brief

A one-day "Training-of-Trainers" workshop was held for assigned teachers from the two schools. Nine topics were then taught sequentially by trained teachers in their schools. Each topic was taught within 1-2 weeks after the previous topic. The class for each topic took 30-45 minutes. A researcher observed every class and assisted in some classroom activities. Leaflets with brief contents of what the students had learned in the class were sent to parents by corresponding students. Information was also collected on food and drinks served or sold in schools while conducting the intervention.—Students took a knowledge test about nutrition and physical activity twice during the study period. A pre-test was performed before learning topic 1 of the nutrition teaching model, and each question was read loudly and clearly for students to prevent misreading. The second testing time, as a post-test, was done after finishing topic 9 (review of the previous 8 topics). The knowledge test was divided into eight topics with three questions related to the relevant contents of each topic, and there were four choices for each question. Each correct answer received 1 point for a total score of 24 points. For the analysis of correctness of answers for each topic, every 3 points were transformed into 1 point per topic. Feedback forms for teachers, students, and parents were also used. After finishing topic 9, teachers and students evaluated the nutrition teaching model in terms of overall feedback by filling in feedback forms for teachers and students, respectively. Parents filled out feedback forms to evaluate the program and leaflets, which were then returned to the researcher by the students.

Statistical analysis

Statistical analysis was performed using SPSS version 18 for Windows. General information and student knowledge scores were shown as mean and standard deviation. Categorical variables were reported as frequency and percentages. Differences in student knowledge scores were compared using the paired Student *t*-test. As appropriate, continuous variables were tested for normality using the Kolmogorov-Smirnov and Shapiro-Wilk tests.

Results

Participant characteristics

The study began in October 2018 in two public schools in peri-urban areas of Bangkok. Teachers from the schools had participated in the "Training-of-Trainers" workshop. However, one

school (School X) dropped out of the study soon after the beginning due to internal difficulties. The first school (School 1) study ended in March 2019. After the first school was finished, another school (School 2) was recruited. The program in School 2 began in June 2019 and ended in February 2020. Schools 1 and 2 contained 194 and 89 students, respectively. The average age of the students was 8.9 ± 0.47 years. The percentage of boys and girls were 53% and 47% in School 1 and School 2. A total of 16 teachers from the three schools attended the workshops; six teachers from School 1 (37.5%), nine teachers from School X (56.3%), and one teacher from School 2. The average age of teachers who participated in the "Training-of-Trainers" workshop was 45.0 ± 11.2 years, with an average teaching experience of 16.7 ± 10.2 years. Although 16 teachers were trained in the workshop, the nutrition teaching model was utilized by only three teachers from 2 schools (2 teachers from School 1 and 1 teacher from School 2). There were only 2 out of 5 classrooms in School 1 that had projectors and computers. There was no electronic teaching equipment in School 2.

Knowledge test

The mean knowledge scores of 283 students from the pre-test and post-test are shown in **Table 1**. Twenty-one and thirty-two students were absent on the day of the pre-test and post-test, respectively. The Normality test was performed, and knowledge scores were compared between the pre-test and post-test using the paired *t*-test, which showed a significant improvement in nutrition knowledge among 232 students (p<0.001). When analyzed separately, the mean scores from School 1 showed a slight increase from 14.06 in pre-test to 14.61 in post-test (p=0.043). However, School 2 showed a remarkable increase from 11.23 in pre-test to 14.30 in post-test (p<0.001). In analyzing the correctness of answers for each topic, 3 points from each question in a topic were transformed into 1 point per topic, as shown in **Table 2**. The differences in mean scores for each topic between the pre- and post-tests were statistically significant in 4 out of 8 topics. However, the mean topic score in Topic 5 slightly decreased. The contents that the students did not understand well were reflected with the analysis of their answers to each knowledge question. The knowledge of each topic that was not improved statistically (expressed in percentages of students answering correctly in pre-test and post-test, respectively) was as follows:

Topic 2: knowing the result of excessive energy intake (45.2, 51.0), and knowing the frequency of being physically active (66.4, 58.2)

Topic 5: identifying the example of food that contains protein (36.3, 31.2), knowing the consequence of iron deficiency (29.0, 22.4), and knowing the importance of foods rich in calcium (60.2, 59.6)

Topic 6: identifying food with high sugar content (87.8, 90.8), select type of food that should be limited as it is high in fat (74.7, 83.7), and results of consuming too much fat and sugar (90.1, 88.0).

Table 1. Knowledge scores of students participating in this study

Test	Scores*				
	Mean	Median	S.D.	Min	Max
Pre-test (n=262)	13.14	13.00	3.06	5	21
Post-test (n=228)	14.32	14.00	3.51	5	24

S.D., standard deviation, * The total score is 24.

Table 2. Mean scores of each topic from participating students in two schools

Topic	Pre-test		Post-test		p-value*
	N	Mean± SD	N	Mean± SD	
1: The healthy way of eating: from pyramid to plate	262	0.53±0.27	250	0.60±0.27	0.002
2: Be Active, be Healthy	232	0.62±0.31	232	0.65±0.29	0.181
3: Cereals, cereal products & tubers for energy	232	0.36±0.32	232	0.55±0.30	<0.001
4: Veggies & fruits for health	231	0.54±0.26	231	0.66±0.26	<0.001
5: Protein foods make you grow stronger	232	0.41±0.33	232	0.38±0.30	0.232
6: Limit fats, sugar & salt for health	232	0.86±0.22	232	0.89±0.22	0.196
7: Choose safe and healthy foods, especially when eating out	232	0.76±0.26	232	0.76±0.26	0.002
8: Use food labels for healthier food choices	232	0.31±0.29	232	0.32±0.31	0.739

* statistically significant (statistical analysis using paired t-test)

Topic 8: knowing which part of food label explains the list of nutrients contained in a food (22.6, 27.2), selecting the term that is not used to represent date marking (41.4, 37.2), and selecting what is not related to the 'list of ingredients' (32.6, 31.2). Students were scheduled to learn each topic within 1-2 weeks after the previous topic. However, students from School 1 were taught all of the topics within nine weeks, while School 2 took 18 weeks to finish all of the lessons, which was a longer duration than the schedule due to the teacher's heavy workload, school activities, and a school break.

Feedback on the nutrition teaching model "Good Nutrition – Key to Healthy Children"

All teachers agreed that the contents of the lessons in the module were appropriate for Grade 3 students. However, the allocated time of 45-60 minutes per lesson to cover a topic was too long. The interactive games as part of the teaching were useful. Nevertheless, there were some challenges in using the module, such as difficulty finding time to conduct the lessons because of heavy workload (**Figure 1**).

Feedback from 283 students was collected using questions with a visual facial scale. Most students (61.3%) found the nutrition lessons easy

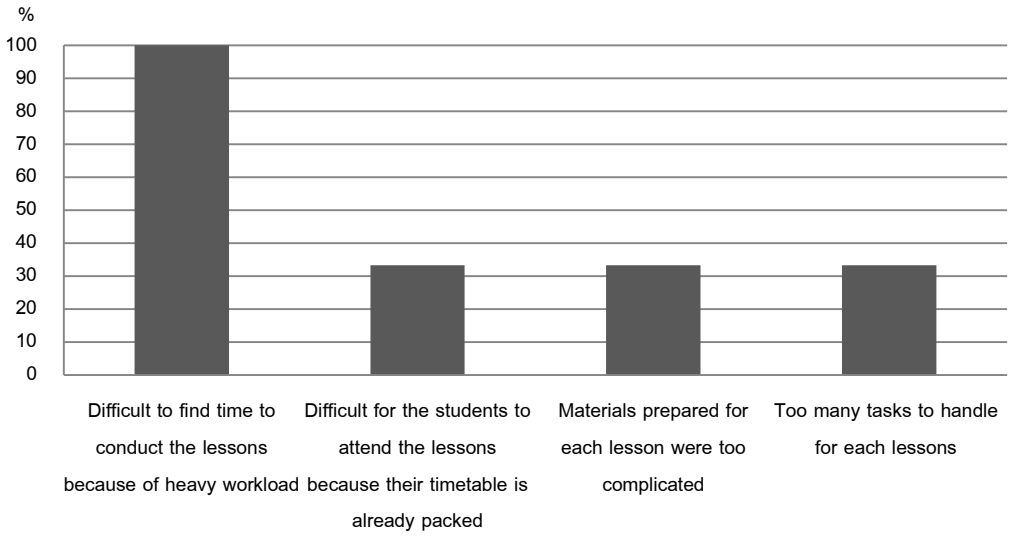

Figure 1. Teachers' feedback on challenges when using the nutrition teaching module (n=3)

to understand. Moreover, most students (80.4%) enjoyed the interactive games. After learning about nutrition from the module, most students (64.4%) sometimes practiced what they learned daily. Feedback from students also revealed that less than 50% of the students gave all of the nutrition leaflets to their parents, while 38% gave some of them. As leaflets were sent to their parents, 75.2% of the students said that their parents had discussed the leaflets with them.

Feedback from 136 parents showed that most parents observed more frequent talking (more than 80%) about nutrition and healthy eating. Of 120 parents (75.9%) that responded to this question, the leaflets were read by more than 70% of the parents. Most parents (52.1%) thought that all the leaflets were easy to understand. Knowledge from the leaflets was advantageous for parents as 53% practiced what they had learned.

School lunch and food shops

In both schools, lunch was provided by the school for all students on every school day, and students could refill their plates with any food available. Desserts containing high fat and high sugar were also served after the main meals, alternating with seasonal fruits. There were also mobile food shops at the front of one of the schools, while mobile food shops were not allowed at the other school. Many snacks, foods, and drinks were sold around or at exits from the schools, such as deep-fried foods, cordial drinks, and carbonated drinks. Fruits were sold occasionally but were not very popular among students.

Discussion

The present study, using the nutrition teaching model "Good Nutrition - Key to Healthy Children", showed significant improvement in student nutrition knowledge. The result of the present study was in agreement with previous studies by Deelert et al.[9] and Boonju et al.[11], which

reported improvements in student knowledge after implementing educational programs. The contents used in this program were similar to the Health Education curriculum for Grade 3 students in Thailand including significance of each food group and choosing healthy meals. Differences from the regular curriculum included that this nutrition teaching model consisted of activities that helped students learn more easily and was more suitable for students' understanding. The students showed no significant improvement in nutrition knowledge for some topics, possibly because the contents were difficult for the students to understand and remember. However, improvement in total mean scores using interactive games in the present study agreed with a study by Munoz et al[12]. Several factors affected the students' learning, including the environment surrounding the classrooms, teachers' teaching skills, teachers' knowledge, and student readiness to learn. Teachers had difficulty conducting activities and lessons because they had to prepare several teaching materials. Noises from outside surroundings could cause difficulties for teachers to communicate with the students as the classrooms were open-aired. Moreover, teachers who showed more enthusiasm in the classrooms created a more interactive learning environment, and students better understood the information they were given. Students should also be ready to learn to absorb new information; however, some students did not bring their workbooks. Consequently, those students had difficulties in catching up with what the teachers were teaching, since most classrooms did not have computers and projectors. This study also had some biases. Firstly, participants were aware they were being monitored for research purposes. Hence, they might not have acted naturally. Secondly, there was no control group. The results of this study can be confirmed by having control groups to ensure that students gain knowledge after using this nutrition teaching model. The present study, "Good Nutrition - Key to Healthy Children", helped improve nutrition knowledge, especially for Grade 3 students. However, some modifications of this module might be needed to improve the attitudes and practices of the students and to make classroom conduct for teachers more explicit, so that the nutrition teaching model can be executed in other public primary schools to promote school nutrition more widely throughout the country.

Conclusion

This study led to an improvement in student knowledge after the completion of the nutrition teaching model "Good Nutrition - Key to Healthy Children", as well as improved student understanding of nutrition. Feedback from teachers noted that the content of the lessons was appropriate for students and relatively easy for Grade 3 students to understand. Most students enjoyed the program and interactive games, while parents observed their children's improvements and thought the leaflets were useful. This study showed some advantages in using this nutrition teaching model to improve student nutrition knowledge. This nutrition teaching model was moderately satisfying for the users. All of the feedback noted that there was room to improve this nutrition teaching model to make it more effective, more interesting, more accessible for teachers to use, more manageable for the

students to understand, and more available to parents.

Acknowledgement

We thank the Southeast Asia Public Health Nutrition (SEA-PHN) Network for providing the original nutrition teaching module and funds. We are grateful to all teachers, students, and their parents who participated in this study and the principals of both schools.

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