J Community Nutrition 2(2) : 146~158, 2000 ☐Original Article☐

Implementation and Evaluation of Nutrition Education Program for Elementary School Children*

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ABSTRACT

This study was designed to develop, implement and evaluate a nutrition education program for elementary school children. Subjects consisted of 47 children in the 6th grade in Seoul, Korea. They received five sessions of nutrition education from June to July, 1999. Topics for nutrition education included function of nutrients, food sources of nutrients, balanced diet, meal planning, and adequate energy intake. Each session lasted 40 minutes. To evaluate program effectiveness, one group pretest-posttest design was used. Subjects were given a pretest and a posttest on nutrition knowledge, eating attitudes, eating behavior, and dietary intake. All data were statistically analyzed mainly using the paired t-test and χ^2-test. There was a significant difference between pretest and posttest score on nutrition knowledge($p<0.001$), subscales of nutrition knowledge including food sources of nutrients, function of nutrients, and balanced diet($p<0.001$). These changes in nutrition knowledge were also shown both in boys($p<0.001$) and in girls($p<0.001$). Eating attitudes, subscales of eating attitudes, and eating behavior were not significantly changed after nutrition education, although some changes were observed in these variables. Dietary intakes were not significantly changed after nutrition education for all subjects ; however, different patterns in dietary intakes were observed when examined by sex. There was an increase in nutrient intakes among boys, while there was a significant decrease in nutrient intakes among girls after program implementation. Especially, it was noted that girls had diets deficient in iron, calcium, and vitamin A, even after nutrition education. It was concluded that a five-week nutrition education program can improve nutrition knowledge or some dietary intake, but this might not be enough to induce changes in food attitudes, eating behavior or dietary intakes. It might be necessary to incorporate diverse approaches, targeting sub-groups of children, and follow-up in nutrition education for elementary school children. (*J Community Nutrition* 2(2) : 146~158, 2000)

KEY WORDS : children nutrition education · effectiveness · nutrition knowledge · eating attitudes · dietary intake.

Introduction

School-aged children are characterized by rapid growth in human development. Nutritional requirements are increased and food habits are established at this age. Experiencing and eating diverse foods at this age helps to promote desirable eating behavior(Birch 1987). Healthy eating behavior acquired during childhood will continue to later life. In addition, inadequate nutrition during this age may result in poor growth and decreased academic performance at school, thus the importance of nutrition for children who are school-aged is widely recognized.

Children's physical status in this country, frequently measured by height and weight, has been considerably improved since the 1970s, due to rapid economic growth and an increase in household income. There have been many changes in eating habits and behaviors among children. One of the striking changes is decreased consumption of plant food such as grains and vegetables. This has been replaced by animal food (Lee 1997 ; Park 1996). Children are more likely to consume snacks, sodas, or several kinds of instant foods, resulting in overconsumption of fat and calories. On the other hand, the intake of micronutrients in school-aged children, such as calcium, iron, Vitamin A, thiamin, and riboflavin is below recommended levels(Kim 1999). Nutritional imbalance, characterized by over- or underconsumption of certain nutrients, emerged as a nutritional problem among children(Kim 1991 ; Park 1996). In addition to societal and env-

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ironmental changes, many children neither seek information regarding health and nutrition nor put much value on health. This often leads to undesirable eating behavior, such as skipping meals, excessive consumption of empty-calorie food, and food selection based just on taste.

Nutrition education is important for school-aged children. It will motivate them to acquire nutrition knowledge and adequate eating behavior. Food habits are acquired through repeated learning and practice, thus nutrition education while school-aged might be more effective. Nutrition education is defined as 'any set of learning experiences designed to facilitate voluntary adoption of eating and other nutrition-related behaviors conductive to health and well-being'(Contento et al. 1995a). This definition suggests that a nutrition education proegram should incorporate diverse approaches and methods, to induce changes in nutrition knowledge, attitudes and eating behaviors. Recently, many nutrition education programs incorporated methods involving active participation of the learner. For children, these include games, puppet shows, small group discussions, and peer teaching(Contento et al. 1995b ; Perez-Rodrigo & Aranceta 1997).

According to a survey of school lunch programs(Kim & Kang 1995), only half of surveyed schools responded that they provide nutrition education to children. Among schools implementing nutrition education, approximately a third(35%) provides nutrition education regularly, and only 11.1% taught nutrition education in class. Another study assessed the needs of nutrition education with parents and principals of elementary schools(Yeom & Kim 1995). In this study, most of the respondents(90%) felt that nutrition education should be implemented systematically in schools. Eighty-four percent of parents also responded that nutrition education should be performed by dieticians who have received professional education. The majority of schools, however, taught nutrition education through homeroom teachers(61.3%) ; only 14.2% of schools implemented nutrition education led by dieticians. Nutrition education was also performed by means of leaflets which provided information about lunch menus (62.3%), using bulletin boards(46.0%), and broadcasting at schools(19.8%). In other studies, elementary school teachers pointed out that the development of educational materials and instructor's manuals is urgently needed for nutrition education of children(Suh & Kim 1998 ; Yoon et al. 2000a). These results suggest that nutrition education for children has been performed, but more systematic approaches using diverse methods are needed.

The purpose of this study is to develop, implement and evaluate a nutrition education program for 6th grade children. More specifically, this study was designed to implement and evaluate the effectiveness of nutrition education on children's nutrition knowledge, eating attitudes, eating behavior and dietary intake.

Methods

1. Subjects

To recruit subjects for this study, the authors contacted an elementary school located in the northeastern region of Seoul. Subjects consisted of students of a 6th-grade class, with the consent of the school principal and the cooperation of a teacher. Subjects participated in a nutrition education program during June and July, 1999. The number of subjects was 48 students at the beginning of the study ; however, a girl did not complete the questionnaire at posttest, lowering the total to 47 students(24 boys, 23 girls).

2. Study design

One group pretest-posttest design was employed to assess the effectiveness of nutrition education(Campbell & Stanley 1966). Anthropometrics such as height, weight and percentage of body fat were measured at pretest. A survey questionnaire was also administered to program participants, in order to examine general characteristics, nutrition knowledge, eating attitudes, eating behavior, and dietary intakes. Nutrition education consisted of 5 sessions, held once a week for 40 minutes. At posttest, the same questionnaire was used to assess changes in nutrition knowledge, eating attitudes, eating behavior and dietary intakes.

3. Nutrition education

Nutrition education was composed of five sessions. Topics and contents of nutrition education are des-

cribed in Table 1. Each session started with the review of previous lessons to reinforce nutrition information and induce changes in nutrition behavior.

The first session dealt with the function of nutrients. More specifically, this session covered the types and roles of nutrients, foods high in each nutrient, and symptoms related to deficient or excessive intake of nutrients. Slides made up of various drawings were used to enhance understanding. Analogies were used ; for example, nutrients in our body were compared to fuel in automobiles. The Korean Food Pyramid was introduced to explain the five food groups and related nutrients(Korean Nutrition Society 1995). For minerals, the function and deficient symptoms associated with iron and calcium were emphasized. Food sources in the five food groups were taught to help children choose and eat a variety of foods. The booklet was produced and distributed to program participants to reinforce the information and to encourage to review and use at home.

The second session focused on understanding of a balanced diet, ideal body weight and how to make entries in a food diary. The concept of a balanced diet was taught by suggesting meals containing a variety of foods from the five food groups. We also emphasized importance of eating balanced meals regularly and balanced. To increase the awareness and interest in weight management, children learned how to calculate ideal body weight using methods such as body mass index, % ideal body weight and Röhler index. Based on the pretest, sheets describing one's ideal body weight and appropriate calorie intake per day were distributed. In addition, energy recommendations for 10 – 12 year-olds were provided(Korean Nutrition Society, 1995). This session ended with an explanation of serving sizes of some foods(cooked rice,

Table 1. Topics, contents, methods of nutrition education

Session	Topics	Contents	Methods/Materials
1	1. Introduction to the program 2. Nutrients	• Brief description of program and topics • What is nutrition and its function? • Role of nutrients/foods high in nutrients • Deficiency, toxicity of nutrients • Food groups	• Slides • Booklet
2	1. Balanced diet 2. Ideal body weight 3. Dietary guideline 4. Recording food diary	• What is a balanced diet? • Menu comprising variety of foods • Adequate energy intake and consumption • Distribution & explanation of individual's anthropometric data • Calculation of ideal body weight • Suggestion of individual diets • Methods for recording food diary	• Flip-chart • Anthropometric data(individual data, for education) • Dietary counseling sheet • Booklet • Food diary • Food model
3	1. Assessment of eating behavior 2. Selecting food sensibly 3. Exercise	• Assessment of eating habit by 24-hour dietary recalls • Calorie of foods • Food selection based on one's calorie requirement • Advantages of exercise • Energy expenditure of exercise	• Flip-chart • Slides • Coated sheet containing calories of foods and exercise • Food model
4	1. Modification of unbalanced diet	• What is an unbalanced diet? • Types of unbalanced diets • Nutritional status with unbalanced diet • Tips for enjoying "disliked" foods • Willingness to modify unbalanced diet	• Flip-chart(for education, game) • Booklet • Prize(gift)
5	1. Prevention of food poisoning 2. Food sanitation 3. Program cessation	• What is food poisoning? • Symptoms & prevention of food poisoning • Right food selection(Reading food labels, checking food freshness) • Sanitation at meals • Reminder of dietary guidelines • Review of nutrition education	• Flip-chart • Food labeling • Booklet

meats, vegetables, etc.) using food models, and how to record information in food diary.

The third session covered assessment of dietary intakes, food selection and exercise considering energy balance. Dietary intake was recorded at pretest using 24-hour recalls for two days, and compared with the Korean RDA for 10 – 12 year-old boys or girls. Summary sheets regarding dietary intake, %RDA and nutrition counseling were given to each participant, in order to help them identify deficient or sufficient nutrients in their diet. To supplement the information regarding food selection and exercise, subjects received coated sheets, which explain caloric contents of foods as well as energy expenditure related to exercises coupled with drawings.

The objective of the fourth session was to modify unbalanced diet and eating behavior. Students participated in a game to identify foods that many children liked or disliked. Answers were given based on pretest data. Students learned what unbalanced diet was, and tips for trying and enjoying "disliked" foods. Another game was done to review the importance of eating a variety of foods.

The fifth session dealt with food sanitation, including types of and prevention of food poisoning, tips for food shopping(reading food labels and selecting fresh food). This final session ended with a review of education materials covesed during the five weeks.

4. Measurement

1) Anthropometric measurement

Anthropometrics such as height, weight and body fat percent were measured only at pretest. Height was measured to the nearest 0.5cm using a linear height scale. Weight and body fat percent were measured using bioelectrical impedance analysis(Inbody 3.0, Biospace Co. Ltd., Seoul, Korea).

2) Nutrition knowledge

Nutrition knowledge was measured using 20 items, which were modified from knowledge scales in Lim & Kyung's study(1990). Questions regarding food groups and food sources, the function and deficient symptoms of nutrients, balanced diet, and adequate calorie intakes were measured using "multiple choice" or "true-false-not sure" questions.

The correct answer was given a point, and score of nutrition knowledge was defined as the summated score on correct answers. Subscales of nutrition knowledge were also constructed and examined. Subscales consisted of the following four sections ; function of nutrients(4 items), food sources of nutrients(8 items), balanced diet(4 items), and 4 items related to calories. The score on each subscale was calculated, and changes in nutrition knowledge after nutrition education were examined.

For overall nutrition knowledge based on 20 items, the degree of perceived knowledge and accuracy was also assessed, as in Kim's study(1984). These were defined as follows ;

$$\text{• Perceived knowledge} = \frac{\text{Number of answered items excluding items marked on 'not sure'} \times 100}{\text{Total number of items}}$$

$$\text{• Degree of accuracy} = \frac{\text{Number of 'correct' answers} \times 100}{\text{Number of answered items excluding items marked on 'not sure'}}$$

3) Eating attitudes

Eating attitudes were assessed in areas regarding attitude toward food selection, attitude toward eating meals and changing eating habits, and interest in nutrition and health. Eating attitudes were measured using thirteen items, and were adapted from a previous study(Kim & Kim 1996). Each item was written using 5-point scales ranging from 'strongly disagree' to 'strongly agree'. In data coding, a score was given from 1(strongly disagree) to 5(strongly agree) for positive items. Negatively written items were reversely coded. Eating attitudes were defined as the summated score of each item, with a higher score indicating a more favorable eating attitudes.

Three subscales of eating attitudes were also examined ; 5 items on attitude toward food selection, 6 items on attitude toward diet modification, 2 items on interest in nutrition and health. Higher score denote more favorable attitudes in each subscale, as in overall eating attitudes.

4) Eating behavior

There were two parts in scales for measuring eating

behavior. The first part assessed food patterns, such as number of meals per day, appetite, regularity and quantity of meals, seasoning, and snacking pattern. Participants were asked to choose five frequently consumed foods as snacks among the list of 25 foods(Sin 1993). By comparing the top five food list for snacks between the pretest and posttest, change in food preference for snacks after program implementation was checked.

The second part, consisting of 17 items, assessed how frequently subjects performed certain behaviors, including eating breakfast, eating moderately, eating a variety of foods, exercising, and eating at night. Subjects answered with check marks on a scale from '0－2 days/week', '3－5 days/week', to '6－7 days per week.'

5) Dietary intake

Dietary intake data were collected using two day 24-hour recalls both at pretest and at posttest. Students were asked to write all foods eaten at each meal and for snacks, and portion size of foods eaten for two days. At pretest, the author explained the portion size of frequently eaten foods using food models, to collect more valid information. Nutrient intakes were analyzed using CAN-pro(Computer Aided Nutritional Analysis Program-Professional, Korean Nutrition Society), and the average intake of nutrients for two days was used. To examine the quality of meals, index of nutritional quality(INQ) was also analyzed(Lee et al. 1999).

$$\cdot \text{INQ} = \frac{\text{Dietary intake of specific nutrient per 1,000kcal energy intake}}{\text{RDA of specific nutrient per 1,000kcal}}$$

Only those who completed 24-hour recalls both at pretest and posttest were eligible for dietary intake analysis, and finally data on 39 children(17 boys, 22 girls) were used for dietary intake.

5. Data analysis

Data were analyzed using the Statistical Analysis System(SAS) PC Package. To examine the effectiveness of nutrition education on nutrition knowledge, eating attitudes, eating behavior and dietary intake, paired t-test was used for continuous variables and χ^2-test was employed for categorical variables. These data were examined for all subjects and by sex. Statistical significance was assessed at $\alpha=0.05$.

Results and Discussion

1. General characteristics of subjects

Mean age of subjects was 11.3 years(Table 2). Mean height and weight were 148.2cm and 43.2kg. For boys, mean height and weight were 147.8cm and 42.4kg, which was below the average of 6th grade boys (152.6cm, 44.6kg, Ministry of Education 1996). A similar pattern was observed for girls, based on recent statistics that mean height and weight of 6th grade girls was 153.2cm and 45.4kg(Ministry of Education 1996).

Röhler index was 132.3 on the average, and fell in the normal range of 118 to 148(Table 2). Mean body mass index(BMI) was 19.6, which was also normal. Body mass index, however, may not be an adequate indicator for assessing obesity for children, as Garrow (1988) suggests the limitation of applicability of BMI for groups such as growing children, older adults, pregnant and lactating women.

Mean body fat percent was 21.6% ; body fat percent was higher among girls(23.6%) than among boys (19.5%, $p<0.05$). Previous study reported that body fat percent of the 5th grade students was 21.6%, with 20.9% for boys and 22.3% for girls(Lee 1998), which was similar to the current study. Cheong et al.(1997) also assessed children's body fat in Pusan area, and reported 23.4% of body fat for non-obese and 33.4% for obese children. Cheong et al.(1997) suggest that environmental factors such as economic status affect the prevalence rate of obesity. In this study, subjects were students from private elementary school, thus,

Table 2. General characteristics of subjects

	Total	Boys	Girls
Age(years)	11.3±0.1[1)]	11.2±0.1	11.4±0.1
Height(cm)	148.2±0.8	147.8±1.3	148.6±0.9
Weight(kg)	43.2±0.9	42.4±1.2	43.9±1.3
BMI	19.6±0.3	19.4±0.4	19.8±0.5
Röhler index	132.3±2.1	131.2±2.8	133.3±3.2
Body fat(%)	21.6±0.9	19.5±1.2*	23.6±1.3
Pocket money (won/week)	3360±322	3214±488	3462±443

1) : Mean±SE. n : total=47, boys=24, girls=23.
* : statistically significant between boys and girls at $p<0.05$ by t-test.

we expect that subjects were from middle to high economic status. Although body fat percent was higher in girls than boys in this study, both data falls in normal range, considering a cutoff of 20% for boys and 26% for girls in assessing obesity.

2. Nutrition Knowledge

Changes in nutrition knowledge are presented in Table 3. Mean score of nutrition knowledge at pretest was 12.4 out of 20, and significantly increased to 15.9 at posttest. To adjust for any interpersonal differences in baseline(pretest) scores, a paired t-test was performed. Paired t-test revealed an increase in nutrition knowledge scores by 3.5 points after program implementation($p<0.001$). When changes in nutrition knowledge were examined by sex, it was clear that nutrition knowledge was significantly increased both in boys($p<0.001$) and in girls($p<0.001$), and the change was greater among boys(3.9 point increase after nutrition education) than among girls(3.0 point increase), although this difference by sex was not statistically significant.

Scores on subscales of nutrition knowledge also increased after nutrition education, except the subscale of calories(Table 3). Students were more knowledgeable regarding food sources of nutrients, function of nutrients, and balanced diet after they received nutrition education($p<0.001$). These results are consistent with previous findings that nutrition education increases knowledge and awareness toward nutrition in children(Kim & Kim 1996 ; Park et al. 1994 ; Yoon et al. 2000). Improvement in subscales of nutrition knowledge was seen both in boys and girls. Among those subscales, change in score on food sources of nutrients was greater in boys(2.3 point increase) than in girls(1.3 point increase)($p<0.05$). This finding suggests that nutrition education program had immediate effects in improving nutrition knowledge of children, especially in boys.

The accuracy of nutrition knowledge increased from 69.7% at pretest to 82.1% at posttest, with a 12.4% increase on average when analyzed by paired t-test ($p<0.001$). Accuracy of nutrition knowledge was high-

Table 3. *Comparison of nutrition knowledge score between pretest and posttest*

Variables		Pretest	Posttest[1]	Change[2]	p[3]
Nutrition knowledge[4]	Total	12.4±0.4	15.8±0.4	3.5±0.3***	
	Boys	12.7±0.6	16.5±0.4	3.9±0.4***	NS
	Girls	12.1±0.5	15.1±0.7	3.0±0.5***	
Accuracy(%)	Total	69.7±1.8	82.2±1.8	12.4±1.5***	
	Boys	69.0±2.4	85.3±1.7	16.2±1.7***	p < 0.05
	Girls	70.5±2.8	78.9±3.2	8.4±2.4**	
Perceived Knowledge(%)	Total	88.9±1.4	95.8±0.8	6.9±1.4***	
	Boys	91.5±2.0	96.9±1.2	5.4±2.1**	NS
	Girls	86.3±1.7	94.8±1.3	8.5±1.9***	
Subscales					
1. Food sources of nutrients[5]	Total	4.6±0.2	6.4±0.3	1.8±0.2***	
	Boys	4.6±0.3	6.9±0.3	2.3±0.3***	p<0.05
	Girls	4.7±0.4	6.0±0.5	1.3±0.3***	
2. Function of nutrients[6]	Total	2.0±0.1	2.6±0.1	0.6±0.1***	
	Boys	2.1±0.2	2.8±0.2	0.7±0.2**	NS
	Girls	1.8±0.2	2.4±0.2	0.6±0.2**	
3. Balanced diet[6]	Total	2.9±0.1	3.6±0.1	0.7±0.1***	
	Boys	2.9±0.2	3.7±0.1	0.8±0.2***	NS
	Girls	2.8±0.1	3.6±0.1	0.7±0.2***	
4. Calories[6]	Total	2.9±0.1	3.2±0.1	0.2±0.1	
	Boys	3.1±0.1	3.2±0.2	0.1±0.2	NS
	Girls	2.8±0.2	3.1±0.1	0.3±0.2	

1) : All values are mean±SE. n : total=47, boys=24, girls=23.
2) : *p<0.05, **p<0.01, ***p<0.001, paired t-test using change(posttest-pretest score).
3) : Statistical significance using t-test for change(posttest-pretest score) between boys and girls.
4) : Higher score indicates having more nutrition knowledge, with a possible score of 0 – 20.
5) : Summated score of 8 items. 6) Each of these subscales : summated score of 4 items.

er at posttest compared to pretest both in boys and in girls. Change in accuracy of nutrition knowledge was significantly greater in boys(16.2% increase, $p<0.001$) than in girls(8.4% increase, $p<0.01$). Degree of perceived knowledge was 88.9% at pretest, and changed to 95.8% at posttest, and the change of perceived knowledge was increased by 6.9% after program implementation($p<0.001$). The change of perceived knowledge was greater in girls(8.5% change) than in boys (5.4% change).

Increase in nutrition knowledge might be attributed to the use of motivating teaching methods(eg., games) and learning through repetition. The nutrition educator reviewed previous lessons at the beginning of each class. In the evaluation of the education program, participants answered that games, group quizes regarding nutrition and unbalanced diets were a very interesting and motivating component of their education. It is suggested that methods including learner participation and motivation, especially in nutrition education of children be applied.

3. Eating attitudes

There was little change in eating attitudes after program implementation(Table 4). The average score of all subjects, on eating attitudes was 43.66 at pretest and 43.79 at posttest on the average, with a possible score of 13 to 65. This suggests that subjects' eating attitudes have not been very favorable. Eating attitudes of boys and girls did not change after program implementation, although there was a slight improvement in the score of the boys.

Score on subscales of eating attitudes showed similar results. Attitude toward food selection, attitude toward diet modification and interest in health and nutrition did not change after nutrition education(Table 4). Changes in subscales of eating attitudes showed slightly different patterns between boys and girls, although there was no significant difference. The observed difference in eating attitudes by sex is similar to the findings of Han et al.(1997). Lee et al.(2000) also reported that nutrition attitudes were not different by level of nutrition knowledge. Nutrition attitudes are formed based on nutrition knowledge or beliefs that individuals have. It might be more difficult and take more time to modify eating attitudes.

4. Eating behavior

Eating behavior was measured in two areas. The first part assessed eating behaviors such as number of meals per day, regularity and quantity of meals. This result is presented in Table 5. There was some improvement in overall eating behavior after nutrition education, however, all the variables examined did not reach statistical significance. Children who ate three meals a day increased from 68.1% at pretest to 80.9% at posttest. Those who ate regularly were 63.8% before education and increased to 68.1% after nutrition education. With respect to quantity of meals, those who ate large amounts at mealtime decreased by 10.

Table 4. Comparison of eating attitudes between pretest and posttest

Variables		Pretest	Posttest[1)]	Change[2)]
Eating attitudes[3)]	Total	43.66±1.16	43.79±1.03	0.13±0.73
	Boys	43.29±1.66	43.75±1.50	0.46±1.00
	Girls	44.04±1.65	43.83±1.45	-0.22±1.09
Subscales				
1. Food selection[4)]	Total	16.36±0.56	16.43±0.48	0.06±0.47
	Boys	16.17±0.86	16.71±0.71	0.54±0.67
	Girls	16.57±0.73	16.13±0.67	-0.43±0.64
2. Diet modification[5)]	Total	19.94±0.55	19.87±0.49	-0.06±0.47
	Boys	19.79±0.72	19.54±0.66	-0.25±0.56
	Girls	20.09±0.86	20.22±0.75	0.13±0.78
3. Interest in health & nutrition[6)]	Total	7.36±0.32	7.49±0.29	0.13±0.26
	Boys	7.33±0.38	7.50±0.42	0.17±0.40
	Girls	7.39±0.52	7.48±0.42	0.09±0.33

1) : All values are mean±SE. n : total=47, boys=24, girls=23.
2) : Paired t-test using change(posttest-pretest score). None of them are statistically significant.
3) : Higher score indicates more favorable eating attitudes, with a possible score of 13-65.
4) : Summated score of 5 items. 5) Summated score of 6 items. 6) Summated score of 2 items.

Table 5. Comparison of eating behavior of children between pretest and posttest

Variables	Pretest (n=47)	Posttest (n=47)
Number of meals per day		
2	10(21.3)[1]	7(14.9)
3	32(68.1)	38(80.9)
4	5(10.6)	2(4.3)
Appetite		
Very good/Good	33(71.7)	32(68.1)
Neither good nor bad	12(26.1)	11(23.4)
Very bad/Bad	1(2.2)	4(8.5)
Regularity of meals		
Regular	30(63.8)	32(68.1)
Irregular	15(31.9)	12(25.5)
Skipped meals often because of snacking	2(4.3)	3(6.4)
Quantity of meals		
Eat much	15(31.9)	10(21.3)
Eat adequately	27(57.5)	26(55.3)
Eat slightly less	5(10.6)	11(23.4)
Time spent on eating		
Eating slowly	6(12.8)	7(14.9)
Average	27(57.5)	24(51.1)
Eating fast	14(29.8)	16(34.0)
Seasoning		
Try to avoid salty food	4(8.5)	6(12.8)
Proper	36(76.6)	31(66.0)
Eat or like salty food	7(14.9)	10(21.3)

1) : n(%). Differences between pretest and posttest were not statistically significant by χ^2 test.

6%. Studies reported that children showed eating habits such as skipping meals, skipping breakfast, having an unbalanced diet, and eating quickly(Kim 1999 ; Lee 1998). The current study addressed these problems and showed some possibility of modifying these behaviors through nutrition education.

The most preferred snack foods at pretest were instant noodles(ramyun), breads/cakes, ice bars, biscuits and fruits in order of decreasing frequency. Children in the current study preferred instant or processed foods for snacks, compared to children in a suburban area reported by Lee(1998). At posttest, the top five preferred snack foods were instant noodles(ramyun), breads/cakes, milk, biscuits and ice cream. Thus, there was not much change in snack preference after nutrition education. It is noteworthy, however, that milk was included as a preferred snack at posttest. We emphasized the importance of consuming adequate calcium in diet and recommended participants drink at least a cup of milk a day during nutrition education.

Results regarding the second part of eating behavior are shown in Table 6. As presented, eating behavior did not change significantly after receiving nutrition education. Food consumption patterns were similar to children of Ulsal area(Kim 1999). Among those 17 behaviors examined, only the consumption of soda and other drinks significantly improved. Those who drank carbonated beverages frequently(3 – 5 days/week) were decreased from 57.8% at pretest to 26.1% at posttest($p<0.01$). Some behaviors, such as eating adequate amount at mealtime, eating green vegetables and exercising, improved after nutrition education, although they did not reach statistical significance.

In summary, there was little change in eating behavior after program implementation. This might be explained by the fact that eating behavior is more difficult to change than any of the other variables(eg., knowledge or eating attitudes). Evaluation was done just after program implementation, and short-time period between education and evaluation might be another explanation for the small change in eating behavior. Han et al.(1997) also reported little effects of nutrition education on change in eating behavior. In contrast, Yoon et al.(2000b) found that a 7-week nutrition education program was effective in improving the dietary diversity of children, suggesting the positive aspects of nutrition education on nutrition behavior.

5. Dietary intake

Results regarding dietary intake are presented in Table 7. Mean caloric intake was 1829.1kcal at pretest and 1744.4kcal at posttest, both of which were lower than the RDA for 10 – 12 years old(Korean Nutrition Society 1995). Consumption of protein, vitamin A, thiamin, and ascorbic acid increased after nutrition education compared to baseline, although these changes were not statistically significant. In contrast, consumption of some nutrients including calcium, iron, riboflavin and niacin decreased after nutrition education. However, these changes also did not reach statistical significance(Table 7). Especially, calcium intake was 75.3% of the RDA, and iron intake was 62.2% of

Table 6. Comparison of food consumption patterns of children between pretest and posttest

	Pretest(n=47)			Posttest(n=47)		
	days/week			days/week		
	0-2	3-5	6-7	0 2	3-5	6-7
Eating breakfast regularly	10(21.3)[1)]	13(27.7)	24(51.1)	8(17.4)	14(30.4)	24(52.2)
Eating adequate amount at meals	8(17.0)	21(44.7)	18(38.3)	6(13.0)	15(32.6)	25(54.4)
Consumption of :						
Green vegetables	25(53.2)	17(36.2)	5(10.6)	22(46.8)	23(48.9)	2(4.3)
Vegetables	18(38.3)	26(55.3)	3(6.4)	24(51.1)	16(34.0)	7(14.9)
Protein-rich foods(meat with less fat, fish, eggs, beans)	12(25.5)	24(51.1)	11(23.4)	17(36.2)	21(44.7)	9(19.2)
Fruits	3(6.4)	12(25.5)	32(68.1)	2(4.3)	14(29.8)	31(66.0)
Milk	1(2.1)	6(12.8)	40(85.1)	5(10.6)	9(19.2)	33(70.2)
Seaweed	27(57.5)	15(31.9)	5(10.6)	24(51.1)	18(38.3)	5(10.6)
Food cooked with oils	19(40.4)	26(55.3)	2(4.3)	21(44.7)	21(44.7)	5(10.6)
Soda and other drinks**	13(28.9)	26(57.8)	6(13.3)	27(58.7)	12(26.1)	7(15.2)
Instant food(ramyun, hamburger, fries)	29(61.7)	15(31.9)	3(6.4)	24(51.1)	20(42.6)	3(6.4)
Snacking after school	32(68.1)	12(25.5)	3(6.4)	33(70.2)	10(21.3)	4(8.5)
Eating food at night, except fruits and vegetables	26(55.3)	12(25.5)	9(19.2)	29(61.7)	12(25.5)	6(12.8)
Eating cooked rice more than a serving size at meals	35(74.5)	10(21.3)	2(4.3)	33(70.2)	13(27.7)	1(2.1)
Eating greasy food(eg., high-fat meat, cream, butter)	32(69.6)	12(26.1)	2(4.4)	32(68.1)	14(29.8)	1(2.1)
Snacking while watching TV	26(55.3)	19(40.4)	2(4.3)	28(59.6)	16(34.0)	3(6.4)
Exercising	23(48.9)	15(31.9)	9(19.2)	18(38.3)	18(38.3)	11(23.4)

1) : n(%).
** : $p<0.01$ by χ^2 test. Except consumption of soda and other drinks, differences between pretest and posttest were not statistically significant.

the RDA at posttest. These data raised serious concerns regarding mineral nutrition. Decreased intakes of calcium and iron, however, might be explained by lower energy intake at posttest.

When dietary intakes were examined by sex, different patterns emerged. Most nutrient intakes except iron increased at posttest among boys, while nutrient intakes decreased among girls. For boys, intakes of energy, calcium, vitamin A, and riboflavin increased and became more close to the RDA after nutrition education. Intakes of nutrients including protein, thiamin, niacin, and ascorbic acid were above the RDA at pretest among boys, and the consumption of these nutrients also increased at posttest, suggesting overconsumption of these nutrients in boys.

In contrast, girls' nutrient intakes were significantly lower at posttest compared to pretest. Decreased consumption of nutrients among girls after nutrition education was observed in energy, protein($p<0.001$), iron, riboflavin, niacin($p<0.01$), calcium, and thiamin ($p<0.05$). Lower intakes of nutrients among girls may be attributed to lower energy intake(1555.0kcal) at posttest, compared to pretest(1822.1kcal). It is possible that girls are more concerned about body weight or body shape, and this might explain significantly decreased energy intake among girls at posttest, regardless of nutrition education. Lee(1998) reported that 5th grade girls had a desire to lose weight. According to this survey, 55.6% of normal weight and 29.2% of underweight girls wanted to lose weight, while such a trend to lose weight was not found in boys. Distorted body image or severe dieting has been of interest to many adolescents or young adult women(Kim et al. 1998 ; Park et al. 1997), however, previous studies suggest that younger girls are also interested in losing weight. Inadequate weight control might have adverse effects on health, especially for growing children. Weight management issues, such as ideal body weight,

Table 7. *Comparison of nutrient intake, percentage of RDA between pretest and posttest*

Variables		Pretest	Posttest[1]	Change[2]	p[3]
Energy (kcal)	Total	1829.1 ± 74.3 (90.5)	1744.4 ± 89.0 (85.6)	− 84.8 ± 78.7 (− 4.9)	
	Boys	1838.2 ±128.8 (83.6)	1989.5 ±167.3 (90.4)	151.3 ± 139.6 (6.9)	p<0.05
	Girls	1822.1 ± 89.2 (95.9)	1555.0 ± 71.0 (81.8)	−267.2 ± 69.1*** (−14.1)	
Protein (g)	Total	73.2 ± 3.6 (122.0)	80.9 ± 16.5 (134.8)	7.7 ± 16.8 (12.8)	
	Boys	76.5 ± 6.9 (127.4)	111.7 ± 36.8 (186.1)	35.2 ± 38.0 (58.7)	NS
	Girls	70.7 ± 3.5 (117.9)	57.1 ± 3.3 (95.1)	− 13.6 ± 2.7*** (−22.7)	
Calcium (mg)	Total	633.2 ± 43.3 (79.1)	602.1 ± 49.5 (75.3)	−31.1 ± 48.0 (− 3.9)	
	Boys	650.9 ± 65.8 (81.4)	743.6 ± 90.7 (93.0)	92.8 ± 86.1 (11.6)	p<0.05
	Girls	619.5 ± 58.6 (77.4)	492.7 ± 41.5 (61.6)	−126.8 ± 45.1* (−15.9)	
Iron (mg)	Total	11.5 ± 2.5 (82.0)	8.8 ± 0.7 (62.2)	−2.7 ± 2.5 (−19.8)	
	Boys	14.9 ± 5.8 (124.5)	11.0 ± 1.2 (91.6)	−4.0 ± 5.8 (−32.9)	NS
	Girls	8.8 ± 0.6 (49.1)	7.1 ± 0.6 (39.4)	−1.7 ± 0.6** (− 9.7)	
Vit. A (RE)	Total	455.4 ± 35.0 (75.9)	527.0 ± 57.8 (87.8)	71.6 ± 46.6 (11.9)	
	Boys	506.0 ± 58.4 (84.3)	640.7 ±112.0 (106.8)	134.7 ± 95.1 (22.4)	NS
	Girls	416.4 ± 42.0 (69.4)	439.2 ± 49.9 (73.2)	22.8 ± 37.1 (3.8)	
Thiamin (mg)	Total	1.20± 0.07 (115.6)	1.35± 0.11 (128.3)	0.15 ± 0.08 (12.8)	
	Boys	1.21± 0.11 (109.8)	1.65± 0.21 (150.3)	0.44 ± 0.16* (40.4)	p<0.01
	Girls	1.20± 0.08 (120.0)	1.11± 0.08 (111.4)	−0.09 ± 0.03* (− 8.6)	
Riboflavin (mg)	Total	1.29± 0.07 (104.0)	1.27± 0.10 (101.5)	− 0.03 ± 0.08 (− 2.5)	
	Boys	1.28± 0.12 (98.4)	1.42± 0.21 (109.0)	0.14 ± 0.16 (10.6)	NS
	Girls	1.30± 0.08 (108.4)	1.15± 0.09 (95.7)	−0.15 ± 0.04** (−12.7)	
Niacin (mg)	Total	17.1 ± 1.0 (127.1)	15.8 ± 1.5 (116.9)	−1.3 ± 1.3 (−10.3)	
	Boys	18.3 ± 1.8 (130.4)	20.0 ± 3.0 (143.1)	1.8 ± 2.5 (12.7)	NS
	Girls	16.2 ± 1.2 (124.6)	12.6 ± 1.0 (96.6)	−3.6 ± 1.2** (−28.0)	
Ascorbic acid (mg)	Total	59.0 ± 6.6 (118.0)	67.2 ± 8.2 (134.5)	8.3 ± 5.4 (16.5)	
	Boys	72.9 ± 12.3 (145.8)	80.4 ± 15.8 (160.9)	7.5 ± 11.0 (15.0)	NS
	Girls	48.2 ± 6.2 (96.4)	57.1 ± 7.4 (114.1)	8.8 ± 4.6 (17.7)	

1) : All values are mean±SE. ( ) : % RDA(1995). n : total=39, boys=17, girls=22.
2) : *p<0.05, **p<0.01, ***p<0.001, paired t-test using change(posttest-pretest).
3) : Statistical significance using t-test for change(posttest-pretest) between boys and girls.

adequate calorie intake and exercise, were also addressed in this nutrition education program. Participants, especially for girls, may perceive these topics for weight loss and try to eat less, although the importance of eating adequate calories are stressed in nutrition education.

To examine the quality of meals and to adjust for the differences in energy intake between pretest and posttest, index of nutritional quality(INQ) was also examined. Results on INQ are shown in Table 8. It was observed that INQ for protein, vitamin A, thiamin, ascorbic acid was slightly increased while INQ for iron and niacin was decreased. However, INQ for nutrients examined except thiamin, was not significantly changed after nutrition education.

Changes in INQ for most nutrients, except iron, improved after nutrition education among boys, although change in INQ for thiamin only was statistically significant($p<0.05$). For girls, change in INQ for most nutrients examined were getting worse after nutrition education. More specifically, INQ for protein($p<0.001$), iron, riboflavin($p<0.01$), calcium, thiamin($p<0.05$) decreased after program implementation. Especially the INQ for iron, calcium and vitamin A was below one(ie., standard) among girls at posttest, suggesting concerns for these nutrients in girls. Previous studies reported that elementary school girls consumed inadequate amounts of nutrients except thiamin(Kim 1999 ; Lee 1990). Considering the importance of calcium and iron nutrition for growing girls, these minerals should be the focus of nutrition education for girls in future studies.

In summary, results regarding dietary intakes revealed that boys consumed more nutrients and girls consumed fewer after nutrition education. Especially, overconsumption of certain nutrients in boys and inadequate intakes of energy, calcium, iron, and vitamin A in girls are pointed out. Low consumption of energy and other nutrients among girls compared to st-

Table 8. Comparison of Index of Nutritional Quality between pretest and posttest

Variables		Pretest	Posttest[1)]	Change[2)]	p[3)]
Protein(g)	Total	1.36±0.04	1.48±0.20	0.37±0.49	NS
	Boys	1.50±0.05	1.89±0.45	1.12±1.13	
	Girls	1.24±0.04	1.17±0.05	−0.22±0.04***	
Calcium(mg)	Total	0.90±0.06	0.88±0.05	−0.01±0.07	p<0.05
	Boys	0.99±0.10	1.03±0.09	0.18±0.14	
	Girls	0.82±0.08	0.77±0.06	−0.15±0.06*	
Iron(mg)	Total	1.09±0.39	0.73±0.08	−0.33±0.36	NS
	Boys	1.82±0.88	1.06±0.14	−0.64±0.85	
	Girls	0.52±0.03	0.48±0.03	−0.10±0.03**	
Vitamin A(RE)	Total	0.85±0.07	0.96±0.06	0.11±0.08	NS
	Boys	1.01±0.11	1.11±0.10	0.21±0.16	
	Girls	0.73±0.07	0.85±0.07	0.03±0.06	
Thiamin(mg)	Total	1.27±0.04	1.47±0.07	0.19±0.10*	p<0.01
	Boys	1.31±0.06	1.63±0.11	0.54±0.20*	
	Girls	1.25±0.07	1.35±0.07	−0.10±0.04*	
Riboflavin(mg)	Total	1.18±0.06	1.19±0.06	0.01±0.08	NS
	Boys	1.19±0.10	1.17±0.07	0.16±0.17	
	Girls	1.17±0.08	1.21±0.09	−0.14±0.04**	
Niacin(mg)	Total	1.42±0.07	1.32±0.07	−0.12±0.11	p<0.05
	Boys	1.54±0.09	1.50±0.10	0.14±0.19	
	Girls	1.33±0.11	1.19±0.09	−0.32±0.12*	
Ascorbic acid(mg)	Total	1.33±0.13	1.47±0.13	0.12±0.12	NS
	Boys	1.73±0.23	1.66±0.24	0.08±0.27	
	Girls	1.02±0.12	1.33±0.14	0.16±0.08	

1) : All values are mean±SE. n : total=39, boys=17, girls=22.
2) : *p<0.05, **p<0.01, ***p<0.001, paired t-test using change(posttest-pretest).
3) : Statistical significance using t-test for change(posttest-pretest) between boys and girls.

andard(ie., RDA) might be attributed to the interest and desire to lose weight. In addition, girls were less active during nutrition education ; Boys showed more interest and motivation, and asked more questions. These findings suggest that nutrition education for children be performed by subgroups(eg., sex). Nutrition education for girls might focus on sensible weight control, iron and calcium nutrition.

Nutrition education in this study was effective in increasing nutrition knowledge and some change in dietary intake. The program was implemented only in five sessions. An educator and co-moderator led education for approximately 50 students, and sometimes it was difficult to counsel all students. However, this program provided the opportunity for participants to realize the importance of nutrition, and to motivate them to change eating behavior.

Summary and Conclusion

This study was designed to develop and evaluate a nutrition education program for elementary school children. This nutrition education program consisted of five sessions, and emphasized basic concepts of nutrition including types and function of nutrients, balanced meals, meal planning, and adequate energy intake. Subjects were forty-seven 6th grade children who received nutrition education once a week during June and July, 1999. Program effectiveness was measured using one group pretest-posttest design. Data analysis was done mainly using paired t-test, and chi-square test. The results of this study are summarized as follows.

1) Subjects' mean age was 11.3 years, height and weight was 148.2cm, 43.2kg. Mean BMI was 19.6 and body fat percent was 21.6%. There were no significant differences between girls and boys in these characteristics, except body fat percent.

2) Nutrition knowledge was significantly increased after receiving nutrition education both in boys($p<0.001$) and in girls($p<0.001$). There was also a significant increase in subscales of nutrition knowledge, including food sources of nutrients, function of nutr

3) Eating attitudes were not significantly changed after program implementation. Scores on subscales of eating attitudes were not changed. Similar patterns were observed in eating behavior. The percentage of children who had better eating behavior such as eating three meals a day and having meals regularly, increased after program implementation, although these differences did not reach statistical significance. With respect to food consumption patterns, only the consumption of soda and other drinks significantly improved($p<0.05$) after nutrition education.

4) Results regarding dietary intake showed different patterns between boys and girls. For boys, dietary intakes increased after program implementation and there was a tendency of overconsuming some nutrients. Dietary intake of girls suggest that girls should increase their consumption of energy, iron, calcium and vitamin A. Thus, future nutrition education might specify the topics of education according to sex, and emphasize adequate energy and other nutrient consumption for boys, and sufficient consumption of some nutrients, such as iron and calcium for girls.

5) In conclusion, a five-week nutrition education program is effective in improving nutrition knowledge or some dietary intake, however, this might not be enough to induce changes in food attitudes, eating behavior or dietary intakes. It is suggested that various approaches and continued effort in nutrition education be necessary for elementary school children's nutrition improvement.

■ **Acknowledgement**

We express our sincere gratitude to the teachers who cooperated in implementing nutrition education. We are also grateful to the children who participated in this project.

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