



Centers for Disease  
Control & Prevention  
Republic of Korea

## ORIGINAL ARTICLE

# Development of a Food Safety and Nutrition Education Program for Adolescents by Applying Social Cognitive Theory

Jounghee Lee<sup>a,\*</sup>, Soyeon Jeong<sup>b</sup>, Gyeongah Ko<sup>c</sup>, Hyunshin Park<sup>d</sup>,  
Youngsook Ko<sup>a</sup>

<sup>a</sup>Department of Nutrition Education, Kyonggi University, Suwon, Korea.

<sup>b</sup>Yongin Center for Children's Food Service Management, Yongin, Korea.

<sup>c</sup>Anyang Center for Children's Food Safety Experience, Anyang, Korea.

<sup>d</sup>Department of Food and Nutrition, Kangwon National University, Samcheok, Korea.

Received: March 10,  
2016  
Revised: May 11, 2016  
Accepted: May 30,  
2016

### KEYWORDS:

adolescents,  
food safety,  
nutrition education,  
social cognitive theory

### Abstract

**Objectives:** The purpose of this study was to develop an educational model regarding food safety and nutrition. In particular, we aimed to develop educational materials, such as middle- and high-school textbooks, a teacher's guidebook, and school posters, by applying social cognitive theory.

**Methods:** To develop a food safety and nutrition education program, we took into account diverse factors influencing an individual's behavior, such as personal, behavioral, and environmental factors, based on social cognitive theory. We also conducted a pilot study of the educational materials targeting middle-school students ( $n = 26$ ), high-school students ( $n = 24$ ), and dietitians ( $n = 13$ ) regarding comprehension level, content, design, and quality by employing the 5-point Likert scale in May 2016.

**Results:** The food safety and nutrition education program covered six themes: (1) caffeine; (2) food additives; (3) foodborne illness; (4) nutrition and meal planning; (5) obesity and eating disorders; and (6) nutrition labeling. Each class activity was created to improve self-efficacy by setting one's own goal and to increase self-control by monitoring one's dietary intake. We also considered environmental factors by creating school posters and leaflets to educate teachers and parents. The overall evaluation score for the textbook was 4.0 points among middle- and high-school students, and 4.5 points among dietitians.

**Conclusion:** This study provides a useful program model that could serve as a guide to develop educational materials for nutrition-related subjects in the curriculum. This program model was created to increase awareness of nutrition problems and self-efficacy. This program also helped to improve nutrition management skills and to promote a healthy eating environment in middle- and high-school students.

\*Corresponding author.

E-mail: [joungheeleee@kgu.ac.kr](mailto:joungheeleee@kgu.ac.kr) (J. Lee).

## 1. Introduction

South Korea has faced various dietary problems with its adolescents. According to the 2013 Korea National Health and Nutrition Examination Survey, 33% of adolescents, aged 12–18 years, have skipped breakfast, and only approximately one out of four adolescents have used the nutrition facts label to make healthier food choices [1]. The 10<sup>th</sup> Korea Youth Risk Behavior Web-based Survey revealed that male students have a higher prevalence of obesity than female students (male 14% vs. female 6%) [2]. Conversely, female students have a higher rate of body image distortion than males (female 36% vs. male 22%) [2]. In addition, 45% of female students have attempted to lose weight in the past 30 days, and a portion of them used unhealthy weight control methods, such as fasting, taking laxatives or diuretics, and vomiting [2]. Therefore, we need a nutrition intervention program targeting Korean adolescents to prevent obesity and encourage the promotion of a healthy body image.

There is an urgent need to develop a food safety education program targeting adolescents in South Korea. One study revealed that 6% of high-school students consumed caffeine above the tolerable upper intake level based on one's own weight [3]. A high intake of caffeine could lead to headache, insomnia, palpitations, and tremors [4]. Additionally, more than half the middle-school students (62%) consumed processed food once or more per day. The level of the general food labelling component check was the lowest for food additives compared with all other components (e.g., date of manufacture, sell-by date, net content, place of origin) [5]. Moreover, one third of the patients with food-borne illness were found at schools [6]. Less than half of middle- and high-school students washed their hands before eating at the schools [7]. Due to the harmful effects of a high caffeine intake, a low level of awareness regarding food additives, and a low level of hand hygiene practice, we need to include food safety education classes into the nutrition intervention program for adolescents.

Middle- and high-schools have faced great challenges with regards to nutrition education due to the lack of sufficient nutrition education programs in South Korea. The research revealed that the biggest barrier to nutrition education was a lack of education material and programs among middle- and high-school dietitians [8,9]. In addition, more than half of the teachers obtained nutrition education materials from the Internet [10]. If the dietitians used unverified content from the Internet, the authority of dietitians would be weakened due to the spreading inaccurate information. There is an urgent need to develop food safety and nutrition education programs based on scientific evidence for healthy eating in adolescents.

It is critical to develop a theory-based nutrition education program because theories help us to understand and predict dietary behaviors. Social cognitive theory has been commonly used to explain dietary behaviors in adolescents. Social cognitive theories state that behavior is determined by personal, behavioral, and environmental factors [10]. According to social cognitive theory, the education program should include multiple avenues, such as cognitive change, skill improvement, and environmental change. In addition to the targeted beneficiary, it is important to educate parents, middle- and high-school teachers, and peers to change the social environment. An effective nutrition education program needs school as well as family support. We developed a food safety and nutrition education program for middle- and high-school students by applying social cognitive theory. The study aimed to: (1) develop a textbook, teacher's guidebook, and teaching-learning plan; and (2) develop school posters for supporting a healthy eating environment in middle and high schools.

## 2. Materials and methods

### 2.1. Development of a nutrition education model

The program themes and objectives were selected by the research team and nutrition professionals, including a nutrition teacher. We designed the nutrition education model based on social cognitive theory. We took into consideration numerous factors affecting a person's behavior: (1) personal factors (i.e., outcome expectations, outcome expectancies, self-efficacy); (2) behavioral factors (i.e., behavioral capability, self-regulation/self-control); and (3) environmental factors (i.e., observational learning/modelling, social environment). We developed a nutrition textbook for middle- and high-school students, a teacher's guidebook, and posters applying social cognitive theory.

### 2.2. Evaluation of nutrition education materials

We conducted a survey to evaluate the nutrition textbook for middle- and high-school students ( $n = 50$ ) and dietitians ( $n = 13$ ) during May 2016 in Kyonggido, Korea. Additionally, dietitians evaluated the teacher's guidebook. The survey questionnaire included the level of understanding and concentrated on the contents, the usefulness of the information, and recommendations for these nutrition education materials by measuring with the 5-point Likert scale (from strongly disagree to strongly agree) [11]. We employed descriptive statistics such as number, mean, and standard deviation to describe the basic features of the data.

### 3. Results

#### 3.1. Development of nutrition textbook

The nutrition textbook consisted of two parts: food safety and nutrition. The textbook targeted middle- and high-school students (Figure 1). The food safety part included: (1) caffeine; (2) food additives; and (3) food borne illness. The nutrition part comprised of: (1) nutrition and meal planning; (2) obesity and eating disorders; and (3) nutrition labeling. We developed an education program for each theme by using the core concepts of social cognitive theory: (1) behavioral capability; (2) outcome expectations; (3) self-efficacy; (4) observational learning/modeling; (5) self-regulation/self-control; and (6) the environment.

The nutrition textbook consisted of an opening section, learning objectives, main text, in-depth information, a class activity, an evaluation, and a take-home message. First, the textbook started with an opening section using a news article, cartoon, or graph to drive the interest of students. Second, the textbook listed two to three learning objectives for each theme. Third, the main section consisted of a question and answer style format covering necessary information for behavior change. Fourth, an in-depth information section contained an explanation of difficult terms listed on food packages. Fifth, we developed two to three hands-on activities so that students would have an opportunity to put the knowledge they gained into practice. Sixth, the

evaluation section had five quizzes to check understanding of the key messages. Finally, the take-home message section indicated the most important messages to keep in mind.

We selected the theme of “caffeine” as an example to describe the structure of the textbook and the components of the social cognitive theory we applied. First, for the opening section, we showed a news article describing one high-school student’s overconsumption of caffeinated drinks. We then asked a question about whether it is a wise choice to overconsume caffeinated drinks so that students could think about this issue in a critical way. Second, we indicated three learning objectives: (1) we will know the contents of caffeine in food; (2) we can explain the effects in our health of the overconsumption of products with caffeine; (3) we can practice ways of caffeine reduction (Table 1). Learning objectives were stated to acquire knowledge, attitude, and behavior change. Third, the main section consisted of six questions and answers. The six questions were as follows: (1) What is caffeine?; (2) Why do adolescents consume products with caffeine?; (3) What are the effects of the overconsumption of caffeine?; (4) How much caffeine is in foods?; (5) What is a tolerable upper intake level of caffeine for adolescents?; and (6) What are the ways to reduce the consumption of caffeine drinks? (Table 1). To create a learner-centered approach, we addressed the barriers to a reduction of caffeine consumption in adolescents. The false and exaggerated



**Figure 1.** Food safety and nutrition textbooks. (A) Middle-school textbook. (B) High-school textbook.

**Table 1.** Food safety and nutrition textbook table of contents.

Category	Theme	Objectives	Contents	Activity
Food safety	Caffeine	<ul style="list-style-type: none"> <li>• We will know the contents of caffeine in foods.</li> <li>• We can explain the effects in our health of overconsumption of products with caffeine.</li> <li>• We can practice ways of caffeine reduction.</li> </ul>	<ul style="list-style-type: none"> <li>• What is caffeine?</li> <li>• Why do adolescents consume products with caffeine?</li> <li>• Overconsumption of products with caffeine, what are the effects?</li> <li>• How much caffeine is in foods?</li> <li>• What is a tolerable upper intake level of caffeine for adolescents?</li> <li>• What are the ways to reduce consumption of caffeine drinks?</li> </ul>	<ul style="list-style-type: none"> <li>• Checking caffeine in foods.</li> <li>• Studying the highly caffeinated drinks.</li> <li>• Calculating a tolerable upper intake level of caffeine.</li> <li>• Matching the questions &amp; answers about caffeine.</li> <li>• A role-playing activity about caffeine reduction.</li> <li>• Writing a class reflection paper.</li> </ul>
	Food additives	<ul style="list-style-type: none"> <li>• We can explain the purpose of using food additives.</li> <li>• We can explain the management system of food additives.</li> <li>• We can check food ingredients by the use of food labeling.</li> </ul>	<ul style="list-style-type: none"> <li>• What are food additives?</li> <li>• Is it safe to consume food additives?</li> <li>• Why do we use food additives?</li> <li>• What are the types of food additives?</li> <li>• How can we check food additives?</li> </ul>	<ul style="list-style-type: none"> <li>• Using the phone application about food additives.</li> <li>• Making mayonnaise</li> <li>• Studying sodium caseinate.</li> </ul>
	Food borne illness	<ul style="list-style-type: none"> <li>• We can explain the characteristics of food-borne illnesses.</li> <li>• We can explain the different types of food-borne illnesses.</li> <li>• We can practice ways to prevent food borne illnesses.</li> </ul>	<ul style="list-style-type: none"> <li>• What is food-borne illness?</li> <li>• What are the signs &amp; symptoms of food-borne illness?</li> <li>• What are the types of food-borne illnesses?</li> <li>• What should we do to prevent food-borne illness?</li> </ul>	<ul style="list-style-type: none"> <li>• Finding causes of food borne illnesses.</li> <li>• Answering the questions about food borne illnesses.</li> <li>• Checking possible germs on your hands.</li> <li>• Checking the proper ways of hand washing.</li> </ul>
Nutrition	Nutrition & meal planning	<ul style="list-style-type: none"> <li>• We can assess our diet &amp; nutritional status.</li> <li>• We can assess the right amount of foods we need.</li> </ul>	<ul style="list-style-type: none"> <li>• Let's evaluate your meal.</li> <li>• Let's check your nutritional status.</li> <li>• Let's calculate your energy requirements.</li> <li>• Let's study your meal planning.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluating your diet.</li> <li>• Meal planning</li> </ul>
	Obesity & eating disorder	<ul style="list-style-type: none"> <li>• We will know health problems due to obesity &amp; eating disorders.</li> <li>• We can practice ways of preventing obesity &amp; eating disorders.</li> </ul>	<ul style="list-style-type: none"> <li>• What is obesity?</li> <li>• Obesity, what are the effects?</li> <li>• How can we prevent obesity?</li> <li>• What are eating disorders?</li> <li>• How can we prevent eating disorders?</li> </ul>	<ul style="list-style-type: none"> <li>• Choosing healthy foods.</li> <li>• Let's have a healthy body.</li> <li>• Detecting high calorie &amp; low calorie foods.</li> <li>• Checking the sign &amp; symptoms of eating disorders.</li> </ul>

(Continued on next page)



Table 1 (Continued)

Category	Theme	Objectives	Contents	Activity
	Nutrition labeling	<ul style="list-style-type: none"> <li>• We can explain nutrition labeling.</li> <li>• We learn how to use nutrition labels.</li> <li>• We can check the nutrition labels.</li> </ul>	<ul style="list-style-type: none"> <li>• What is nutrition labeling?</li> <li>• Why do we need to check the nutrition label?</li> <li>• Do all processed foods have the nutrition labeling?</li> <li>• How can we read the nutrition label?</li> <li>• What contents are in the nutrition label?</li> <li>• How can we use the nutrition label?</li> </ul>	<ul style="list-style-type: none"> <li>• Answering the questions about nutrition labeling.</li> <li>• Comparing nutrition facts of processed foods with its nutrition labeling.</li> <li>• Checking nutrition facts in food by nutrition labeling.</li> <li>• Sorting out high sodium containing foods.</li> </ul>

advertisement of energy drinks informed students of alertness effects without mentioning the side effects of caffeine. Therefore, we stated the reasons adolescents consume energy drinks and provided information to overcome their barriers to reducing caffeine consumption. For the in-depth information section, we addressed ways of checking the content of drinks and discussed regulations against caffeine in schools. Fourth, four class activities are provided to put their new knowledge into practice: (1) grouping foods by the contents of caffeine; (2) calculating the amount of caffeine consumed; (3) role playing of an activity about caffeine reduction; and (4) writing a class reflection paper (Table 1). Fifth, we developed five quizzes to appraise the level of understanding regarding these class concepts: (1) the health effects of caffeine; (2) misconceptions of caffeine consumption; (3) the contents of caffeine in foods; (4) the definition of high caffeinated drinks; and (5) the control of energy drink consumption. Finally, the take-home message section included three key messages: (1) the adverse effects of caffeine overconsumption; (2) ways to reduce caffeine intake; and (3) the contents of caffeine in foods.

We developed the nutrition education materials by applying social cognitive theory. Three factors (personal, behavioral, and environmental) were all taken into account (Tables 2 and 3). Firstly, the personal factors consisted of outcome expectations, outcome expectancies, and self-efficacy. For outcome expectations, a reduction in caffeine consumption would prevent the adverse effects of high caffeine consumption such as arrhythmias, high blood pressure, and decreased calcium absorption. Regarding outcome expectancies, although caffeine has alertness effects, dietitians emphasize caffeine reduction so students put more value on their health. As for self-efficacy, students would explain the adverse effects of caffeine overconsumption to others by role playing. Secondly, the behavioral factors contained behavioral capability and self-regulation/self-control. For behavioral capability, we developed a class activity about how to check the amount of caffeine in drinks. As for self-regulation/self-control, we developed content that focused on monitoring caffeine consumption and setting one's own intake level of caffeine. Thirdly, environmental factors included observational learning/modeling and the social environment. For observational learning/modeling, students observe their classmates' drinking water or milk instead of highly caffeinated drinks. To change the social environment, we created and posted school posters showing the adverse effects of caffeine overconsumption.

### 3.2. Development of posters

We developed school posters for each educational theme to increase awareness for teachers and peers. Each theme has its own poster: (1) caffeine: adverse effects of caffeine overconsumption; (2) food additives:

**Table 2.** Food safety education program by using social cognitive theory.

Category	Theme	Behavioral capability	Outcome expectations	Self-efficacy	Observational learning/modelling	Outcome expectancies	Self-regulation/self-control	Environment
Food safety	Caffeine	<ul style="list-style-type: none"> <li>Students can check the amount of caffeine they consumed.</li> </ul>	<ul style="list-style-type: none"> <li>If we reduce caffeine consumption, we would prevent side effects such as arrhythmias, high blood pressure, &amp; decreased calcium absorption.</li> </ul>	<ul style="list-style-type: none"> <li>Students can explain side effects of high caffeine consumption &amp; how to reduce it by participating in role playing.</li> </ul>	<ul style="list-style-type: none"> <li>Students would observe that their friends drink water or milk instead of high caffeinated drinks.</li> </ul>	<ul style="list-style-type: none"> <li>Although caffeine has alertness effects, it is important to reduce caffeine consumption due to its side effects such as insomnia, arrhythmia, &amp; caffeine obsession.</li> </ul>	<ul style="list-style-type: none"> <li>Students will monitor their caffeine consumption.</li> <li>Student will set their own standards to reduce their caffeine consumption.</li> </ul>	<ul style="list-style-type: none"> <li>We will create a poster showing the side effects of high caffeine consumption.</li> </ul>
	Food additives	<ul style="list-style-type: none"> <li>Students can understand the use of food labeling in the processed foods.</li> </ul>	<ul style="list-style-type: none"> <li>Students can choose healthier foods by the use of food labeling.</li> </ul>	<ul style="list-style-type: none"> <li>Students can explain how to read &amp; use the food labels.</li> </ul>	<ul style="list-style-type: none"> <li>Students will bring their preferred foods &amp; can share some thoughts about food labeling with their friends.</li> </ul>	<ul style="list-style-type: none"> <li>Although processed food is tasty, students need to reduce the consumption of processed foods that is high in sugars, sodium, &amp; fats.</li> </ul>	<ul style="list-style-type: none"> <li>Students will check the food labeling of the processed foods that they will consume.</li> </ul>	<ul style="list-style-type: none"> <li>Students &amp; teachers will appreciate the poster showing the importance of the food labeling.</li> </ul>
	Food-borne illness	<ul style="list-style-type: none"> <li>Students will learn the types &amp; characteristics of the food-borne diseases.</li> <li>Students will learn how to prevent food borne diseases.</li> </ul>	<ul style="list-style-type: none"> <li>We can improve our health by practicing proper hand washing &amp; proper handling of foods, with the help of boiling water.</li> </ul>	<ul style="list-style-type: none"> <li>Students will learn to practice ways in preventing food-borne diseases.</li> </ul>	<ul style="list-style-type: none"> <li>Students will share experiences of food-borne illnesses as well as how to prevent it.</li> </ul>	<ul style="list-style-type: none"> <li>Students will become aware of the importance of proper hand washing, proper handling of foods &amp; the importance of boiling of water because these actions can prevent food-borne illnesses.</li> </ul>	<ul style="list-style-type: none"> <li>Students will monitor their hand-washing before eating, after outdoor activities, &amp; after going to the toilet.</li> <li>Students will also monitor the proper handling of raw foods when cooking.</li> </ul>	<ul style="list-style-type: none"> <li>We will create &amp; post an educational image showing that proper hand-washing is important in preventing food-borne illnesses.</li> </ul>

**Table 3.** Nutrition education program by using social cognitive theory.

Category	Theme	Behavioral capability	Outcome expectations	Self-efficacy	Observational learning/modeling	Outcome expectancies	Self-regulation/self-control	Environment
Nutrition	Nutrition & meal planning	<ul style="list-style-type: none"> <li>• Students can calculate their healthy weight, which depends on their age &amp; height.</li> <li>• Students can develop their own healthy meal plan.</li> </ul>	<ul style="list-style-type: none"> <li>• Following the healthy meal plan would promote one's health.</li> </ul>	<ul style="list-style-type: none"> <li>• Students can create their own meal plan &amp; follow it consistently.</li> </ul>	<ul style="list-style-type: none"> <li>• Students can observe their peers following each own healthy meal plan &amp; its positive health effects.</li> <li>• Students would encourage themselves by observing healthy eating habits of their peers.</li> </ul>	<ul style="list-style-type: none"> <li>• Following one's healthy meal plan is more important than an unhealthy diet because it improves their physical fitness &amp; academic performance.</li> </ul>	<ul style="list-style-type: none"> <li>• Students will monitor &amp; evaluate their dietary patterns.</li> </ul>	<ul style="list-style-type: none"> <li>• Students &amp; teachers will appreciate the poster showing the importance of the balanced meals.</li> </ul>
	Obesity & eating disorder	<ul style="list-style-type: none"> <li>• Students can choose healthy snacks.</li> <li>• Students can have a healthy body image.</li> </ul>	<ul style="list-style-type: none"> <li>• One's healthy body image would be the foundation for good mental &amp; physical health.</li> <li>• Consumption of healthy snacks will improve one's nutritional status.</li> </ul>	<ul style="list-style-type: none"> <li>• Students will encourage their peers to be aware of obesity or eating disorder problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Students will observe the dietary habits of their peers with obesity or with eating disorders.</li> </ul>	<ul style="list-style-type: none"> <li>• A fad diet is easy &amp; quick way to lose weight, but following fad diets are harmful to our health due to a loss of body water &amp; muscle.</li> </ul>	<ul style="list-style-type: none"> <li>• Students will monitor their nutritional status consistently.</li> </ul>	<ul style="list-style-type: none"> <li>• The poster will show that having a healthy body image is the 1<sup>st</sup> step of the nutrition management.</li> </ul>
	Nutrition labeling	<ul style="list-style-type: none"> <li>• Students can use nutrition labeling in checking their foods.</li> </ul>	<ul style="list-style-type: none"> <li>• Checking the nutrition labeling can help us choose the foods with less sugars, sodium, or fats.</li> </ul>	<ul style="list-style-type: none"> <li>• Students will gradually use the nutrition labeling of processed foods.</li> </ul>	<ul style="list-style-type: none"> <li>• Students would share the nutrition labeling of processed foods they regularly consumed with their peers.</li> </ul>	<ul style="list-style-type: none"> <li>• Nutrition labeling is more useful than considering taste &amp; cost of processed foods to maintain good health.</li> </ul>	<ul style="list-style-type: none"> <li>• Students would monitor the use of nutrition labeling of foods they will purchase.</li> </ul>	<ul style="list-style-type: none"> <li>• The poster will consist of image that when a customer will choose their foods they should carefully check the nutrition labeling of the processed foods.</li> </ul>

checking food labels; (3) food-borne illness: washing hands to prevent food-borne illness; (4) nutrition and meal planning: consuming a balanced diet; (5) obesity and eating disorders: promoting a healthy body image; and (6) nutrition labeling: checking the nutrition label of food prior to purchasing (Figure 2).

### 3.3. Characteristics of the participants

This study included two groups: middle- and high-school students ( $n = 50$ ) and dietitians ( $n = 13$ ; Table 4). The average age of the students was 15.8 years, consisting of 52.0% middle-school students and 48.0% high-school students. The mean age of dietitians was 31.1 years, and the mean duration of work experience as a dietitian was 6.6 years. Most of them (76.9%) were working at elementary, middle, or high schools.

### 3.4. Evaluation of nutrition education materials

We conducted a pilot test to evaluate the understanding and usefulness of the textbook for dietitians and students and to assess the guidebook for dietitians. The overall mean score for the textbook was 4.50 points

for dietitians (Table 5). Certain items showed relatively higher scores: (1) consistent use of language (4.77 points); (2) improvement of students' nutrition knowledge (4.71 points); (3) matching the contents of the textbook with objectives (4.69 points); (4) gaining useful information from the textbook (4.68 points); and (5) pictures and cartoons help to understand the contents (4.68 points). However, the design of the textbook inducing the interest of students had a comparatively lower score (4.18 points).

For the dietitians' guidebook, the overall mean score was 4.53 points in dietitians (Table 6). Evaluation items that had the highest score were in the following order: (1) consistent use of language (4.81 points); (2) inclusion of the appropriate amount of information for each class (4.73 points); (3) the contents matching with each theme of the textbook (4.73 points); and (4) easy to understand the contents (4.69 points). However, the design of the guideline had the lowest score (4.01 points).

The results of the students' overall evaluation of the textbook showed a relatively lower mean score than that



**Figure 2.** Food safety and nutrition posters. (A) Caffeine. (B) Food additives. (C) Food-borne Illness. (D) Nutrition and meal planning. (E) Obesity and meal planning. (F) Nutrition labeling.



**Table 4.** General characteristics of the participants.

Characteristics	Students ( <i>n</i> = 50)
Age (y)	15.82 ± 1.66
Sex	
Male	14 (28.0)
Female	36 (72.0)
School	
Middle school	26 (52.0)
High school	24 (48.0)
Residential area	
Kyonggido	50 (100.0)
Had food safety & nutrition education for the last 1 y	
Yes	44 (88.0)
No	6 (12.0)
	Dietitians ( <i>n</i> = 13)
Age (y)	31.08 ± 4.27
Sex	
Female	13 (100.0)
Work experience as a dietitian (y)	6.57 ± 3.53
Type of institution	
Elementary school	1 (7.7)
Middle school	2 (15.4)
High school	7 (53.8)
Others	3 (23.1)
Working area	
Seoul	4 (30.8)
Kyonggido	9 (69.2)

Data are presented as *n* (%) or mean ± standard deviation.

of the dietitians (students 4.00 points vs. dietitians 4.50 points; Table 7). One evaluation item out of the 15 questions had the highest mean score (4.31 points): it is easy to understand the contents of the textbook. However, two items had the lowest mean score in the following order: (1) obtaining useful information about healthy eating (3.84 points); and (2) the class will help to improve my dietary habits (3.85 points).

#### 4. Discussion

We created the food safety and nutrition education program by applying social cognitive theory. A few studies showed that the main resources for gaining nutritional information were television/radio, newspaper/magazine, or the Internet [12–15]. However, certain data from the mass media were based on insufficient scientific evidence or exaggerated advertisement of certain foods [16]. This wrong or inaccurate information can lead to an unbalanced diet and unhealthy eating habits in children. Therefore, we attempted to correct misinformation gained from the mass media regarding food safety and nutrition when we developed this education program. Additionally, social cognitive theory emphasizes that the social environment

determines one's behavior. As a result, we included teachers, families, and peers in this nutrition education effort to make this program successful by developing a leaflet for parents and creating posters for teachers and peers [17,18].

There are limited resources regarding food safety and nutrition education programs at the national level. To target elementary students, available resources were the “Nutrition and health” textbook for the upper grades in elementary school (the Korean Dietetic Association, 2006) [19], the “Health management and balanced diet” textbook and teacher's guidebook for extracurricular activities in elementary schools (the Korean Dietetic Association, 2007) [20], and the “Nutrition and diet” textbook and teacher's guidebook for 1–2, 3–4, and 5–6 graders of elementary schools (Ministry of Food And Drug Safety, 2010) [21]. For middle- and high-school students, the available resources were the “Making *kimchi*” textbook for middle-school students (Rural Development Administration, 2009) [22], the “Green food education” textbook and teacher's guidebook (Ministry for Food, Agriculture, Forestry, and Fisheries, 2010) [23], and the “Nutrition and health of adolescents” textbook and teacher's guidebook (Ministry of Health and Welfare, 2011) [24]. The number of educational materials for dietitians was very limited. Moreover, the materials only included contents about nutrition, not food safety issues. Therefore, the food safety and nutrition education program we developed would be very useful for dietitians to educate adolescents in middle and high schools.

The ultimate goal of food safety and nutrition education is behavior change. However, existing textbooks of physical education, home economics education, and health education partially cover information regarding food safety and nutrition and has a teacher-centered approach [25]. For example, the middle school textbook of physical education delivered information-oriented knowledge regarding caffeine. Because there were no class activities or dietary guidelines, it was hard for students to apply their new knowledge to change their dietary behaviors. Hence, we created the food safety and nutrition education program by supplementing the weakness of the existing textbooks. For instance, we have added role playing, a write-up of the class reflection paper, and meal planning activities for hands-on experiences.

There are a few limitations in this study. First, this education model covers only six subjects regarding food safety and nutrition. Future research needs to include more themes to cover additional critical dietary problems in adolescents, such as safe food handling and healthy food purchases. Second, when we conducted a pilot study to evaluate the textbook targeting middle- and high-school students, “obtaining useful information about healthy eating” had comparatively lower scores. Therefore, it will be useful to conduct focus group

**Table 5.** Evaluating food safety and nutrition textbook for dietitians ( $n = 13$ ).\*

No.	Questions	Caffeine	Food additives	Food-borne illness	Nutrition & meal planning	Obesity & eating disorder	Nutrition labeling	Total
1	Do the contents of the textbook clearly match with objectives?	4.77 ± 0.44	4.15 ± 1.07	4.85 ± 0.55	4.69 ± 0.75	4.69 ± 0.63	5.00 ± 0.00	4.69 ± 0.35
2	Can you easily understand the contents of the textbook?	4.62 ± 0.65	3.54 ± 0.66	4.67 ± 0.49	4.62 ± 0.77	4.77 ± 0.44	4.46 ± 0.88	4.43 ± 0.34
3	Does it emphasize key messages?	4.85 ± 0.38	4.15 ± 1.07	4.77 ± 0.83	4.69 ± 0.75	4.62 ± 0.65	4.77 ± 0.44	4.64 ± 0.35
4	Does it have the appropriate amount of information for each class?	4.54 ± 0.78	4.08 ± 1.19	4.62 ± 0.51	4.62 ± 0.65	4.46 ± 0.66	4.83 ± 0.39	4.51 ± 0.41
5	Can we obtain useful information from the textbook?	4.92 ± 0.28	4.31 ± 0.85	4.69 ± 0.85	4.77 ± 0.60	4.62 ± 0.77	4.77 ± 0.44	4.68 ± 0.39
6	Can we easily pay attention to the contents of the textbook?	4.23 ± 0.73	3.31 ± 1.18	4.31 ± 0.85	4.54 ± 0.78	4.46 ± 0.88	4.31 ± 0.75	4.19 ± 0.51
7	Do the class activities have the appropriate level?	4.54 ± 0.66	4.08 ± 1.12	4.46 ± 0.88	4.23 ± 1.24	4.69 ± 0.48	4.54 ± 0.66	4.42 ± 0.50
8	Does the design of the textbook induce interest of students?	4.38 ± 1.04	3.54 ± 1.33	4.46 ± 0.97	4.15 ± 0.99	4.54 ± 0.88	4.00 ± 1.15	4.18 ± 0.90
9	Do the figures, pictures, & cartoons help to understand the contents?	4.85 ± 0.38	4.08 ± 1.19	5.00 ± 0.00	4.69 ± 0.63	4.69 ± 0.48	4.77 ± 0.44	4.68 ± 0.27
10	Is language use consistent?	4.62 ± 0.87	4.77 ± 0.44	4.85 ± 0.38	4.85 ± 0.38	4.77 ± 0.44	4.77 ± 0.44	4.77 ± 0.34
11	Are the themes appropriate to improve the dietary habits of students?	4.85 ± 0.38	3.15 ± 1.57	4.54 ± 0.78	4.54 ± 0.78	4.54 ± 0.66	4.54 ± 0.66	4.36 ± 0.48
12	Do you think it improve nutrition knowledge of students?	4.85 ± 0.38	4.54 ± 1.13	4.62 ± 0.65	4.69 ± 0.63	4.85 ± 0.38	4.69 ± 0.63	4.71 ± 0.33
13	Do you think students can easily apply the knowledge to a real diet?	4.46 ± 0.97	3.23 ± 1.30	4.46 ± 0.66	4.54 ± 0.78	4.33 ± 0.89	4.46 ± 0.78	4.24 ± 0.60
14	After reading this textbook, do the contents remain in your memory?	4.85 ± 0.38	4.08 ± 0.86	4.62 ± 0.65	4.54 ± 0.78	4.62 ± 0.65	4.46 ± 0.97	4.53 ± 0.43
15	Will you recommend this textbook to others?	4.69 ± 0.63	3.62 ± 1.12	4.54 ± 0.66	4.62 ± 0.65	4.62 ± 0.65	4.62 ± 0.65	4.45 ± 0.47
Total		4.67 ± 0.33	3.91 ± 0.72	4.63 ± 0.38	4.58 ± 0.52	4.62 ± 0.46	4.60 ± 0.50	4.50 ± 0.33

\*The data analysis was based on the 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Data are presented as mean ± standard deviation.

**Table 6.** Evaluating the guideline of food safety and nutrition textbook for dietitians ( $n = 13$ ).\*

No.	Questions	Caffeine	Food additives	Food-borne illness	Nutrition & meal planning	Obesity & eating disorder	Nutrition labeling	Total
1	Is the guideline prepared easier to use?	$4.77 \pm 0.44$	$4.62 \pm 0.65$	$4.77 \pm 0.44$	$4.38 \pm 0.77$	$4.69 \pm 0.48$	$4.69 \pm 0.48$	$4.65 \pm 0.41$
2	Is it easy to understand the contents of this textbook?	$4.85 \pm 0.38$	$4.69 \pm 0.48$	$4.77 \pm 0.44$	$4.54 \pm 0.66$	$4.69 \pm 0.48$	$4.62 \pm 0.65$	$4.69 \pm 0.41$
3	Does the guideline have the appropriate amount of information for each class?	$4.83 \pm 0.39$	$4.77 \pm 0.44$	$4.85 \pm 0.38$	$4.54 \pm 0.78$	$4.69 \pm 0.63$	$4.77 \pm 0.44$	$4.73 \pm 0.44$
4	Are the supplementary educational materials useful?	$4.15 \pm 1.21$	$4.46 \pm 1.13$	$4.38 \pm 1.19$	$4.54 \pm 0.66$	$4.85 \pm 0.38$	$4.62 \pm 0.65$	$4.50 \pm 0.66$
5	Can you easily use “introduction” & “activity” part of the class?	$4.62 \pm 0.65$	$4.23 \pm 1.09$	$4.31 \pm 0.75$	$4.33 \pm 0.89$	$4.54 \pm 0.88$	$4.54 \pm 0.66$	$4.42 \pm 0.60$
6	Does it induce interest of students in the class?	$4.69 \pm 0.77$	$4.15 \pm 1.14$	$4.46 \pm 0.78$	$4.46 \pm 0.88$	$4.77 \pm 0.44$	$4.38 \pm 0.77$	$4.49 \pm 0.54$
7	Are the guidebook explained well to induce interest?	$4.54 \pm 0.66$	$4.38 \pm 0.65$	$4.46 \pm 0.78$	$4.62 \pm 0.65$	$4.69 \pm 0.63$	$4.46 \pm 0.78$	$4.53 \pm 0.49$
8	Is the guideline useful for teachers to prepare for the classes?	$4.62 \pm 0.77$	$4.15 \pm 1.21$	$4.62 \pm 0.65$	$4.23 \pm 0.93$	$4.54 \pm 0.66$	$4.46 \pm 0.78$	$4.44 \pm 0.63$
9	Is language use consistent?	$4.85 \pm 0.38$	$4.85 \pm 0.38$	$4.85 \pm 0.38$	$4.69 \pm 0.63$	$4.77 \pm 0.44$	$4.85 \pm 0.38$	$4.81 \pm 0.38$
10	Is the design of this guideline excellent?	$4.08 \pm 1.04$	$3.92 \pm 1.32$	$4.00 \pm 1.29$	$3.92 \pm 1.32$	$4.08 \pm 1.32$	$4.08 \pm 1.32$	$4.01 \pm 1.23$
11	Do the contents of the textbook match with each theme of the textbook?	$4.77 \pm 0.44$	$4.62 \pm 0.87$	$4.69 \pm 0.48$	$4.69 \pm 0.63$	$4.77 \pm 0.60$	$4.85 \pm 0.38$	$4.73 \pm 0.43$
12	Is the guideline organized to promote two-way interactions between students & teachers?	$4.85 \pm 0.38$	$4.46 \pm 0.78$	$4.46 \pm 0.66$	$4.54 \pm 0.66$	$4.54 \pm 0.52$	$4.69 \pm 0.63$	$4.59 \pm 0.37$
13	Are the actions suggested in the textbook appropriate to exercise?	$4.69 \pm 0.63$	$4.08 \pm 1.50$	$4.46 \pm 0.66$	$4.54 \pm 0.78$	$4.62 \pm 0.65$	$4.69 \pm 0.48$	$4.51 \pm 0.53$
14	Are the profoundly education materials included to supplement the contents of the textbook?	$4.46 \pm 0.97$	$3.77 \pm 1.48$	$4.46 \pm 1.13$	$4.69 \pm 0.63$	$4.62 \pm 0.65$	$4.31 \pm 1.18$	$4.38 \pm 0.63$
15	Will you recommend this guidebook to others?	$4.62 \pm 0.51$	$3.85 \pm 1.34$	$4.62 \pm 0.51$	$4.46 \pm 0.66$	$4.62 \pm 0.51$	$4.69 \pm 0.48$	$4.47 \pm 0.48$
Total		$4.62 \pm 0.42$	$4.33 \pm 0.61$	$4.54 \pm 0.43$	$4.48 \pm 0.60$	$4.63 \pm 0.47$	$4.58 \pm 0.51$	$4.53 \pm 0.44$

\*The data analysis was based on the 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Data are presented as mean  $\pm$  standard deviation.

**Table 7.** Evaluating food safety and nutrition textbook for middle- and high-school students ( $n = 50$ ).\*

No.	Evaluation items	Caffeine	Food additives	Food-borne illness	Nutrition & meal planning	Obesity & eating disorder	Nutrition labeling	Total
1	It is easy to understand the contents of the textbook.	4.28 ± 0.83	4.14 ± 0.90	4.44 ± 0.67	4.34 ± 0.77	4.28 ± 0.78	4.38 ± 0.70	4.31 ± 0.60
2	The textbook emphasizes key messages.	3.92 ± 0.99	3.86 ± 0.95	4.00 ± 0.83	4.24 ± 0.85	3.92 ± 1.01	3.98 ± 0.96	3.99 ± 0.69
3	The textbook has the appropriate amount of information for each class.	3.92 ± 1.05	3.84 ± 1.04	3.98 ± 0.98	3.90 ± 0.91	4.10 ± 0.89	4.20 ± 0.90	3.99 ± 0.75
4	Language use is consistent.	3.96 ± 1.01	3.90 ± 0.93	3.84 ± 1.00	4.00 ± 0.90	3.98 ± 0.91	4.04 ± 0.90	3.95 ± 0.70
5	Introduction part is interesting.	4.24 ± 0.96	4.04 ± 0.95	3.90 ± 0.99	4.24 ± 0.80	4.22 ± 0.91	4.02 ± 1.02	4.11 ± 0.68
6	It is easy to understand class objectives.	3.68 ± 1.20	3.82 ± 1.06	3.88 ± 1.14	3.94 ± 0.96	4.04 ± 0.97	3.94 ± 1.06	3.88 ± 0.83
7	Introduction part helps to understand the class.	4.00 ± 0.86	3.78 ± 0.93	4.16 ± 0.89	4.06 ± 0.91	4.06 ± 0.91	4.14 ± 0.81	4.03 ± 0.65
8	The class activities are interesting.	3.86 ± 1.20	3.94 ± 1.00	3.90 ± 1.09	4.00 ± 0.95	3.92 ± 0.92	3.94 ± 1.06	3.93 ± 0.81
9	The class activities help to understand the class.	4.22 ± 0.93	4.08 ± 0.92	4.16 ± 0.98	4.24 ± 0.80	4.14 ± 1.05	4.22 ± 0.86	4.18 ± 0.68
10	The class activities have the appropriate level.	3.98 ± 0.91	3.98 ± 0.91	4.04 ± 0.90	4.10 ± 0.84	3.98 ± 0.96	3.92 ± 1.03	4.00 ± 0.72
11	Organization of the textbook (including the contents & design) is interesting.	3.94 ± 0.87	3.94 ± 1.10	4.04 ± 0.90	3.92 ± 0.90	4.06 ± 0.89	3.98 ± 0.87	3.98 ± 0.70
12	The figures & pictures help to understand the class.	4.14 ± 0.73	3.96 ± 0.78	4.06 ± 0.87	3.96 ± 0.99	4.04 ± 0.95	4.00 ± 0.81	4.04 ± 0.64
13	The class will help to improve my dietary habits.	3.80 ± 0.97	3.66 ± 0.96	3.94 ± 1.08	3.82 ± 0.98	3.92 ± 1.10	3.96 ± 1.03	3.85 ± 0.82
14	I can obtain useful information about healthy eating from this textbook.	3.68 ± 1.13	3.90 ± 0.97	3.74 ± 1.10	3.88 ± 1.02	3.92 ± 1.01	3.94 ± 1.02	3.84 ± 0.82
15	I will recommend this textbook to others.	3.90 ± 0.99	3.84 ± 1.00	3.96 ± 1.16	4.08 ± 0.94	3.94 ± 1.02	4.08 ± 0.85	3.97 ± 0.80
Total		3.97 ± 0.70	3.91 ± 0.69	4.00 ± 0.71	4.05 ± 0.63	4.03 ± 0.69	4.05 ± 0.64	4.00 ± 0.62

\*The data analysis was based on the 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Data are presented as mean ± standard deviation.

interviews of adolescents regarding their life styles and the barriers to change their dietary behavior so that we can provide them with more practical and useful information. Third, we conducted a pilot study that evaluated the textbook and teacher's guidebook with a small sample size. Therefore, we need to conduct an intervention study using both the intervention and the control group with a larger sample size to investigate the effects of this nutrition education program.

## Conflicts of interest

The authors have declared and confirmed no conflict of interest regarding publication of this paper.

## Acknowledgments

This project was supported by the Ministry of Food and Drug Safety, Korea.

## References

1. Korea Centers for Disease Control and Prevention. Korea National Health and Nutrition Examination Survey (KNHANES VI-1). Seoul (Korea): The Ministry of Health and Welfare Division of Health Policy; 2014.
2. Korea Centers for Disease Control and Prevention. The 10th Korea Youth Risk Behavior Web-based Survey. Chung-buk (Korea): Korea Centers for Disease Control and Prevention; 2014.
3. Do YS, Kang SH, Kim HT, et al. Investigation on the consumption of caffeinated beverages by high school students in Gyeonggi-do. *J Food Saf Hyg* 2014 Jun;29(2):105–16.
4. Shirlow MJ, Mathers CD. A study of caffeine consumption and symptoms; indigestion, palpitations, tremor, headache and insomnia. *Int J Epidemiol* 1985 Jun;14(2):239–48.
5. Goh EK, Park ES. Intake of processed food and perceptions of food labeling in middle school students. *Korean J Hum Ecol* 2010 Feb;19(1):179–89.
6. Ministry of Food and Drug Safety. Statistics of foodborne illness 2016 [Internet]. Available from: <https://www.foodsafetykorea.go.kr/portal/healthyfoodlife/foodPoisoningStat.do> [accessed 18.05.16].
7. Korea Centers for Disease Control and Prevention. Main results of Korea youth risk behavior web-based survey, 2005–2015. Sejong (Korea): Korea Centers for Disease Control and Prevention; 2015.
8. Park HR. Development of nutrition textbooks for middle and high school students. Seoul: The Korean Society of Community Nutrition; 2011.
9. Park ES. Operation and training demand on dietary life education of dietitians in Jeon-buk province. *Korean J Hum Ecol* 2014 Feb; 23(1):149–61.
10. Lee KH, Kim KW, Lee YK, et al. Nutrition education and counseling. 3rd ed. Seoul: Life Science; 2015.
11. Nam EJ, Kim HH, Park YH, et al. Development and evaluation of food safety training program for employees in foodservice operations. *J Korean Soc Food Cult* 2005 Oct;20(5):615–20.
12. Won HR, Yun HR. College students' dietary behavior for processed foods and the level of perception on food labeling systems according to the level of nutrition knowledge in Wonju province. *Korean J Community Living Sci* 2011 Sep;22(3):379–93.
13. Lee SG, Jun JS. Dietary and health behaviors and nutrition education environments of high school students in Gwang-myeong, Gyeonggi province. *Korean J Community Living Sci* 2015 May; 26(2):287–301.
14. Jeong NY, Kim KW. Nutrition knowledge and eating behaviors of elementary school children in Seoul. *Korean J Community Nutr* 2009 Feb;14(1):55–66.
15. Jung HJ. A study on the perception of eating behaviors and needs of nutrition education of middle school students in Seoul province. Seoul: Sungshin Women's University; 2008.
16. Moon HK, Yong MJ, Jang YJ. Analysis of food and nutrition information for articles and advertisements in the daily newspapers (Year 2002). *J Korean Diet Assoc* 2004 May;10(2):143–58.
17. Lee JS, Choi YS, Bae BS. Association between nutritional knowledge and dietary behaviors of middle school children and their mothers. *Korean J Nutr* 2011 Apr;44(2):140–51.
18. Oh YJ, Lee YM, Kim JH, et al. Interview survey of elementary school students' nutrition education and practice. *Korean J Community Nutr* 2008 Aug;13(4):499–509.
19. Korean Dietetic Association. Nutrition and health, textbook and guidebook for upper level elementary school students. Seoul: Korean Dietetic Association; 2006.
20. Korean Dietetic Association. Nutrition and health, textbook and guidebook for special class of elementary school students (Health management, balanced diet). Seoul: Korean Dietetic Association; 2007.
21. Ministry of Food and Drug Safety. Textbook and guidebook about nutrition and diet for elementary school students (1–2, 3–4, and 5–6 graders). Chungbuk: Ministry of Food and Drug Safety; 2010.
22. Rural Development Association. Textbook about *kimchi* for elementary, middle, and high school students. Jeonbuk: Rural Development Association; 2009.
23. Ministry of Agriculture, Food, and Rural Affairs. Textbook and guideline about green dietary life education for lower and upper grade elementary, middle, high school students. Sejong: Ministry of Agriculture, Food, and Rural Affairs; 2010.
24. Ministry of Health and Welfare. Textbook and guideline about nutrition and health for middle and high school students. Sejong: Ministry of Health and Welfare; 2011.
25. Lee JH, Jung SY, Park HS, et al. Development of food safety and nutrition management program for adolescents by using the effective communication methods. Suwon: Kyonggi University; 2013.