

## Exploratory study on effect of eco-friendly program in high school foodservice on adolescents' dietary behavior and satisfaction with foodservice

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### ABSTRACT

**Purpose:** The purpose of this study was to evaluate the effects of an eco-friendly foodservice program at a high school on dietary behaviors of students, awareness of importance of eco-friendly activities, and foodservice satisfaction. **Methods:** The survey was conducted with students at two schools in Gyeonggi, Korea. A total of 576 of 650 students were used for this study. Data were analyzed using Chi-square test, independent t-test, and factor analysis to test the two group's differences. **Results:** The practices of 'eat balanced meals' or 'finish all food on the plate' scored high ( $p < 0.001$ ) in students that participated in the eco-friendly foodservice program than those who did not. Regarding awareness of the importance of eco-friendly activities, all attributes scored higher in students that participated in the eco-friendly foodservice program. All attributes for satisfaction except two scored higher ( $p < 0.05$ ) in students that participated in the eco-friendly foodservice program. Principal Components Analysis (PCA) of the correlation showed that high subjective income status was positively associated with foodservice satisfaction. **Conclusion:** Students that participated in the eco-friendly foodservice program are highly aware of the importance of eco-friendly activities. They demonstrate more positive dietary behaviors and higher awareness of the importance of eco-friendly programs with greater foodservice satisfaction.

**KEY WORDS:** Eco-friendly program, school foodservice, dietary behavior, satisfaction with foodservice, adolescents

### Introduction

School foodservices are provided to students with the following purposes in Korea: 1) to achieve physical and mental development of students, 2) to improve national dietary life, 3) to maintain sound food policy, and 4) to help students establish healthy eating habit.<sup>1</sup> Since the School Meals Act was established in 1981, school foodservices of elementary, middle, and high schools have been completely implemented nationwide around 2003.<sup>2</sup> According to the report of the Ministry of Education in 2015, a total of 11,619 elementary, middle, high, and special schools have completely implemented school foodservices and 98.0% of them are directly operated from school.<sup>3</sup>

Unhealthy and unbalanced eating habits without much vegetables and fruits in childhood and adolescence are public health problems around the world.<sup>4</sup> Dietary habits and behaviors established from childhood and adolescence

are hard to change during adulthood. Therefore, it is important to establish healthy and balanced meals in childhood and adolescence. One of the effective solutions to promote healthier dietary habits and to provide safer food to students has been proposed by recommending organic school meals with farming experience.<sup>5</sup> In Korea, key trends in school food policy are healthy eating, sustainability, organic foods, and so on.<sup>6</sup> With increasing concerns about sustainable practices in foodservice, use of organic vegetable in meals has been reported to improve students' health,<sup>7</sup> to provide positive perception on environment protection to students,<sup>8</sup> and to understand food production channels better. Moreover, global public attention to environmental damage, climate change, and food insecurity has increased.

Eco-friendly programs can be deployed in school foodservice are included the following activities. First, it includes providing organic school meals for students. A

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study based on the theory of planned behavior has suggested that organic school meals could be more effective in providing healthy food to students and promoting healthy eating habits of students.<sup>5</sup> More specifically, students in schools with organic meals have more positive evaluation toward their school meal experience, including better understanding on environmental-friendly produces. Second, the activities related to farming or gardening activities and making foods such as Kimchi, Doenjang, are included. It helps students to understand how to produce vegetable and make food and how much efforts needed for those activities. From around 2006, in Korea, the importance of eco-friendly consumption has been introduced in school.<sup>9</sup> But, majority of the related education are focused on the knowledge-based training, not experience-centered one. Fortunately, in recent, very limited school foodservice has begun to implement eco-friendly consumption practices such as school gardens and education about environment protection. Through these activities students learn to sustainable consumptions which protect an environment, consider others, and share things with the community.

A previous study reported that eco-friendly programs integrated with school curriculum increase vegetable consumption of students, booster healthy dietary patterns such as eating breakfast or reduction of sweeten beverage consumption.<sup>10</sup> Moreover, from the farm-to-school programs, school meal programs including tastes on meals is reported to be improved by using fresh fruit.<sup>7</sup> Farming or food preparation program<sup>11</sup> helps adolescents have the supportive attitude on food preparation and form a better dietary quality, that is, higher knowledge on sustainable food consumption, more positive attitude on sustainable practice and dietary life. Thus, hands-on eco-friendly program integrated with school curriculum and school foodservice should be developed and customized by school situation.

Recently, several studies have presented the perception and satisfaction of environment-friendly agricultural products among students,<sup>7</sup> parents,<sup>12,13</sup> and dietitians.<sup>14-17</sup> Other studies on eco-friendly foodservice have focused on purchasing position for environment-friendly produces in school foodservice,<sup>18</sup> dietary behaviors of children in care centers,<sup>19</sup> and satisfaction with foodservice in organizations with eco-friendly foodservice day.<sup>7</sup> However, no research has tested whether students with and without having experienced environment-friendly activities especially integrated in high school curriculum including school

lunch program have different students' dietary behaviors or attitudes toward foodservice in Korea. Therefore, the objective of this study was to identify if an eco-friendly program integrated in school curriculum and high school foodservice have an influence on students' dietary behaviors, attitudes, and satisfaction with foodservice providers.

In this study, two schools with or without eco-friendly program were selected. Their students' perceptions on the awareness toward green activities, dietary behaviors, and foodservice satisfaction were compared. The research questions of this study are as follows:

Do students from school with eco-friendly curriculum and eco-friendly foodservice programs have more awareness about the importance of eco-friendly activities?

Do students from school with eco-friendly program and eco-friendly foodservice have more positive dietary behaviors and more satisfy with the foodservice?

## Methods

### Participants and Instruments

A survey was conducted in students of one eco-friendly school and one non-eco-friendly school in Gyeonggi from February 15, 2015, to February 22, 2015. A total of 576 out of 650 were used for the analysis. The rests of them were not analyzed due to missing data. This study included two counterpart schools. One was an 'eco-friendly school'. It had an organic or environment friendly school food policy in place. In Table 1, we compared the schools in terms of food cost for organic food ingredients, operation type, and activities in school curriculum between the eco-friendly school and the non-eco-friendly school. More than 95% of the food cost it serves are organic, non-pesticide, non-antibiotic fresh ingredients (vegetables, fruits, grains, meats and dairy, etc.), and non-additive of processed food ingredients. The other 'non-eco-friendly school' purchases and uses less than 20% of organic ingredients in its school meals. The foodservices of the two schools directly operated by the school, and meal prices were 5,000 won for 'eco-friendly school' and 4,500 won for 'non-eco-friendly school'. The eco-friendly school has special activities related eco-friendly in school curriculum such as gardens, farming activities, making fermented soybean and red pepper paste, rural service and Gimjang (making large quantities of Kimchi for winter) project. For the practices in foodservice, eco-friendly school has 'no plate waste campaign'

**Table 1.** Comparison of characteristics between schools with and without eco-friendly programs

	School with eco-friendly program	School without eco-friendly program
Food cost rate for organic food ingredients in foodservice		
Using organic, non-pesticide, non-antibiotic fresh ingredients (vegetables, fruits, grains, meats and dairy, etc.) and non-additives of processed food ingredients)	More than 95% of total cost	Less than 20% of total cost
Operation type	Self-operation	Self-operation
Meal price	5,000 won	4,500 won
Activities in school curriculum : farm-to-school program		
School gardening	Yes	No
Farming activity	Yes	No
Nutritional education	Yes	Yes
Gimjang project, making Daeonjang	Yes	No
Class activities of eco-system	Yes	No
Activities in school foodservice		
Practice of no plate waste	Always	Seldom (once a month)
Parent volunteering in preparing meals	Yes	No

on every meal and parent volunteering for preparing lunch regularly. On the other hand, the non-eco-friendly school implements no plate waste campaign once a month.

The questionnaire consisted of three sections including general characteristics of respondents and dietary behaviors (3 items including eat balanced meals usually, check nutrition labeling expiration date of foods, and finish all food on the plate usually), students' evaluation on satisfaction of their foodservice (16 items including nutritional and sanitary quality, kindness of dietitian, food taste, and service quality), and awareness of students on the importance of eco-friendly activities in school foodservice.<sup>20,21</sup> These items were measured in a 5-point Likert scale (1, strongly disagree; 3, normal; 5, strongly agree). The study was approved by the institutional review board of Kyunghee University (KHUIRB(SU)-15-G08), Suwon, Korea.

### Data analysis

All data were analyzed using Statistical Package for Social Science (Ver. 21.0, SPSS, Inc., Chicago, IL). For the categorical variables, frequency analysis was used to calculate the frequency (n) and percentage (%). Chi-square test ( $\chi^2$ -test) was used to determine significant differences. Descriptive analysis was used to calculate mean values and standard deviation (SD) for continuous variables. T-test and ANCOVA (Analysis of Covariance) by adjusted variables (gender, age and subjective income status) were performed to analyze significant differences. Principal components analysis (PCA) was conducted to visualize the correlation between general characteristics and foodservice satisfaction.

## Results

### General characteristics of respondents

The general characteristics of respondents are summarized in Table 2, showing significant differences between the two groups in gender, age, grade, family number, subjective income status, residential status of respondents. The mean ages of these respondents were 16.9 years in the eco-friendly school and 17.2 years in the non-eco-friendly school. The percentages of female respondents in the eco-friendly school and the non-eco-friendly school were 53.1% and 66.6 %, respectively. In the eco-friendly school, more than 70% of students lived in apartments, while students in the non-eco-friendly school lived in multi-units house (34.0%) or apartments (38.6%). The majority of respondents in both schools thought that their household income belonged to the medium income class.

### Dietary behaviors of respondents from eco-friendly and non-eco-friendly school

Dietary behaviors of respondents from eco-friendly and non-eco-friendly school are shown in Table 3. The respondents of both schools scored more than 3.5 out of 5 points of all three items about practicing dietary behaviors. The practice of "eat balanced meals usually" or "finish all food on the plate usually" were scored higher by respondents from eco-friendly school than their counterpart ( $p < 0.001$ ). The respondents of non-eco-friendly school practiced the item of "check nutrition labeling and expiration date of food" better than those from eco-friendly school ( $p < 0.001$ ).

**Table 2.** The general characteristics of respondents

	School with eco-friendly program (n = 226)	School without eco-friendly program (n = 350)	Total (n = 576)	p-value <sup>1)</sup>
	n (%)	n (%)	n (%)	
Gender				
Boy	106 (46.9)	117(33.4)	223 (38.7)	***
Girl	120 (53.1)	233 (66.6)	353 (61.3)	
Age				
≤ 16	78 (34.5)	36 (10.3)	114 (19.8)	***
17	72 (31.9)	201 (57.4)	273 (47.4)	
18	76 (33.6)	113 (32.3)	189 (32.8)	
Average age	16.9 ± 0.9 <sup>3)</sup>	17.2 ± 0.6	17.1 ± 0.8	*** <sup>2)</sup>
Grade				
Freshman	75 (33.2)	36 (10.3)	111 (19.3)	***
Sophomore	74 (32.7)	201 (57.4)	275 (47.7)	
Junior	77 (34.1)	113 (32.3)	190 (33.0)	
Family number	4.0 ± 0.8 <sup>3)</sup>	4.3 ± 0.6	4.2 ± 0.7	*** <sup>2)</sup>
Subjective income status				
High	7 (3.2)	6 (1.7)	13 (2.3)	***
Middle-high	78 (35.1)	159 (45.7)	237 (41.6)	
Middle-low	105 (47.3)	176 (50.6)	281 (49.3)	
Low	32 (14.4)	7 (2.0)	39 (6.8)	
Residential status				
Apartment	165 (74.0)	135 (38.6)	300 (52.4)	***
House	29 (13.0)	92 (26.3)	121 (21.1)	
Officetel	3 (1.3)	3 (0.9)	6 (1.0)	
Multi-units house	21 (9.4)	119 (34.0)	140 (24.4)	
Others	5 (2.2)	1 (0.3)	6 (1.0)	

1) p-value by chi-square ( $\chi^2$ -test) 2) p-value by t-test, \*\*\*p < 0.001 3) Mean ± SD

**Table 3.** Dietary behaviors of respondents from schools with or without eco-friendly program

	School with eco-friendly program (n = 226)	School without eco-friendly program (n = 350)	Total (n = 576)	Adjusted p-value <sup>1)</sup>
	Mean ± SD	Mean ± SD	Mean ± SD	
Eat balanced meals usually	3.7 <sup>3)</sup> ± 1.0	3.3 ± 0.5	3.5 ± 0.8	*** <sup>2)</sup>
Check nutrition labeling and expiration date of food	3.2 ± 1.2	3.7 ± 0.6	3.5 ± 0.9	***
Finish all foods on the plate usually	4.2 ± 0.9	3.9 ± 0.6	4.0 ± 0.7	***

1) Adjusted for gender, age and subjective income status 2) \*\*\*p < 0.001 3) Rating scales: 1. Do not practice very well, 3. Normal, 5. Practice very well

### Awareness toward the importance of eco-friendly activities in school foodservice by students from eco-friendly and non-eco-friendly school

Table 4 presents the results of awareness toward the importance of eco-friendly activities by students from eco-friendly and non-eco-friendly school. The important items used for evaluation included nutritional quality of meals, sanitary quality of meals, kindness of foodservice workers, taste of food, service quality, environment-friendly foodservice, and education of dietary life. The respondents from the eco-friendly school scored higher (p < 0.001) for

all seven items than those from the non-eco-friendly school. Especially, the respondents from the eco-friendly school thought that eco-friendly activities deployed in school foodservice could improve the nutritional quality and sanitary quality of meals as well as dietary life of students.

### Satisfaction over school foodservice by students from eco-friendly and non-eco-friendly school

Table 5 shows whether respondents from eco-friendly and non-eco-friendly school were satisfied with their

**Table 4.** Awareness of the importance of eco-friendly activities in school foodservice by students

	School with eco-friendly program (n = 226)	School without eco-friendly program (n = 350)	Total (n = 576)	Adjusted p-value <sup>1)</sup>
	Mean ± SD	Mean ± SD	Mean ± SD	
Improvement of nutritional quality of meals	4.3 <sup>3)</sup> ± 0.8	3.0 ± 0.3	3.5 ± 0.9	*** <sup>2)</sup>
Improvement of sanitary quality of meals	4.2 ± 0.8	3.5 ± 0.7	3.8 ± 0.8	***
Improvement of kindness of foodservice workers	4.1 ± 0.9	3.2 ± 0.5	3.6 ± 0.8	***
Improvement of food taste	3.9 ± 1.1	3.4 ± 0.6	3.6 ± 0.9	***
Improvement of service quality	4.0 ± 0.9	3.4 ± 0.7	3.7 ± 0.8	***
Improvement of environment-friendly foodservice	4.2 ± 0.9	3.4 ± 0.6	3.7 ± 0.8	***
Improvement of dietary life (e.g. eating education)	4.0 ± 1.0	3.4 ± 0.6	3.6 ± 0.8	***

1) Adjusted for gender, age and subjective income status 2) \*\*\*p < 0.001 3) Rating scales: 1. Strongly disagree, 3. Normal, 5. Strongly agree

**Table 5.** Students' evaluation on satisfaction with their foodservice

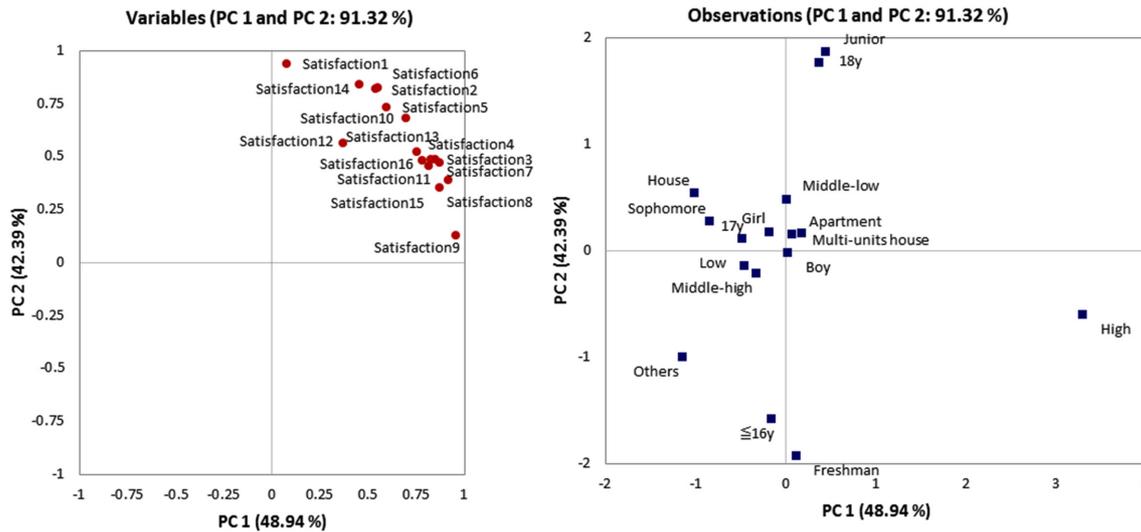
	School with eco-friendly program (n = 226)	School without eco-friendly program (n = 350)	Total (n = 576)	Adjusted p-value <sup>1)</sup>
	Mean ± SD	Mean ± SD	Mean ± SD	
Quantity of food	3.6 <sup>2)</sup> ± 1.1	3.0 ± 0.2	3.2 ± 0.8	*** <sup>2)</sup>
Food taste	3.7 ± 1.0	3.6 ± 0.6	3.6 ± 0.8	*
Food temperature	3.9 ± 0.9	3.2 ± 0.6	3.5 ± 0.8	***
Variety of food	4.0 ± 0.9	3.6 ± 0.6	3.8 ± 0.7	***
Nutritional value of food	4.3 ± 0.8	3.5 ± 0.6	3.8 ± 0.8	***
Good appearance of meals including color	3.4 ± 1.1	3.5 ± 0.6	3.5 ± 0.8	NS
Good sanitary quality of meals	4.3 ± 0.9	3.6 ± 0.6	3.9 ± 0.8	***
Cleanliness of worker including proper work attire	4.4 ± 0.7	3.6 ± 0.5	4.0 ± 0.7	***
Hazard-free of ingredients	4.5 ± 0.7	3.6 ± 0.6	3.9 ± 0.8	***
Cleanliness of food utensils	4.0 ± 0.9	3.6 ± 0.6	3.8 ± 0.7	***
Cleanliness of dining room	4.1 ± 0.8	3.7 ± 0.6	3.8 ± 0.7	***
Proper waiting time for meals	3.6 ± 0.9	3.3 ± 0.8	3.4 ± 0.8	***
Kindness of service worker	4.0 ± 1.0	3.1 ± 0.6	3.4 ± 0.9	***
Rapid response for customers' complaints	3.3 ± 1.1	3.3 ± 0.6	3.3 ± 0.8	NS
Good atmosphere of dining room	4.0 ± 0.9	3.3 ± 0.7	3.6 ± 0.8	***
Health benefits of school meals for me	4.1 ± 0.9	3.3 ± 0.6	3.6 ± 0.9	***

1) Adjusted for gender, age and subjective income status 2) Rating scales: 1. Do not practice very well, 3. Normal, 5. Practice very well 3) NS: No significance, \*p < 0.05, \*\*\*p < 0.001

school meals. For the analysis of school foodservice satisfaction, the top 5 items rated by students from eco-friendly school were: 'hazard-free of ingredients' (score, 4.5), 'cleanliness of worker including proper work attire' (4.4), 'nutritional value of food' (4.3), 'good sanitary quality of meals' (4.3), and 'health benefits of school meals for me' (4.1), in the order from high score to low score. All attributes except two ('good appearance of meals including color' and 'rapid response of foodservice organization on customer's complaints') were rated significantly ( $p < 0.001$ ) higher by respondents in the eco-friendly school than those from the non-eco-friendly school.

#### Principal component analysis of correlation between general characteristics and foodservice satisfaction

Results of PCA for correlation between general characteristics and foodservice satisfaction are presented in Fig. 1. The biplot of PCA accounted for 91.32% of the total variance, with PC 1 and PC 2 explaining 48.94% and 42.39% of total variance, respectively. The attributes that contributed most to the right hand side (the positive direction) of PC 1 were satisfaction attributes of "food temperature", "variety of food", "good sanitation quality of meals", "cleanliness of worker in terms of work attire", "hazard-free of ingredients", "cleanliness of dining-room", "kindness of service worker", "good atmosphere of dining room", and "health benefits of school meals for me"



**Fig. 1.** PC loadings regarding scores of the general characteristics and foodservice satisfaction in organic school

1) Satisfaction 1: Quantity of food, Satisfaction 2: Food taste, Satisfaction 3: Food temperature, Satisfaction 4: Variety of food, Satisfaction 5: Nutritional value of food, Satisfaction 6: Good appearance of meals including color, Satisfaction 7: Good sanitary quality of meals, Satisfaction 8: Cleanliness of worker including proper work attire, Satisfaction 9: Hazard-free of ingredients, Satisfaction 10: Cleanliness of food utensils, Satisfaction 11: Cleanliness of dining-room, Satisfaction 12: Proper waiting time for meals, Satisfaction 13: Kindness of service worker, Satisfaction 14: Rapid response for customers' complaints, Satisfaction 15: Meal atmosphere, Satisfaction 16: Health benefits of school meals for me

(Factor loading  $\geq |0.5|$ ). These are closely associated with high subjective income status, while others of residential status and sophomore among general characteristics were located on the left hand side (the negative direction) of PC 1. The results of PC 2, including attributes of “food quantity”, “food taste”, “nutritional value of food”, “good appearance of meals including color”, and “rapid response for customers' complaints” which were closely related to age of eighteen and junior were located on the right hand side (Factor loading  $\geq |0.5|$ ), while  $\leq$  age of 16 and freshman among general characteristics were negatively related to those attributes.

## Discussion

This study examined whether eco-friendly activities integrated in high school curriculum and school lunch programs have influence on students' dietary behaviors, food service satisfaction as well as awareness about the importance of eco-friendly activities between two schools with or without eco-friendly activities. As presented in Table 1, the eco-friendly school has special eco-friendly school curriculum such as gardening, farming activities as well as eco-friendly foodservice programs (e.g. use of organic foods, no plate waste campaign). Results of this

study revealed that students from eco-friendly school had positive dietary behaviors and higher satisfaction of school foodservice than those from non-eco-friendly school. The practice of “eat balanced meals usually” or “finish all foods on the plate usually” were scored higher ( $p < 0.001$ ) by students from the eco-friendly school than by those from the non-eco-friendly school. Two attributes (‘good appearance of meals including color’ and ‘rapid response for customers' complaints’) were not significant difference between the two groups ( $p > 0.05$ ).

These results might be attributed to the operation of gardening activities as well as eco-friendly meals in the eco-friendly school. This study demonstrates that school food service with eco-friendly program can significantly contribute to the improvement of dietary behavior and quality for adolescents. This point is meaningful in the following perspectives. First, adolescents spend at least 6 ~ 8 hours at school and get up to 50% of their energy from school meals and snacks.<sup>22</sup> Second, childhood health problem and obesity are thought to be due to low consumption of fruit and vegetable. Third, unhealthy dietary patterns for adolescents were pointed as overconsumption of food away from home, and more high-energy and low-nutrient foods.<sup>10</sup> Due to increasing importance of school meal programs, school food services are considering

quality improvements through offering safe and healthy foods using high quality ingredients and by enhancing education of dietary life. Gosliner<sup>23</sup> has reported that institutional school-level factors such as length of the lunch period, visual quality of fruit, and variety of salad bars are closely associated with fruit and vegetable consumption of students, suggesting that school environment is one of the important factors for promoting healthier diet of adolescents.

In the Office of Education at Jeollanam-do, the basic plan of school meals in 2013 suggests to use eco-friendly agricultural products, products approved by Hazard Analysis Critical Control Point (HACCP) system, agricultural products approved by Good Agricultural Practices (GAP), and labeling origin of products with traceability.<sup>24,25</sup> Heo<sup>26</sup> has identified the following effects of organic school meals: 1) it contributes to both physical and mental health of students through providing safe and whole food ingredients and balanced menus, 2) it promotes the sense of community and healthy eating habit, and 3) it provides stable sales of organic agricultural products for farmers. In America, school food service program is also important. It plays a role in promoting students' health and healthy eating behaviors. In 2002, the school lunch and breakfast programs from the National School Lunch Act encouraged schools to purchase locally produced foods, farm-to-school activities such as school garden programs and field trips to local farms, and classroom-taught skills with education.<sup>27</sup> Farm-to school movement in America aims to improve the health of children and adolescents as well as support local farmers. Nicholson et al.<sup>28</sup> have demonstrated that state farm-to-school laws can positively affect the availability of fruits and vegetables in school lunches through a cross-sectional analysis.

In this study, students from the eco-friendly school, not those from the non-eco-friendly school, strongly believed that the eco-friendly activities of the school help the improvement of nutritional quality of meals, sanitary quality, food taste, environment-friendly foodservice, and education of dietary life. Especially, they pointed out that attributes of nutritional and sanitary quality and environment-friendly foodservice were the most important satisfactory factors of school food service. These results are consistent with the findings of a previous study that compared parental perceptions on foodservice between kindergartens with or without environment-friendly produces. The parents of both groups have answered that the main reasons of

purchasing environment-friendly produces are food safety and health.<sup>19</sup>

This study revealed that students from school with eco-friendly program scored much higher in terms of satisfaction with foodservice items, particularly 'hazard-free of ingredients' (score of 4.5), 'cleanliness of worker including proper work attire' (4.4), 'nutritional value of food' (4.3), 'good sanitary quality of meals' (4.3), and 'health benefits of school meals for me' (4.1). Various farm-to-school activities might have induced positive attitudes on organic produces and health, consequently having a positive impact on dietary behavior and customer satisfaction with foodservice. In our study the attributes of food quality, food taste, and variety of menu showed higher scores. These results are thought to be secondary effects from the eco-friendly programs. Through the activities which are experience-centered training in the eco-friendly school such as farming activities, food preparation, the students have increasingly felt the appreciations on the foodservice workers and felt how much required physical labor in meals preparation. So, the students have rated higher satisfaction on foodservice than those of the other.

Similar to our result, a study has reported that the perception of parents on eco-friendly foodservice is positively correlated with their satisfaction with foodservice after the implementation of eco-friendly foodservice in elementary schools.<sup>29</sup> That study has also reported that the satisfaction from parents on foodservice is increased due to 'safer foodservice' (70.5%), 'improvement of foodservice quality' (26.3%), and 'improvement of taste (2.6%)' of the meal'.<sup>29</sup> The eco-friendly school used in this present study has implemented quite a number of "farm-to-school" programs such as purchasing farm fresh or local foods, school gardens, voluntary farm activities, making fermented soybean and red pepper paste, Gimjang (making large quantities of Kimchi throughout winter) project, and offering classes on environment and food system. All school administrators, teachers, parents, and dietitian teacher in this school pay great attention to sustainable foods and environment as well as high quality school foodservice. A previous cross-sectional study has examined the attitudes of young adults toward organic, local, sustainable, and non-processed foods (alternative production practices) as well as their dietary behaviors.<sup>27</sup> They also compared the relationship between preferences for those food and dietary quality. The result showed that approximately 50% of young adults

placed moderate or high importance on those foods. In addition, young adults with positive attitudes toward those food have higher dietary quality.<sup>27</sup> With increasing interest in the quality of life among consumers, environment-friendly food have been rapidly consumed by young housewives and high earners (40~50<sup>th</sup>) in Korea.<sup>13</sup> It has been reported that consumers with high purchase of organic foods are generally more concerned about health and nutrition than their counterparts.<sup>30,31</sup> A study has reported that juice from organic tomato has significantly higher contents of  $\beta$ -carotenoid, phenolic acid, garlic acid, and flavonoid than non-organic tomato juice in Poland.<sup>32</sup> In addition, 6<sup>th</sup> graders with organic school meals in Denmark have positive attitudes toward healthy and organic foods with healthy eating habits.<sup>5</sup>

Some studies have suggested that positive attitudes toward organic, local, sustainable foods among adolescents and young adults are highly associated with greater participation in food farming or shopping and preparation with greater knowledge and concern about the environmental impact of agricultural practices.<sup>11,33</sup> Robinson-O'Brien et al. have examined the characteristics and dietary patterns of adolescents in Minnesota and reported the importance of eating locally grown, organic, non-genetically engineered, and non-processed food. Their result showed that adolescents with supportive attitudes toward alternative production practices tended to have better dietary quality and behavior. Moreover, adolescents who valued those practices were more likely to be nonwhite (especially Asian and Latino Americans) than White/Caucasian because traditional cultural heritage affected their views of food production practices among Asian and Hispanic adolescents.<sup>11</sup> They usually participate in farming or gardening, food shopping, and food preparation. Therefore, they have higher food knowledge and positive attitudes toward sustainable food system and environmental protection.<sup>11</sup> A recent study has determined the effect of school garden programs on academic performance and dietary outcomes of students and found that school garden-based interventions have the potential of increasing students' academic performance and consumption of fruits and vegetables.<sup>34</sup> Research studies on school food service have mostly been focused on food service satisfaction by students and parents.<sup>35-37</sup> Song<sup>38</sup> has suggested that satisfaction of school food-service is associated with various and complex factors such as adequate food intakes, attitudes and emotion of students,

specific culture of school foodservice, teachers' attitudes and perception for school foodservice, and home education. These factors may affect the healthy dietary habit of students, the efficacy of school foodservice, and the satisfaction of school foodservice.

This study has a limitation. It is a case study with two high schools. We could not collect enough survey samples because eco-friendly high schools are very rare in Korea. In addition, the effectiveness of the eco-friend programs in school was evaluated by the self-reporting method from the respondents. The method is pointed to be able to lead to a subjective evaluation. Therefore, caution needs to be taken when interpreting or generalizing the results of this study.

Nonetheless, this study provides important information on how to integrate sustainability concept into school programs. In terms of the implication for students' health, sustainable practices in school are important to ensure that students are healthy and environment is protected.<sup>39,40</sup> Adolescents learn the concept of sustainability or green movement in schools. However, they lack information on how to implement it in real life. The sustainable activities integrated in school curriculum and foodservices operations in schools are good examples for schools and foodservice facilities without any eco-friendly program. In the perspectives of students, they can get hands-on education opportunities so that they can know how to protect the environment, how to make traditional foods, and how to reduce wastes. From this point of view, this study has a good implication for adolescents to practice sound and healthy dietary life. Especially for students who live in urban area with little chance to experience green movement, they only learned about the sustainable concept.

In our result, the score of checking food labeling was higher in students of no eco-friendly school than students of no eco-friendly school. This may results in nutritional education from school or media. Considering that knowledge-focused education is hard to lead behavior changes, the case study is a good example with hands-on education. This study also demonstrated that gardening program of schools had positive effect on satisfaction with foodservice and healthy dietary habits.<sup>41</sup> Previous studies in Korea have tested customer satisfactions with foodservice with or without eco-friendly foods provision. To the best of our knowledge, this study is the first one that examines adolescents' dietary behaviors, satisfaction with foodservice, and awareness of the importance toward the eco-friendly

program in schools by comparing students in schools with or without farming activities as well as organic produces. Our findings suggest that it might be helpful to improve children and adolescents' health by providing fresher and tastier foods through school foodservice with more fruit and vegetable consumption. Our results also provide important information on whether eco-friendly school foodservice should be expanded in Korea. It also contributes to improve students' dietary habits through eco-friendly hands-on education.

In conclusion, our study tested the effect of eco-friendly foodservice and program in high school on dietary behaviors of students, awareness on the importance of eco-friendly activities, and their foodservice satisfaction. The result showed the eco-friendly activities of foodservice and curriculum increased the dietary practices of adolescents, especially in eating balanced meals or reduction of food waste. It also showed positive influences on awareness of students toward the importance of eco-friendly activities and satisfaction with their school foodservice.

### Summary

This study determined the effects of eco-friendly activities in school on dietary behaviors of adolescents, awareness of their importance, and satisfaction with foodservice. Eco-friendly activities included both activities in school curriculum (e.g., school gardening, farm activity, movement of no plate waste) and activities in foodservice (e.g., providing organic/non-pesticide vegetables/on-antibiotic vegetable, dairy, meat). This study found that students from eco-friendly school have more awareness about the importance of eco-friendly activities. In addition, students in the eco-friendly school have more positive dietary behaviors, and more satisfaction with the foodservice than their counterpart.

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