

# Impact of a school-based culinary nutrition education program on vegetable consumption behavior, intention, and personal factors among Korean second-graders

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**BACKGROUND/OBJECTIVES:** Veggiecation was developed to improve children's vegetable consumption through classroom lecture and cooking activities. In this study, we explored potential determinants of vegetable consumption behavior and intention, and examined the impact of Veggiecation on vegetable consumption behavior, intention and personal factors among Korean children.

**SUBJECTS/METHODS:** The 4-week Veggiecation program was implemented for second-graders in South Korea (35 children in the intervention group, 36 in the control group). We identified personal and environmental factors influencing vegetable consumption behavior and intention using multiple regression analyses. Consumption behavior, intention and, personal factors such as preference, attitude, and self-efficacy were compared between the groups before and after the intervention.

**RESULTS:** Children's vegetable consumption behavior was significantly correlated with personal, social-, and physical-environmental factors as well as intention. Among the variables, preference was the most influential factor on intention, and attitude and intention had great influence on the behavior. After the program, children in the intervention group demonstrated significant improvements in vegetable consumption, intention, attitude, preference, and self-efficacy compared with children in the control group.

**CONCLUSION:** Veggiecation, a school-based culinary nutrition education program, improved vegetable consumption and intention, as well as preference, attitude, and self-efficacy, in second-graders. Veggiecation has great potential, as a global program, to increase children's vegetable consumption. This program can be expanded through various channels, such as after-school programs or camps, to provide a positive impact for children.

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## INTRODUCTION

Balanced nutrient intake during childhood is important because of its impact on physical, emotional, and cognitive well-being throughout life. Children's avoidance or low consumption of vegetables is associated with health problems such as constipation, obesity, and chronic diseases as well as micronutrient deficiencies [1]. A wide variety of nutrition interventions have been implemented to increase children's vegetable consumption [2-4]. These interventions should be tailored to the most important determinant to be successful [5].

According to ecological models, four broad influences interact to affect eating behavior: personal (or individual), social, physical, and macro-level environments [6]. Personal factors include attitude, preference, and demographic factors. The social

environment includes interactions with family, friends, peers, and others in the community and can influence eating behavior through role modeling, social support, and social norms. The physical environment includes vegetable availability and accessibility in the place where children spend their time, such as home, school, or after school. The macro-level environment involves policy and economic price structures. Studies have shown that vegetable consumption among children is influenced by personal, social, and physical environmental factors [7-9]. Of all factors, taste preference was found to be the most important and consistent determinant of vegetable consumption in children aged 6-12 years [5].

Since cooking and tasting experience can help increase food preference, nutrition interventions that include cooking as part of their programs have been tried to increase vegetable

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consumption [10-12]. Cooking programs have shown positive effects on children's vegetable preferences, attitude, and behaviors [13].

A nutrition education program, Veggiecation, was created to improve children's acceptance and intake of vegetables through interactive learning and engagement [14]. This program aims at changing behaviors by creating an environment leading to favorable attitude and intention toward vegetable consumption. Children learn about vegetables in nutrition education sessions and participate in cooking and tasting new vegetables. Veggiecation has been expanded to a variety of settings in the United States, including after-school care and camps [15]. The program was implemented in South Korea as part of the globalization of Veggiecation.

The first aim of our study was to explore potential determinants of vegetable consumption in Korean children that can be used as target variables for intervention programs. The second aim was to assess whether Veggiecation (the school-based culinary nutrition education program) increases vegetable consumption, intention, and personal variables such as preference, attitude, and self-efficacy toward vegetable consumption among Korean children.

## SUBJECTS AND METHODS

### *Study design and participants*

We conducted a pre-post, quasi-experimental study in one elementary school in Cheongju, South Korea, where we obtained permission from the principal and teachers to implement the program after explaining the purpose and procedures. Children in two second-grade classes participated in the study. One class (35 children) was designated as the intervention group, and the other class (36 children) was designated as the control group. The teachers gave the children a package with the study information, a consent form, and a checklist to screen for those with allergies to vegetables used in the program to take home. All parents returned written affirmative consents and the checklists. The Institutional Review Board of Chungbuk National University approved the study protocol (CBNU-201405-BMSB-054-01).

Children in the intervention group participated in a four-session cooking program. They were asked to complete questionnaires before and after the program for outcome evaluation as well as a questionnaire for process evaluation after each session. Parents of the children in the intervention group

were also asked to complete a questionnaire after the intervention about activities at home and children's behavioral changes. Children in the control group completed questionnaires before and after the program in which they did not participate.

### *Veggiecation intervention*

We implemented the Veggiecation program for four weeks in June 2014. The intervention consisted of a weekly 40-min session including classroom lecture and hands-on cooking activities. Two vegetables were introduced in each session. Table 1 shows two main vegetables, the name of the dish, cooking activities, and key nutrients in each session. For the first 10 minutes, a nutrition teacher introduced the vegetables and their key nutrients. For the next 30 minutes, the children prepared recipes, with the help of teacher assistants, and tasted the vegetables they prepared. For the cooking activities, we developed eight new recipes including vegetables familiar to Korean children: bell pepper, daikon, zucchini, tomato, sweet potato, spinach, cucumber, and oyster mushroom. To create a learning and interactive environment, Veggiecation posters of program vegetables were translated into Korean and displayed in the intervention classroom [15]. The title song of the original Veggiecation was played in the background during the cooking activities. All preparation and cooking procedures followed the Hazard Analysis and Critical Control Point system guidelines.

### *Questionnaire*

We developed a self-report questionnaire to measure vegetable consumption behavior, intention, and possible influencing factors based on previous studies [7-9,16]. We categorized possible factors as personal, social-environmental, and physical-environmental factors. Demographic questions included the children's gender, the mother's work status, and who prepared the meals at home.

Table 2 presents an overview of the study variables. Vegetable consumption behavior was measured with four statements: I eat vegetables at breakfast, I eat vegetables at school lunch, I eat vegetables at dinner, and I eat more vegetables than my friends. Each statement measured the behavior frequency on a four-point scale (often, sometimes, rarely, and never). The behavior was scored by the mean of the points in the four items. The Cronbach alpha was 0.696.

Intention was assessed using three statements: vegetables are food that I want to eat; I plan to increase vegetable intake; and I plan to eat more vegetables in the next six months. Each

**Table 1.** Main vegetables and contents of the program

	Main vegetable	Name of dish	Cooking activity	Key nutrient and message
Week 1	Bell pepper	Bell pepper rice-ball	Mix & make a ball with a mold	Vitamin A - growth
	Daikon	Diced daikon kimchi	Dice & mix	Dietary fiber - healthy heart
Week 2	Zucchini	Zucchini na-mul <sup>1)</sup>	Mix	Zinc - healthy hair and skin
	Tomato	Tomato juice	Slice & blend	Dietary fiber - constipation prevention
Week 3	Sweet potato	Sweet potato salad	Dice & mash	Vitamin A - bright eyes
	Spinach	Spinach na-mul	Mix	Calcium - healthy bones
Week 4	Cucumber	Cucumber salad	Slice	Vitamin C - disease prevention by enhancing immune function
	Oyster mushroom	Mushroom na-mul	Mix	Dietary fiber - obesity prevention

<sup>1)</sup>Na-mul is a Korean-style vegetable cooking method including blanching and mixing with salt, garlic, sesame seed, and sesame oil.

**Table 2.** Overview of the study variables

Variables	Number of questions	Example of question	Response scale	Cronbach $\alpha$
1. Behavior	4	I eat vegetables at school lunch.	1 = <i>Never</i> , 2 = <i>Rarely</i> , 3 = <i>Sometimes</i> , 4 = <i>Often</i>	0.696
2. Intention	3	I will eat more vegetables in the next six months.	1 = <i>very unlikely</i> to 4 = <i>very likely</i>	0.619
Personal factors				
3. Attitude	3	Eating vegetables is (not enjoyable/enjoyable).	1 = <i>Not very (enjoyable)</i> to 5 = <i>Very (enjoyable)</i>	0.668
4. Preference	8	I (like/dislike) spinach.	1 = <i>Dislike very much</i> to 5 = <i>Like very much</i>	0.777
5. Self-efficacy	1	I can eat vegetables any time I want.	1 = <i>Very unlikely</i> to 4 = <i>Very likely</i>	-
Social-environmental factors				
6. Modeling	3	My mother eats vegetables at every meal.	1 = <i>Very unlikely</i> to 4 = <i>Very likely</i>	0.639
7. Encouragement	3	My mother tells me to eat vegetables.	1 = <i>Never</i> , 2 = <i>Rarely</i> , 3 = <i>Sometimes</i> , 4 = <i>Often</i>	0.775
Physical-environmental factors				
8. Previous exposure	8	I have eaten spinach.	0 = <i>No</i> , 1 = <i>Yes</i>	0.508
9. Availability at home	1	I always have vegetables available at home.	1 = <i>Very unlikely</i> to 4 = <i>Very likely</i>	-
10. Availability at school	1	I always have vegetables available at school.	1 = <i>Very unlikely</i> to 4 = <i>Very likely</i>	-

statement measured the likelihood of the statement on a four-point scale (very likely, likely, unlikely, and very unlikely). The intention was scored as the mean of the points in the three items. The Cronbach alpha was 0.619.

Personal factors included attitude, preference and self-efficacy. The attitude toward eating vegetables was assessed as the mean of the points of three bipolar statements using a five-point scale: eating vegetables is hard/easy, not enjoyable/enjoyable, and not good/good for health. The Cronbach alpha for the attitude measurement was 0.668. Preference was measured by the mean of the scores relative to like or dislike of the eight vegetables used in the intervention on a five-point scale. The Cronbach alpha for the preference was 0.777. Self-efficacy was assessed using the statement "I can eat vegetables any time I want" on a four-point scale (very likely, likely, unlikely, very unlikely). We only included neutral responses for statements assessing attitude and preference in our questionnaire, making it clear that children could express a neutral opinion. The rest of the questions did not include neutral responses to avoid their use as an "I do not know" option for children [17].

Social-environmental factors included modeling and encouragement. Three significant others were listed for the questions to measure modeling and encouragement: mother, father, friends for modeling; and mother, father, a nutrition teacher for encouragement. The Cronbach alphas for modeling and encouragement were 0.639 and 0.775, respectively.

Physical-environmental factors included previous exposure, availability at home, and availability at school. Previous exposure was measured by scoring the experience of eating eight vegetables used in the program. The Cronbach alpha for the previous exposure was 0.508. Availability was assessed by scoring the statement "I always have vegetables available at home/school" on a four-point scale.

Cronbach alpha, a measure of variable reliability, is influenced by the study sample size and the target population's characteristics [18]. The reliability coefficients of mediating variables used in 265 nutrition intervention studies were reported mostly around 0.6-0.7 [18]. In addition, in studies assessing reliabilities of attitude scales, Cronbach alphas ranged between 0.5 and 0.8 among school-aged children, and between

0.4 and 0.7 among preschool children [18]. As the current study participants were second graders, a coefficient above 0.6 should be acceptable [19]. In cases of previous exposure to any of the vegetables used, the Cronbach alpha was not an appropriate reliability measure.

After each session, the children were given another questionnaire for process evaluation to measure the level of comprehension of the lecture, the degree of their satisfaction with cooking, and the taste preference for the vegetables they prepared. A questionnaire for parents after the intervention asked whether the children had brought the program content home, whether the parents saw the recipe used at school and prepared it at home, and whether the children had any changes in their vegetable consumption behavior.

#### Data analysis

Frequency distributions or means and standard deviations for each item were calculated. Pearson correlations were computed between vegetable consumption behavior, intention, and possible factors. Our regression analyses identified the relative influence of theoretical constructs on the intention to eat vegetables and also on the behavior. We entered mean scores of the construct measures into the regression model. To measure the intervention's impact, we compared the mean scores of behavior, intention, and the personal factors within each group before and after the intervention using the paired *t*-test. We also used an analysis of covariance to determine intervention effects between the two groups after the intervention. The variables' values before the intervention served as covariates in these analyses. *P*-values < 0.05 were considered as statistically significant. All statistical analyses were performed using the statistical analysis system software (SAS, version 9.4, SAS Institute Inc., Cary, NC, USA).

## RESULTS

#### Descriptive statistics

Seventy-one children participated in this study, with a 100% survey response. Our participants included 36 boys and 35 girls; 62% of children had working mothers, and 81.7% came from

**Table 3.** Correlations among the study variables (n = 71)

Variables	1	2	3	4	5	6	7	8	9	10
1. Behavior	1									
2. Intention	0.476***	1								
Personal factors										
3. Attitude	0.733***	0.432***	1							
4. Preference	0.473***	0.510***	0.613***	1						
5. Self-efficacy	0.275*	0.343**	0.371**	0.171	1					
Social-environmental factors										
6. Modeling	0.367**	0.299*	0.449***	0.491***	0.135	1				
7. Encouragement	-0.322**	-0.171	-0.278*	-0.339**	-0.087	-0.274*	1			
Physical-environmental factors										
8. Previous exposure	0.362**	0.154	0.323**	0.336**	0.210	0.164	-0.171	1		
9. Availability at home	0.413***	0.138	0.376**	0.278*	0.148	0.339**	-0.089	0.374**	1	
10. Availability at school	0.334**	0.226	0.267*	0.129	0.055	0.043	0.200	0.209	0.253*	1

\*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$  by Pearson correlation analysis

**Table 4.** Regressions explaining intention and behavior to consume vegetables (n = 71)

Variables	Intention				Behavior			
	Model 1		Model 2		Model 1		Model 2	
	Standardized $\beta$	t	Standardized $\beta$	t	Standardized $\beta$	t	Standardized $\beta$	t
Intention	-	-	-	-	0.22	2.26*	0.22	2.26*
Personal factors								
Attitude	0.09	0.66	0.05	0.36	0.69	6.30***	0.60	5.26***
Preference	0.41	3.27**	0.43	3.13**	-0.05	-0.49	-0.09	-0.79
Self-efficacy	0.24	2.22*	0.26	2.38*	-0.05	-0.51	-0.06	-0.63
Social-environmental factors								
Modeling	-	-	0.06	0.50	-	-	0.02	0.21
Physical-environmental factors								
Previous exposure	-	-	-0.08	-0.70	-	-	0.11	1.22
Availability at home	-	-	-0.07	-0.63	-	-	0.12	1.30
Availability at school	-	-	0.17	1.63	-	-	0.08	0.97
Adjusted R <sup>2</sup>	0.302		0.295		0.545		0.563	
F	11.08***		5.18***		21.94***		12.26***	

\*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$  by t-test or F-test in multiple regression analysis

homes in which the mother prepared the meals. The demographic characteristics were similar between the intervention and control groups ( $P > 0.05$ ). The most frequent response to the question about reasons for not enjoying vegetables was taste, followed by texture, lack of exposure to the vegetable, and smell. The response patterns were similar between the two groups ( $P > 0.05$ ) (data not shown).

#### Correlations among the study variables

Table 3 shows the correlations between vegetable consumption behavior, intention, and the study variables. Behavior was significantly correlated with all the variables; attitude ( $r = 0.733$ ), preference ( $r = 0.473$ ), availability at home ( $r = 0.413$ ), modeling ( $r = 0.367$ ), previous exposure ( $r = 0.362$ ), availability at school ( $r = 0.334$ ), and self-efficacy ( $r = 0.275$ ). However, encouragement of parents and a nutrition teacher was negatively correlated with behavior ( $r = -0.322$ ).

Children's intention was positively associated with preference ( $r = 0.510$ ), attitude ( $r = 0.432$ ), self-efficacy ( $r = 0.343$ ), and modeling ( $r = 0.299$ ). Attitude was associated with all variables.

Preference was positively associated with attitude ( $r = 0.613$ ), modeling ( $r = 0.491$ ), exposure ( $r = 0.336$ ), and availability at home ( $r = 0.278$ ), and negatively associated with encouragement ( $r = -0.339$ ). Self-efficacy was not correlated with any environmental variables.

#### Determinants of intention and behavior to consume vegetables

The regression analysis results for intention and behavior are presented in Table 4. We deleted encouragement from the determinant list of intention and behavior before running the regression analyses because encouragement of parents and a nutrition teacher to eat vegetables was negatively associated with the vegetable consumption behavior in children, indicating that children who consumed fewer vegetables were encouraged more as a result.

The first model for intention, which included personal factors alone, explained 30.2% of the variance ( $F = 11.08$ ,  $P < 0.001$ ). Preference and self-efficacy were identified as influencing factors for intention; and preference was the most determining factor. We added environmental factors to the second model

**Table 5.** Comparison of the study variables before and after the intervention

	Intervention group (n = 35)			Control group (n = 36)			
	Before	After	t <sup>1)</sup>	Before	After	t <sup>1)</sup>	F <sup>2)</sup>
Behavior (4) <sup>3)</sup>	3.0 ± 0.7 <sup>4)</sup>	3.3 ± 0.6	2.60*	2.9 ± 0.5	2.9 ± 0.6	0.17	34.42***
Intention (4)	3.6 ± 0.6	3.9 ± 0.4	2.71*	3.5 ± 0.6	3.5 ± 0.5	0.26	26.49***
Attitude (5)	4.2 ± 0.7	4.5 ± 0.7	2.74**	3.9 ± 0.6	3.8 ± 0.5	-0.67	29.64***
Preference (5)	4.0 ± 0.9	4.5 ± 0.6	3.78***	3.9 ± 0.6	3.9 ± 0.7	-0.69	31.06***
Self-efficacy (4)	3.3 ± 0.9	3.7 ± 0.5	1.72	3.2 ± 0.9	3.3 ± 0.8	0.81	8.06**

<sup>1)</sup> Paired t-test<sup>2)</sup> Analysis of covariance<sup>3)</sup> Maximum score<sup>4)</sup> Mean ± SD\*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$  by paired t-test or analysis of covariance**Table 6.** Evaluation of taste of each dish and willingness to eat if provided at school lunch

	Name of dish	Taste <sup>1)</sup>			Willingness to eat <sup>2)</sup>		
		Very tasty (A)	Tasty (B)	A+B	Sure to eat (C)	Try to eat (D)	C+D
Week 1	Bell pepper rice-ball (n = 35)	33 (94.3) <sup>3)</sup>	2 (5.7)	35 (100.0)	34 (97.1) <sup>3)</sup>	1 (2.9)	35 (100.0)
	Diced daikon kimchi (n = 35)	17 (48.6)	13 (37.1)	30 (85.7)	27 (77.1)	8 (22.9)	35 (100.0)
Week 2	Tomato juice (n = 34) <sup>4)</sup>	33 (97.1)	0 (0.0)	33 (97.1)	33 (94.3)	2 (5.7)	35 (100.0)
	Zucchini na-mul <sup>5)</sup> (n = 35)	23 (65.7)	10 (28.6)	33 (94.3)	29 (82.9)	6 (17.1)	35 (100.0)
Week 3	Spinach na-mul (n = 32) <sup>6)</sup>	28 (87.5)	3 (9.4)	31 (96.9)	30 (85.7)	5 (14.3)	35 (100.0)
	Sweet potato salad (n = 32) <sup>6)</sup>	28 (87.4)	2 (6.3)	30 (93.7)	30 (85.7)	4 (11.4)	34 (97.1)
Week 4	Mushroom na-mul (n = 35)	27 (77.1)	5 (14.3)	32 (91.4)	27 (77.1)	7 (20.0)	34 (97.1)
	Cucumber salad (n = 35)	25 (71.4)	7 (20.0)	32 (91.4)	25 (71.4)	4 (11.5)	29 (82.9)

<sup>1)</sup> The answer options were 'very tasty', 'tasty', 'not tasty', 'not tasty at all'. The results for negative answers were not presented because the frequencies were too low.<sup>2)</sup> The answer options were 'sure to eat', 'try to eat', 'will not eat'. The results for negative answers were not presented because the frequencies were too low.<sup>3)</sup> n (%)<sup>4)</sup> One child did not participate in the tasting activity due to tomato allergy.<sup>5)</sup> Na-mul is a Korean-style vegetable cooking method including blanching and mixing with salt, garlic, sesame seed, and sesame oil.<sup>6)</sup> Three children did not participate in the intervention due to absence from school.

for intention. The variance explained by both personal and environmental factors was also significant with 29.5% ( $F = 5.18$ ,  $P < 0.001$ ), yet lower than the variance accounted by the personal factors alone. Our results suggest that intention was mainly dictated by personal factors. In this second model, preference was the most influential factor determining intention.

The first model for behavior explained 54.5% of the variance ( $F = 21.94$ ,  $P < 0.001$ ). The second model for behavior with additional environmental factors accounted for 56.3% of the behavior variance ( $F = 12.26$ ,  $P < 0.001$ ), an increase of 1.8% from the first model with personal factors alone. In both models, attitude and intention were associated with behavior, and attitude had the greatest influence.

#### Impact of intervention on vegetable consumption behavior, intention, and personal factors

Means and standard deviations of variables in the intervention and control groups before and after the intervention are shown in Table 5. We detected no differences between the groups at baseline. We found a significant improvement in vegetable consumption behavior among children in the intervention group ( $P < 0.05$ ). Similarly, we found significant improvements in intention, attitude, and preference among children in the intervention group. On the other hand, children in the control group showed no changes in vegetable consumption or any variables during the period between the two assessments. After

the intervention, controlling for pre-intervention scores, we found the intervention group had significantly higher scores in all the variables, including self-efficacy, than the control group.

#### Process evaluation

After each weekly cooking activity, children completed a short questionnaire about the intervention process. The children expressed high satisfaction with the cooking: all except one child in the second week indicated the cooking activity was fun or extremely fun. The Veggiecation curricula were well understood by the children: over 85% of them expressed full understanding of the lectures. In addition, more than 85% of children rated all program dishes they had prepared as tasty or extremely tasty (Table 6). More than 70% of children answered that they would surely eat the dish if it were provided at school lunch.

The parents in the intervention group completed a post-intervention survey to evaluate the process (85.7% response), and the results are shown in Table 7. The Veggiecation program was well received by the families: 96.7% of parents were aware of the program recipes that children brought home. However, only 43.3% of parents tried the recipes at home. Most parents (83.3%) reported that the children in the intervention group tried new vegetables after the intervention. The vegetables children tried to eat included bell pepper (46.7%), oyster

**Table 7.** Parent survey results (n = 30)

Question	Answer	n (%)
I checked Veggiecation recipes children brought home.	Yes	29 (96.7)
	No	1 (3.3)
I tried to cook vegetables using the recipes.	Yes	13 (43.3)
	No	17 (56.7)
My child tried new vegetables.	Yes	25 (83.3)
	No	5 (16.7)
Vegetables to try to eat <sup>1)</sup>	Bell pepper	14 (46.7)
	Oyster mushroom	7 (23.3)
	Daikon	6 (20.0)
	Tomato	5 (16.7)
	Zucchini	5 (16.7)
	Spinach	2 (6.7)
	Cucumber	2 (6.7)
	Sweet potato	1 (3.3)
I want my child to continue participating in Veggiecation.	Strongly agree	27 (90.0)
	Agree	3 (10.0)
	Disagree	0 (0.0)
	Strongly disagree	0 (0.0)

<sup>1)</sup> Multiple response

mushroom (23.3%), daikon (20.0%), tomato (16.7%), and zucchini (16.7%) in that order. All parents had a positive attitude about continuing the intervention at school.

## DISCUSSION

Our study showed that the vegetable consumption behavior of children was significantly correlated with personal, social, and physical-environmental factors as well as with intention. The regression analyses indicated that vegetable preference was the most influential factor on the intention to eat, and attitude and intention had the greatest influence on vegetable consumption behavior. Therefore, interventions to improve preference and attitude are needed to increase vegetable consumption.

Several strategies are known to improve taste preference for children, such as repeated exposure, exposure in a pleasant physical or social environment, combination of a new taste with a favorable taste, and modeling [20,21]. Hands-on cooking activities played an important role in alleviating neophobia toward unfamiliar vegetables and increased vegetable preference [11-13]. Therefore, an intervention to provide cooking and tasting experiences in a pleasant environment is a good approach for improving taste preference in children.

The culinary nutrition education program, Veggiecation, was designed to introduce new vegetables to children by incorporating kid-friendly vegetable preparation into fun activities and exciting experiences that had a great impact on preference [14]. For example, in a bell pepper rice-ball, we mixed bell peppers (which children dislike the most) with rice (our staple food) to make a star, a triangle or an animal face with a fun shape. Therefore, children did not refuse to eat the bell pepper and even liked it. The increased preference resulted in increased intention.

Intention is defined as the likelihood of performing a behavior, and it is the most proximal behavior determinant according to the theory of planned behavior [22]. Studies have shown that intention is a good predictor of dietary change, and those with higher behavioral intention consume more vegetables [23,24]. Our study confirmed that intention is an important determinant of vegetable consumption.

Attitude refers to the individual's evaluation of a given behavior as favorable or unfavorable. Although the importance of children's attitudes toward vegetable consumption has been inconsistent and depends on the population under consideration [9,16], attitude was a key factor for vegetable consumption in our study. After the intervention, the magnitude of the children's attitudes, as well as their preferences and self-efficacy, increased. These improvements synergistically strengthened the children's intention, thus leading to improved vegetable consumption.

In our study, encouragement of parents and nutrition teachers was negatively associated with vegetable consumption, suggesting that children who consumed fewer vegetables were more encouraged that they eat vegetables as a result. The association between parental encouragement and children's dietary behavior has been inconsistent [5,9] and needs to be further investigated.

The positive impact of Veggiecation on Korean children's vegetable consumption was evident in this study. Another study assessing the effect of Veggiecation on American children also reported increased vegetable intake after the program compared with control children [14]. Having baseline data which were lacking in the aforementioned study strengthens the validity of our study findings. The integrity of the program implementation was supported by the high satisfaction rates and children's behavioral changes perceived by their parents. The most frequent response to the question about reasons for not enjoying eating vegetables was that the vegetable does not taste good. However, after the cooking session, more than 85% of participants stated that the food they made tasted good, and more than 70% declared that they would surely eat it in the future.

Considering the high correlations between vegetable availability and eating behavior of children in the literature [5,25] as well as in our study participants, providing a vegetable-friendly environment at school and at home improves children's vegetable consumption. In our study, the families were aware of Veggiecation's implementation and noticed the children's better acceptance of unfamiliar vegetables. However, they did not try the program vegetable recipes at home. Future interventions should improve communication channels between school and home to produce a larger impact on behavioral changes than that in our study.

The limitations of this study include its small sample size, short duration, and self-reporting of consumption. In addition, the fact that both the intervention and control groups were in the same school may have led to contamination. Future studies should expand this study with a larger sample size and longer duration of the intervention to assess the lasting impact of the intervention.

The current study's strengths include the unique investigation

regarding the determinants of vegetable consumption among Korean elementary school children that identified possible avenues for intervention. In addition, we found significant improvement in attitude, preference, self-efficacy, and intention as well as vegetable consumption in the children participating in the intervention even after only four weeks.

Our study provides evidence that Veggiecation can be globalized and tailored to diverse populations. Developing simple recipes that children can easily prepare and they like may be instrumental for expanding the program. The barrier to implementing school-based culinary nutrition education programs might be tight curriculum for academic achievement even in elementary schools in Korea. In spite of the barrier, efforts should be made to integrate culinary nutrition education into the school curriculum to increase food preference, attitude, and eating behaviors of children to improve their healthy dietary habits.

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## CONFLICT OF INTEREST

The authors declare no potential conflicts of interests.

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