Nutraceuticals & Food
Vol. 7, p.207~214 (2002)

Nutraceuticals and Food

Effect of Cooking Methods and Lifestyle on Elementary School Children's Preference for Vegetables Provided in School Lunches

Hong-mie Lee†

Department of Food Science and Nutrition, Daejin University, Kyeonggi-do 487-711, Korea

Abstract

Food preference of children may be determined by various lifestyle and environmental factors. This study evaluated the effect of rural or urban inhabitance, cooking methods, and frequency of exposure to vegetable dishes on the acceptance of vegetables by 452 fifth grade children. The subjects were students utilizing meal service in public elementary schools in Boryeoung-city, Chungcheong-nam-do (urban); Cheolwon-gun, Gangwon-do (rural); or Pocheon-gun, Kyeonggi-do (suburban). A survey was used to determine the preference of students for 59 foods containing vegetables as a primary ingredient, and categorized by fat content (high, low, or intermediate). Children with working mothers and those living in urban areas tended to have less preference for vegetables than their counterparts in rural areas or with mothers who remained at home. Preference for vegetable foods was correlated with the frequency that vegetable foods were prepared by mothers. Vegetable dishes with a high fat content were preferred over those with low or intermediate fat content, except for soup. This study suggests that children who live in urban areas and whose mothers work outside of the home may be predisposed to nutritional deficiencies due to poor acceptance of vegetable foods, and that all children may be at risk for over-consumption of dietary fat, due to a preference for high fat foods.

Key words: food preferences, vegetables, elementary school children

INTRODUCTION

Consumption of animal foods is increasing in Korea. The increase in animal food consumption may be due to the influence of Western culture, increased affluence of the Korean population, or the development of food technology, which may increase the availability and decrease the cost of animal foods. A shift in food consumption patterns away from vegetables and toward increased animal foods may have a deleterious effect on nutritional status by simultaneously causing over consumption of energy, protein, and fat while decreasing the intake of many vitamins, minerals, and dietary fiber. Furthermore, avoidance of vegetable foods may decrease the intake of many phytochemicals whose dietary value are still not clear, but may be important. Therefore, continued increases in animal foods, at the expense of vegetables, may pose a public health liability in Korea. Avoidance of vegetable foods is more common in children than adults; possibly due to a greater influence of mass media on eating habits. Previous studies have reported that children have a very low preference for vegetables, especially strong-flavored vegetables (1-3).

A well balanced diet is essential for maintaining optimal nutritional status. School lunch menus that do not consider food preferences, even if nutritionally adequate, may not provide adequate nutrition if healthful foods in the menu are avoided. Furthermore, menus that do not consider food preference may result in a general dissatisfaction with the school lunch program (4). When possible, adjusting menus to healthfully accommodate food preferences of students may be the most effective method of improving their diets. Taste preference has been shown by Harneck et al. (5) to be a barrier to changing dietary behaviors in Americans and Han et al. (6) suggested that it may be more difficult to change food preference than nutritional knowledge through nutrition education.

Food preference is determined by multiple factors, including family, dietary experience, health status, nutrition knowledge, as well as variations in climate, soil, and race (7,8). While food preferences of pre-school children are primarily determined by family influences, preferences of school-aged children may be altered by outside influences such as teachers and peers and the changes may occur more rapidly than in younger children (9). School lunch programs are an ideal setting for nutrition education according to Downie et al. (10). Including a wide variety of foods with varied cooking methods in lunch menus

E-mail: hmlee@road.daejin.ac.kr
Phone: 82-31-539-1862. Fax: 82-31-539-1860

provide students with an opportunity to experience new foods and cooking methods that may lead to improved eating habits which can last throughout their lives. Improved nutrition may also facilitate enhanced physical development and scholastic performance.

Food preference should be considered in meal planning for groups of children in order to reduce food waste and improve the nutritive value of the food consumed. Innovative preparation and planning can make less preferred foods more palatable and increase their acceptance by children (11). Knowledge of food preferences and how they are affected by cooking methods may be a useful tool for menu planners, enabling them to include foods not normally accepted by students. However, there have been no previous studies that provided specific data on the acceptance of a large variety of vegetable foods with varied methods of preparation. Therefore, the purpose of this study was to determine the degree of preference of elementary school students for a variety of foods, and to evaluate the effects of lifestyle factors and cooking methods on the acceptance of vegetable foods by the students. This knowledge may enable food service directors to better meet the needs of students and assist them in learning to accept a larger variety of vegetable foods.

METHODS

Four hundred and fifty two fifth grade students from urban, rural, and suburban public school systems and their mothers were enrolled in the study. All students used school meal services for lunch and were from Boryeoung-city, Chungcheong-nam-do (urban); Chelowon-gun, Gangwon-do (rural); or Pocheon-gun, Kyeonggi-do (suburban). Data was obtained from questionnaires in November, 2000.

Questionnaires

Children were asked to respond to their degree of preference for 59 vegetable foods, and to their reason for lack of preference. The foods were categorized by the amount of fat used in preparing them. Cooking methods using intermediate amount of fat (about 2.5 g/serving) were simmering after stir-fry (*jorim*) and stir fry (*bokkeum*). Cooking methods using little or no fat (less than 1 g/ serving) were soup/stew (*jjigae*), steaming, salad with Korean dressing (*saengchae*) and blanching before seasoning (*namul*). Pan cake (*jeon*, 5 g), salad with mayonnaise dressing (5 g/serving) and deep frying (10 g/serving) were cooking methods using large amount of fat.

Preference was evaluated using a 5-point Likert analysis with students indicating: "like a lot", "like", "average", "dislike", and "dislike a lot" as 5 through 1, respectively. Respondents were instructed to mark as 0 for any food they had never eaten, and that data was excluded from the analysis. Vegetable foods included were selected from foods utilized in previously published reports and those included in the menus of the participating schools (12).

Mothers of the students were questioned about frequency of preparing and serving the vegetable foods as well as about family housing, income, family type, and education and employment of their mothers.

Data analysis

All data were analyzed using the SPSS/PC software. A Chi-square test was employed for the analysis of categorical variables (Table 1 and 2). Cooking frequency between regions (Table 2) and means of vegetable preference between general characteristics (Table 3) and regions (Table 5, 6 and 7) were compared by Duncan's multiple range test after analysis of variance (ANOVA). Means of vegetable preferences according to levels of mother's employmental status and type of housing were compared by Student's t-test. Correlation between preferences and cooking frequencies were examined by Pearson's correlation coefficients (Table 4). Differences in preference scores between cooking methods (Table 8) and the effect of the second ingredient added on the preference on vegetable dishes (Table 9) were examined by paired t-test.

RESULTS AND DISCUSSION

General characteristics of the subjects

Significantly more mothers living in Boryeong-city reported having received higher education and living in apartment than those living in rural and suburban areas (Table 1). There were no differences in family type or percentage of working mothers between groups living in urban, suburban, or rural areas. There were no significant differences between areas in income, but there was a trend toward higher income in Boryeong city.

Avoidance of vegetable foods and reasons for preferences

Table 2 shows that significantly more rural children responded that they like vegetables than those from the other regions (74.7% vs 53.3% and 55.0%). It also shows that 58.1% and 41.0% of the total children in this study answered that they like and dislike vegetables respectively. In contrast, it has been shown that 85.3% and 3.5% of elderly persons in Suwon answered that they like and dislike vegetables, respectively (13). This shows that there is a much lower acceptance of vegetables among children than older people. The lower acceptance of vegetables by children than adults or elderly may be physiologically natural. However, the acceptance for vegetable foods among children, especially in urban and suburban regions need to be increased by finding strategies

Table 1. General characteristics of the subjects Number (%)

	City (240)	In-between (121)	Country (91)	Total (452)
Mother's Education				
Middle school graduation	28 (11.9)	6 (13.6)	12 (13.7)	56 (12.7)
High school graduation	137 (58.1)	80 (67.8)	62 (71.3)	279 (63.3)
More than college graduation	71 (30.1)	22 (18.6)	13 (14.9)	106 (24.0)
Total	236	118	87	441*[1)]
Mother's employmental status				
Yes	108 (45.4)	65 (55.1)	40 (45.5)	213 (48.0)
No	130 (54.6)	53 (44.9)	48 (54.5)	231 (52.0)
Total	238	118	88	444
Household income (1,000 Won/month)				
< 1,000	41 (17.5)	28 (23.7)	20 (23.5)	89 (20.4)
1,000~2,000	121 (51.7)	62 (52.5)	52 (60.2)	235 (53.8)
> 2,000	72 (30.8)	28 (23.7)	13 (15.3)	113 (25.9)
Total	234	118	85	437
Type of family				
Nuclear	207 (87.0)	96 (80.7)	70 (79.5)	373 (83.8)
Extended	28 (11.8)	20 (16.8)	16 (18.2)	64 (14.4)
Others	3 (1.3)	3 (2.5)	2 (2.3)	8 (1.8)
Total	238	119	88	445
Type of housing				
Apartment	154 (64.2)	40 (33.1)	32 (35.2)	226 (50.0)
Others	86 (35.8)	81 (66.9)	59 (64.8)	226 (50.0)
Total	240	121	91	452*

[1)]Significantly different between areas.

to include a variety of vegetables in menus. Nutrition education has been recognized to be one important tool for promoting vegetable acceptance among elementary school and pre-school children (14,15).

The reason most frequently given for disliking vegetables was the "unpleasant taste" by both urban and rural students (71.4% and 64.7%, respectively), whereas significantly fewer students in the Pocheon area answered "unpleasant taste" (47.6%) and nearly as many gave "unpleasant texture" (41.3%) as the reason for disliking vegetables. Nevertheless, unpleasant taste was the most common reason for not liking vegetables in all areas, demonstrating the need for new sauces or other methods of preparation to mask the unpleasant taste of vegetables (Table 2).

Vegetables were prepared by mothers an average of 1.7 times per day, and there were no significant differences between areas in the frequency of vegetable preparation and serving (Table 2).

Children's preference for vegetables according to general characteristics

Mother's education, household income, type of family and housing did not affect children's vegetable preference (Table 3). Compared to children of working mother, those of full-time housekeeper had a significantly higher preferences for vegetables prepared as *jorim* and deep-fry and there was a non-significant trend toward lower preference for vegetables steamed, stir-fried, and prepared as *jeon* (pan cake) and *namul* (blanching before seasoning).

There was a correlation between the frequency of preparing vegetable foods by their mothers and preferences for vegetable dishes steamed, stir-fried and prepared as *jeon* (pan cake), *jorim* (simmering after stir-fry) and salad with mayonnaise (Table 4). It remains clarified whether mothers' cooking vegetables frequently results in or from the higher vegetable preference of their children.

Effects of cooking methods and region on vegetable preferences

Rural students, in Cheolwon, had a higher preference for vegetables and responded positively to a greater variety of cooking methods (Tables 5~7). Compared to Boryeong-city and Pocheon-gun (urban and suburban) the Cheolwon students had a significantly higher preference for spinach soup, lettuce *saengchae*, dried radish *muchim*, eggplant *namul*, and *chuinamul*. Boryeoung-city children had a significantly lower preference for spinach *namul*, *siraegi bokkeum*, and eggplant *bokkeum* than those in Cheolwon, and had the lowest overall preference for vegetables of all children in the study. In general, vegetable preference declined from rural to more urban

Table 2. Elementary school children's avoidance for vegetables and the reasons and their mothers' frequencies of cooking and serving vegetable dishes

	City (240)	In-between (121)	Country (91)	Total (452)
Do you like vegetables?				
Yes	128 (53.3)[1)]	66 (55.0)	68 (74.7)	262 (58.1)
No	12 (46.7)	54 (45.0)	23 (25.3)	189 (41.9)
Total	240	120	91	451****[2)]
Why do you dislike vegetables?				
Taste	90 (71.4)	30 (47.6)	22 (64.7)	142 (63.4)
Texture	28 (22.2)	26 (41.3)	6 (17.6)	60 (26.8)
Smell	4 (3.2)	4 (6.3)	2 (5.9)	10 (4.5)
Appearance	0 (0.0)	2 (3.2)	1 (2.9)	3 (1.3)
Others	4 (3.2)	1 (1.6)	3 (8.8)	8 (3.6)
Total	126	63	34	224*
Frequency that mother cooks vegetable dish per day	1.69±0.98 (240)[3)]	1.69±1.06 (119)	1.67±0.98 (88)	1.68±0.10
Frequency that mother serve vegetable dishes per meal				
Rarely	21 (8.8)	12 (10.1)	12 (13.8)	45 (10.1)
1	100 (41.7)	48 (40.3)	30 (34.5)	178 (39.9)
2	77 (32.1)	34 (28.6)	31 (35.6)	142 (31.8)
3	31 (12.9)	21 (17.6)	13 (14.9)	65 (14.6)
4	11 (4.6)	4 (3.4)	1 (1.1)	16 (3.6)
Total	240	119	87	446

[1)]Number (%). [2)]*,****Significantly different among areas at $p<0.05$ and $p<0.0001$. [3)]Mean±Standard deviation (number)

Table 3. Elementary school children's preference for vegetable dishes according to general characteristics

	Soup/*jjigae*	Steamed	Salad with Korean seasoning	Blanched before seasoning	Simmered after stirfry	Stir fry	Pancaked	Salad with Mayonnaise dressing	Deep fry
Frequency that mother cook vegetable dishes per day									
Rarely	3.42 (31)	2.91 (29)	3.03 (22)	2.78 (21)	2.73 (28)[b]	3.13 (15)	3.07 (27)[b2)]	3.75 (43)	4.15 (36)
1	3.41 (130)	2.93 (114)	2.85 (98)	2.77 (98)	2.75 (103)[b]	2.94 (92)	3.33 (118)[ab]	3.79 (157)	4.10 (160)
2	3.55 (110)	3.21 (93)	3.08 (88)	3.03 (88)	3.03 (88)[ab]	3.20 (76)	3.57 (96)[a]	4.04 (120)	4.21 (118)
3	3.50 (47)	2.94 (39)	3.16 (40)	2.87 (36)	3.13 (36)[ab]	3.23 (30)	3.59 (37)[a]	4.01 (57)	4.17 (53)
>4	3.63 (12)	2.64 (11)	3.38 (8)	2.65 (11)	3.20 (10)[a]	3.18 (8)	3.36 (18)[ab]	4.23 (13)	4.28 (13)
Mother's education (years)									
< 9	3.56 (39)	3.05 (33)	2.95 (32)	2.90 (34)	2.94 (33)	2.97 (26)	3.39 (38)	3.78 (48)	4.05 (47)
10~12	3.44 (204)	2.98 (181)	3.06 (161)	2.85 (159)	2.92 (159)	3.12 (144)	3.42 (179)	3.95 (244)	4.23 (241)
> 12	3.52 (83)	3.05 (68)	2.90 (59)	2.82 (58)	2.83 (62)	3.01 (48)	3.47 (68)	3.86 (94)	4.06 (88)
Mother's employmental staus									
Yes	3.47 (163)	2.89 (141)	2.95 (129)	2.79 (125)	2.80 (123)[b]	3.00 (105)	3.36 (139)	3.92 (188)	4.09 (186)[b]
No	3.50 (165)	3.12 (144)	3.04 (127)	2.95 (128)	3.01 (134)[a]	3.17 (116)	3.48 (149)	3.89 (203)	4.24 (193)[a]
Household income (1,000 Won/month)									
1,000	3.42 (65)	2.99 (65)	2.96 (52)	2.81 (49)	2.83 (50)	3.18 (39)	3.28 (57)	3.89 (77)	4.16 (79)
1,000~2,000	3.46 (171)	2.97 (143)	2.98 (134)	2.81 (135)	2.91 (137)	3.01 (115)	3.42 (150)	3.88 (206)	4.14 (200)
>2,000	3.53 (86)	3.12 (72)	3.07 (63)	2.99 (65)	2.93 (65)	3.13 (63)	3.51 (74)	3.85 (107)	4.19 (93)
Type of family									
Nuclear	3.52 (282)	2.99 (219)	3.05 (222)	2.86 (218)	2.93 (219)	3.11 (195)	3.45 (247)	3.90 (330)	4.16 (318)
Extended	3.24 (43)	3.25 (34)	2.81 (31)	3.02 (31)	2.83 (32)	3.08 (22)	3.26 (37)	3.93 (54)	4.15 (54)
Others	3.24 (5)	2.60 (5)	2.78 (3)	2.74 (5)	3.00 (5)	2.65 (4)	3.55 (4)	4.38 (7)	4.38 (8)
Type of housing									
Apartment	3.45 (168)	3.03 (143)	2.98 (127)	2.87 (132)	2.91 (127)	3.09 (113)	3.56 (147)	3.89 (203)	4.17 (194)
Others	3.50 (166)	2.98 (147)	3.04 (131)	2.87 (125)	2.90 (132)	3.09 (111)	3.47 (146)	3.93 (193)	4.15 (191)

[1)]Mean (number). [2)]Numbers sharing the same superscript are not signiticantly different at $p<0.05$. [3)]*Signiticantly different between groups at $p<0.05$.

Table 4. Correlation between elementary school children's preference for vegetable dishes and their mother's frequency of cooking vegetable dishes

	Soup/Stew	Steamed	Salad with Korean seasoning	Blanched before seasoning	Simmered after stirfry	Stir fry	Pan cake	Salad with maynnaise dressing	Deep Fry
Mother's frequency of cooking vegetable dishes	0.076	0.148*	0.096	0.081	0.184*	0.145*	0.148*	0.123*	0.015

*Significantly correlated at $p<0.05$ by Pearson's Correlation Coefficient.

environments except for *doraji namul* and squash *jeon* (pan cake) which were least accepted in Pocheon among the three regions and bean sprout soup which was best accepted in Boryeong city.

Potatoes and bean sprouts were the most preferred vegetables regardless of cooking methods, with the exception of potato salad (Tables 5~7). The preference for potatoes and bean sprouts are in agreement with previous studies in Seoul/Kyeonggi-do (11), Taejeon (12), and Ulsan (16); suggesting that the preference for those vegetables is consistent across all regions of Korea, and that they would be best accepted for new recipes used to increase vegetable usage in school lunch menus.

The cooking methods most preferred by the students in order of preference were: deep fry (4.16) > salad (3.91) > soup/stew (3.48), pancake (3.41) > stir fry (3.08) > *saengchae* (3.01), *jjim* (steaming, 3.0), *jorim* (simmering after stir-fry, 2.91), and *namul* (blanching before seasoning, 2.86) (Table 5, 6 and 7). Cooking methods that utilize higher amounts of fat in preparation were typically the most preferred with the exception of soup/stew, which was a well accepted low-fat food.

Effect of fat content on the vegetable preferences are also shown in Table 8 which compares the preferences

Table 5. Elementary school children's preference for vegetable dishes cooked with little amount of fat

	City (240)	In-between (121)	Country (91)	Total (452)
Soup/stew				
Bean sprout soup	4.07±0.99 (236)[1)a2]	3.78±1.33 (120)[b]	4.00±1.04 (89)[ab]	3.96±1.16 (445)
Potato soup with soybean sauce	3.79±1.13 (225)	3.75±1.27 (106)	3.61±1.24 (88)	3.74±1.19 (419)
Auk (*Malva verticillata*) soup	3.50±1.82 (221)	3.04±1.29 (97)	3.25±1.17 (80)	3.34±1.60 (398)
Spinach soup with soybean sauce	3.25±1.17 (227)[b]	3.21±1.30 (112)[b]	3.61±1.18 (90)[a]	3.32±1.22 (429)
Naengyi (*Capsella bursa*) soup	2.91±1.14 (205)	2.99±1.32 (104)	2.98±1.22 (82)	2.95±1.20 (391)
Total	3.56±0.80 (183)	3.31±0.90 (80)	3.47±0.73 (71)	3.48±0.82 (334)
Steamed				
Perilla leaves	3.05±1.03 (190)	3.05±1.33 (77)	3.05±1.33 (77)	3.08±1.36 (350)
Cabbage	2.83±1.18 (189)	2.67±1.29 (72)	2.67±1.29 (72)	2.81±1.25 (344)
Total	3.00±1.02 (157)	2.89±1.06 (65)	2.87±1.06 (65)	3.00±1.07 (290)
Salad with Korean seasoning (*Saengchae*)				
Cucumber *saengchae*	3.37±1.26 (211)	3.45±1.48 (108)	3.27±1.23 (85)	3.37±1.31 (404)
Lettuce *saengchae*	3.18±1.10 (207)[b]	3.12±1.22 (100)[b]	3.54±114 (85)[a]	3.24±1.15 (392)
Radish *saengchae*	3.05±1.28 (202)	3.04±1.51 (90)	3.04±1.08 (74)	3.05±1.30 (366)
Dried *radish saengchae*	2.77±1.31 (201)[b]	2.91±1.54 (106)[b]	3.39±1.29 (80)[a]	2.93±1.39 (392)
Dalae muchim	2.52±1.22 (192)	2.65±1.26 (91)	2.68±1.23 (73)	2.29±1.23 (356)
Doraji (*Platycodon grandiflorum*) *saengchae*	2.45±1.19 (201)	2.23±1.31 (106)	2.40±1.22 (84)	2.38±1.23 (391)
Total	2.97±0.82 (136)	3.01±1.00 (60)	3.10±0.74 (56)	3.01±0.85 (258)
Blanched before seasoning				
Bean sprout *namul*	3.99±1.08 (231)	3.77±1.24 (117)	3.98±1.13 (89)	3.93±1.14 (437)
Spinach *namul*	2.97±1.24 (236)[b]	3.40±1.30 (118)[a]	3.68±1.20 (91)[a]	3.23±1.28 (445)
Naengyi (*Capsella bursa*) *namul*	2.63±1.11 (202)	2.83±1.38 (105)	2.89±1.24 (84)	2.74±1.22 (391)
Minari (*Oenanthe stolonifera*) *namul*	2.52±1.18 (211)	2.65±1.12 (102)	2.77±1.36 (86)	2.60±1.23 (399)
Eggplant *namul*	2.30±1.02 (200)[b]	2.59±1.36 (100)[b]	2.93±1.32 (82)[a]	2.51±1.21 (345)
Chuinamul	2.30±1.11 (188)	2.41±1.38 (81)	2.59±1.24 (75)	2.39±1.21 (345)
Ssukgat namul	2.35±1.00 (201)	2.24±0.96 (102)	2.41±1.16 (83)	2.33±1.02 (386)
Total	2.72±0.80 (135)[b]	2.97±1.00 (59)[ab]	3.06±0.95 (60)[a]	2.86±0.89 (254)

[1)]Mean±standard deviation (number).
[2)]Numbers sharing the same superscript are not different at $p<0.05$.

Table 6. Elementary school children's preference for vegetable dishes cooked with moderate amount of fat

	City (240)	In-between (121)	Country (91)	Total (452)
Simmered after stir-fry (*Jorim*)				
Potato *jorim*	3.73±1.06 (227)[1)]	3.87±1.22 (110)	3.89±1.15 (89)	3.80±1.12 (426)
Ueong (*Arctium lappa*) *jorim*	2.57±1.13 (160)	2.79±1.16 (71)	2.48±1.08 (66)	2.60±1.13 (297)
Green pepper *jorim*	2.11±1.07 (186)	2.16±1.22 (91)	2.24±1.03 (74)	2.15±1.10 (350)
Total	2.88±0.75 (141)	3.03±0.79 (61)	2.84±0.77 (57)	2.91±0.76 (259)
Stir fry (*Bokkeum*)				
Potato *bokkeum*	4.08±1.08 (238)	402±1.01 (115)	4.13±1.07 (90)	4.14±1.06 (443)
Sweet potato stem *bokkeum*	3.61±1.22 (199)	3.70±1.29 (105)	3.74±1.29 (88)	3.66±1.25 (392)
Vegetable *bokkeum*	3.46±1.21 (225)	3.44±1.33 (112)	3.77±1.19 (90)	3.62±1.24 (427)
Perilla leaves *bokkeum*	3.41±1.30 (224)	3.32±1.14 (108)	3.62±1.25 (90)	3.43±1.32 (422)
Water brown seaweed (*Mulmyeok*) *bokkem*	2.83±1.20 (199)	3.00±1.45 (92)	2.93±1.35 (80)	2.89±1.30 (371)
Dried green (Siraegi) *bokkeum*	2.75±1.13 (217)[b2]	2.87±1.28 (112)[ab]	3.14±1.25 (90)[a]	2.87±1.20 (419)
Squash *bokkeum*	2.75±1.15 (125)	2.70±1.36 (104)	2.87±1.35 (87)	2.76±1.25 (406)
Mushroom *bokkeum*	2.59±1.17 (227)	2.62±1.40 (109)	2.93±1.44 (89)	2.67±1.30 (425)
Radish *bokkeum*	2.62±1.11 (194)	2.62±1.16 (92)	2.67±1.12 (78)	2.63±1.12 (364)
Eggplant *bokkeum*	2.26±1.07 (200)[b]	2.56±141 (99)[ab]	2.80±1.44 (85)[a]	2.46±1.27 (384)
Chuinamul bokkeum	2.32±1.04 (185)[b]	2.42±1.23 (89)[b]	2.81±1.20 (80)[a]	2.46±1.14 (354)
Doraji (*Platycodon grandiflorum*) *namul*	2.49±1.18 (211)[ab]	2.19±1.26 (92)[b]	2.58±1.33 (89)[a]	2.43±1.24 (407)
Total	3.05±0.68 (117)	3.04±0.87 (54)	3.21±0.69 (53)	3.08±0.73 (224)

[1)]Mean±standard deviation (number). [2)]Numbers sharing the same superscript are different at $p<0.05$.

Table 7. Elementary school children's preference for vegetable dished cooked with large amount of fat

	City (240)	In-between (121)	Country (91)	Total (452)
Pan cake (*Jeon*)				
Potato *jeon*	3.91±1.06 (223)[1)]	4.03±1.16 (144)	3.94±1.22 (90)	3.95±1.12 (427)
Perilla leaf *jeon*	0.32±1.31 (205)	3.40±1.42 (94)	3.38±1.26 (81)	3.35±1.33 (380)
Squash *jeon*	3.38±1.25 (211)[a2)]	2.86±1.37 (107)[b]	3.06±1.38 (87)[ab]	3.17±1.32 (405)
Onion *jeon*	3.17±1.37 (223)	3.29±1.38 (111)	2.96±1.26 (82)	3.16±1.36 (416)
Scallion *jeon*	3.18±1.27 (199)	2.89±1.29 (91)	3.04±1.32 (81)	3.08±1.29 (371)
Total	3.47±0.84 (150)	3.38±0.77 (76)	3.32±0.93 (67)	3.41±0.84 (293)
Salad with mayonnaise dressing				
Vegetable salad	3.91±1.17 (236)	3.92±1.37 (118)	4.21±1.03 (91)	3.98±1.20 (445)
Potato salad	3.78±1.31 (220)	3.73±1.42 (114)	3.87±1.35 (89)	3.78±1.35 (423)
Cabbage salad	3.65±1.29 (228)	3.81±1.42 (107)	3.97±1.26 (86)	3.76±1.32 (421)
Total	3.86±0.87 (211)	3.95±1.06 (101)	3.98±0.95 (84)	3.91±0.95 (396)
Deep fry (*twigim*)				
Potato *twigim*	4.40±0.95 (233)	4.49±0.88 (118)	4.48±0.84 (89)	4.44±0.91 (440)
Sweet potato *twigim*	4.33±0.90 (238)	4.47±0.88 (119)	4.42±0.86 (91)	4.39±0.89 (448)
Vegetable *twigm*	3.54±1.25 (207)	3.67±1.28 (99)	3.76±1.26 (86)	3.62±1.26 (392)
Total	4.11±0.74 (204)	4.20±0.70 (97)	4.22±0.64 (84)	4.16±0.71 (385)

[1)]Mean±standard deviation (number). [2)]Numbers sharing the same superscript are not significantly different at $p<0.05$.

of same vegetables prepared differently. The method using more fat significantly increased preference scores of most vegetables (Potato *jorim* or *bokkeum* → deep fry, potato *jorim*→*bokkeum*, vegetable *bokkeum*→salad with mayonnaise dressing, squash *bokkeum*→pan cake, steamed cabbage and perilla leaves→*bokkeum*). Exception is soup. Spinach, naengyi and bean sprout are not better accepted when served as a namul to which alittle fat is added as a seasoning compared when served as a soup which is prepared without additional fat.

Although students in all three areas reported a high preference for deep fried vegetables, this method of cooking is the least acceptable from a nutritional standpoint since it is high in fat and may contribute to the increasing obesity rates among elementary school students (17). It is noteworthy that there is not a higher preference for deep-fried foods than steamed or braised foods among elderly people according to the previous studies (13,18), which examined a broad range of foods. Fried foods were the least preferred type of side dishes among the elderly

Table 8. Effect of cooking methods on the children's preference for the same vegetables

Vegetables	Number	Cooked with less fat		Cooked with relatively more fat	
		cooking method	preference	cooking method	preference
Potato	420	jorim[2)]	3.80±1.12	deep fry	4.45±0.90**[1)]
Potato	433	stir fry	4.15±1.06	deep fry	4.44±0.92**
Vegetables	380	stir fry	3.54±1.24	deep fry	3.63±1.26
Vegetables	423	stir fry	3.54±1.24	salad[3)]	4.00±1.18**
Squash	388	stir fry	2.87±0.65	pan cake	3.19±1.33**
Potato	422	jorim	3.80±1.12	stir fry	4.16±1.05**
Cabbage	332	jjim[4)]	2.81±1.24	stir fry	3.73±1.32**
Perilla leaves	344	jjim	3.08±1.36	stir fry	3.42±1.31**
Cuinamul	345	namul[5)]	2.55±1.16	stir fry	2.49±1.14*
Spinach	426	soup	3.33±1.22	namul	3.24±1.28
Naengyi	379	soup	2.94±1.21	namul	2.75±1.21**
Bean sprout	434	soup	3.97±1.11	namul	3.93±1.14

[1)]*,**Signiticantly different by cooking method at $p<0.001$, $p<0.005$.
[2)]Simmered after stir-fry. [3)]Salad with mayonnaise dressing. [4)]Steamed. [5)]Blanched before seasoning.

subjects in that study. The stronger preference of fried foods among elementary school students may suggest a shift in dietary preferences due to Western influence.

Effect of other ingredients on vegetable preferences

It may be possible to increase the acceptance of vegetable foods by combining less preferred vegetables with more preferred vegetables or animal foods. Therefore, the effect of combinations on the acceptance of vegetables was examined (Table 9). Adding other vegetables or clams tended to decrease the preference scores for vegetables, whereas the addition of animal foods to green onion *jeon* (pan cake) and vegetable *bokkeum* (stir fry) significantly increased the preference scores (assorted seafood and small octopus, hamor beef).

SUMMARY

The goal of this study was to evaluate factors affecting the preferences for vegetables of elementary school students, with the ultimate objective of facilitating strategies for increasing the acceptance of vegetable foods by children. The subjects were 452 5th grade students and their mothers from Boryeoung-city, Chungcheong-nam-do (urban); Cheolwon-gun, Ganwon-do (rural); and Pocheon-gun, Kyeoggi-do (suburban). Surveys of students evaluated preference for vegetable foods and how they were affected by cooking methods, region, exposure to the foods at home, and lifestyle characteristics. A summary of the results are as follows:

1. Preference scores for vegetables among the students in this study were much lower than previously reported for the elderly, and was lowest among urban students. Children of working mother tended to have less preference for vegetables than their counterparts with mothers who remained at home.

2. There was a correlation between preference scores for vegetable dishes and the frequency of preparing vegetable foods by their mothers.

Table 9. Effect of other ingredient added on childen's preference for vegetable dishes

Vegetable dishes	Second ingredient	Preference score		Number
		before addition	after addition	
Spinach soup	Clam	3.39±1.17[1)]	3.01±1.27**[2)]	337
Bean sprout soup	Clam	3.98±1.13	3.17±1.28**	352
Cucumber *sangchae*	Scallion	3.39±1.31	3.09±1.26**	361
	Wild garlic (*dalae*)	3.36±1.33	3.10±1.30**	370
Radish *saengchae*	Oyster	3.09±1.29	2.73±1.27**	306
	Green laver (*parae*)	3.03±1.29	2.59±1.21**	307
Mushroom *bokkeum*	Green onion	2.72±1.40	2.44±1.19**	326
Vegetable *bokkeum*	Small octopus (*nakji*)	3.41±1.36	3.81±1.22**	394
	Beef	3.53±1.24	3.88±1.08**	418
	Ham	3.53±1.22	4.16±1.06**	428
Green onion *jeon*	Seafoods	3.19±1.35	3.37±1.38*	365
Potato *twigim*	Potato crocket	4.42±0.92	3.92±1.15**	418

[1)]Mean±standad deviation. [2)]*,**Significantly different at $p<0.05$ and $p<0.001$.

3. Large amounts of fat and deep-frying increased the preference scores for most vegetables, suggesting that a preference for fat may lead to excessive fat consumption and possibly obesity among children with a exception of soup which was a well accepted low fat vegetable food.

4. The predominant reason for disliking vegetables was "unpleasant taste"; demonstrating the need for the development of new sauces and methods of preparation to improve the taste of vegetables.

5. It was also demonstrated that addition of animal foods to vegetables can increase student's acceptance of those foods.

There are some limitations to this study in regards to sample size and limited number of regions within Korea. However, this study clearly demonstrates that there is a need for better understanding of factors that influence food choices by children and underscores the importance of continued research in this area. This study confirmed many aspects of previous studies that reported a low tolerance of vegetables by children, and evaluated the factors that may be responsible for poor acceptance of vegetables by children. The development of new cooking methods that utilize less fat, but remain acceptable to children, would be expected to help reverse the trend toward increasing obesity among elementary school students. Finally, it is concluded that acceptance of vegetables by children may be improved by preparing as soup, adding animal foods to recipes and by masking the flavor of some vegetables.

ACKNOWLEDGEMENTS

This work was supported by Daejin University Research Fund in 2001.

REFERENCES

1. Yeon HS, Rhie SG. 2000. Meal behavior and food preferences by different body types of 6th grade elementary school children residing in Anyang city. *J Comm Nutr* 2: 97-104.
2. Kim CI, Park YS, Chun HJ. 1998. Characteristics and discriminant analysis of the food preferences of rural obese children. *Kor J Comm Nutr* 3: 810-817.
3. Cheong HS. 1995. A study on the relationship between nutrition knowledge and food habit of mothers and food preference and other factors of their elemtntay school childen. *J Kor Home Economics* Assoc 33: 207-223.
4. Lee MS, Park YS, Lee JW. 1998. Comparisons of children' and parents' satisfaction of school lunch program in elementary school children by foodservice system. *Kor J Nutr* 31: 179-191.
5. Harneck L, Block G, Lane S. 1997. Influence of selected environmental and personal factors on dietary behavior for chronic disease prevention: A review of the literature. *J Nutr Edu* 29: 306-312.
6. Han HY, Kim EK, Park KW. 1999. Effects of nutrition education on nutrition knowledge, food attitude, food habits, food preference and plate waste of elementary school children served by the national school lunch program. *Kor J Nutr* 30: 1220-1228.
7. Axelson ML. 1986. The impact of culture on food-related behavior. *Ann Rev Nutr* 6: 345-363.
8. Rozin P, Vollecke TA. 1986. Food likes and dislikes. *Ann Rev Nutr* 6: 433-456.
9. Birch I. 1987. The role of experience in children's food acceptance pattern. *J Am Diet Assoc* 87 (Suppl 9): 536-544.
10. Downie R, Tannahill C, Tannahill A. 1996. *Health Promotion.* 2nd ed. Oxford Univ. Press, London. p 110-113.
11. Yim KS, Lee TY. 1998. Menu analysis of the national school lunch program: The comparison of the frequency of menu with the students' food preference. *J Kor Diet Asso* 4: 188-199.
12. Koo NS, Park CI. 1998. Food preference of elementary school children under meal service in Taejon. *Kor J Comm Nutr* 3: 440-453.
13. Yim KS, Min YH, Lee TY, Kim YJ. 1998. Strategies to improve nutrition for the elderly in Suwon: Analysis of dietary behavior and food preferences. *Kor J Comm Nutr* 3: 410-422.
14. Lee YJ, Kim GM, Chang KJ. 2000. The analysis of effect on nutrition education of elementary school children, Inchon. *J Kor Diet Assoc* 6: 86-96.
15. Park SJ. 2000. The effect of nutrition education program for elementary school children - especially focused on being familiar with vegetables. *J Kor Diet Assoc* 6: 17-25.
16. Kim HK. 1999. Nutritional status and food preference of school children in Ulsan. *Kor J Comm Nutr* 4: 345-355.
17. Kang YJ, Hong CH, Hong YJ. 1997. The prevalence of childhood and adolescent obesity over the last 10 years in Seoul area. *Kor J Nutr* 30: 832-839.
18. Kim JH, Koo BK, Kim KJ, Baek JW, Lee YK, Lee SK, Lee HS. 1999. Characteristics of eating behaviors of the long-lived elderly people in Kyungpook Sung-Ju. *Kor J Comm Nutr* 4: 219-230.

(Received April 1, 2002; Accepted June 3, 2002)