

Original Article

Fruit and vegetable intake of Korean children and adolescents according to cooking location and daily meal: study based on 2010 and 2011 Korea National Health and Nutrition Examination Survey data

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Background and Objectives: This study analyzed the intake of fruits and vegetables by cooking location and daily meals for Korean children and adolescents. **Methods and Study Design:** For this study, 2,538 Korean children and adolescents aged 7–18 years, who participated in the 2010 and 2011 Korea National Health and Nutrition Examination Survey dietary intake survey (24-hour recall methods), were sampled. **Results:** The total unsalted vegetable and fruit intake for all subjects was 300 g (aged 7–12 years, 280 g; aged 13–18 years, 316 g). Regarding cooking location, the combined unsalted vegetable and fruit intake was 159 g at home, 206 g at commercial locations, and 104 g at institutions. The combined unsalted vegetable and fruit intake in snack form was 128 g, which was higher than that during daily meals. In total, 24.9% of subjects satisfied the recommended fruit and vegetable intake (≥ 400 g), according to the guidelines created by the World Health Organization/World Cancer Research Fund. Logistic regression analysis results revealed that the fruit and vegetable intake of girls was 1.4 times higher than that of boys, and the number of people who ate more than 400 g of fruits and vegetables was 1.7 times higher in the group with higher education. **Conclusions:** Based on the above results, in-depth measures to continuously increase intake of fruits and vegetables in children and adolescents are needed. This study can be used as basic data for the development of educational programs for dietary improvements.

Key Words: vegetable, fruit, child, adolescent, KNHANES

INTRODUCTION

Preferences for foods are established in childhood, and the foundation of dietary habits and dietary life is formed.¹⁻³ Dietary habits in this period not only affect the physical and mental growth directly, but also influence adolescent growth and health, as well as lifetime health and nutrition status indirectly.⁴ Adolescence is a transitional period from childhood to adulthood, in which there is rapid intellectual, emotional and physical development, and the need for various nutrients is greatly increased. Thus, it is also a period that requires proper dietary habits, as in childhood.^{5,6} However, an imbalance in the dietary life of Korean children and adolescents has been indicated as a big problem due to the introduction of a westernized diet that includes instant and fast foods.^{7,8} In particular, a decrease in fruit and vegetable intake has become a serious problem.^{6,7,9,10} Fruits and vegetables are rich in micronutrients, such as vitamins, minerals, and physiologically active substances, and studies have reported that fruits and vegetables help relieve various stresses and prevent cancer, obesity, and cardiovascular diseases.^{6,9,11-13}

The recommended fruit and vegetable intake according to the National Cancer Institute in the United States is more than five servings through the '5 A day for better Health (5 A Day)' program.¹⁴ The World Health Organi-

zation (WHO)¹⁵ and the World Cancer Research Fund (WCRF)¹⁶ has recommend eating more than 400g of fruits and vegetables a day. In Korea, the nutrition section of the Third National Health Promotion Plan (2011–2020) suggests more than 500 g of fruits and vegetables daily.¹⁷ However, according to the in-depth report of the 2010 and 2011 Korea National Health and Nutrition Examination Survey (KNHANES), the daily intake of fruits and vegetables in Korean children and adolescents was less than 400 g.^{18,19}

Studies on fruit and vegetable intake in Korean children and adolescents have largely focused on the current intake status,^{20,21} dietary behaviors,^{22,23} preference,^{3,9,10,24} effects of nutrition education,^{4,25} and clinical studies.⁶ Previous studies have reported that fruit and vegetable intake in childhood and adolescence is very important for physical growth, health maintenance, and chronic disease prevention in adulthood.^{6,9,11-13,26} However, studies on

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fruit and vegetable intake in childhood and adolescence have been mostly conducted in random sample groups of children and adolescents. Studies using national data or big data have seldom been conducted, with the exception of studies that have analyzed vegetable/fruit intake in all Koreans who participated in KNHANES,^{27,28} studies on vegetable/fruit intake in adults,²⁹⁻³² and a study on factors affecting the frequency of vegetable/fruit intake in adolescents using Korea Youth Risk Behavior Web-based Survey (KYRBWS) data.²¹

Thus, this study was performed to analyze the current status of fruit and vegetable intake in Korean children and adolescents using KNHANES data from 2010 and 2011, which represents all children and adolescents in Korea. Additionally, this study also contains basic data that may be used to identify measures to increase fruit and vegetable intake by understanding the socio-demographic and dietary life-related factors affecting the intake of fruits and vegetables, as well as to prepare basic guidelines for dietary and nutrition education.

MATERIALS AND METHODS

Survey data and subjects

This study used raw data from the 2010~2011 KNHANES. KNHANES integrates the 'National Nutrition Survey' that was implemented in 1969 and the 'National Health and Health Behavior Survey', which was implemented in 1971. KNHANES was administered every three years from the first (1998) to the third (2005) surveys, and it has been administered every year since the fourth survey (2007~2009) by The Korea Centers for Disease Control and Prevention, under the Ministry of Health and Welfare.³³ KNHANES is a large-scale survey that includes various health-related surveys to obtain reliable and broad statistics on the health and nutrition status of Koreans, and the consciousness and behaviors affecting them. Currently, KNHANES contains a 'Health Examination', 'Health Interview', and 'Nutrition Survey (food frequency questionnaire, dietary life, and food intake according to a 24-hour recall method)'.^{18,19} Among KNHANES participants, data from children and adolescents aged 7–18 years who participated in the 24-hour recall survey were analyzed. After excluding individuals with daily total energy intakes less than 500 kcal or more than 5,000 kcal, there were 2,538 analyzed subjects. General characteristics included sex, age, household income, region, mother's education level, and subjective weight status. Participants were divided into an elementary school group, consisting of those aged 7–12 years, and a middle and high school group, consisting of those aged 13–18 years. Survey regions were primarily classified as cities (Korean name: *Dong*) or rural areas (Korean name: *Eup/Myeon*). Cities were further classified as large cities for metropolitan areas (Busan, Daegu, Daejeon, Gwangju, and Ulsan) and capital areas (Seoul, Incheon, and Gyeonggi areas), and middle & small cities for those other than the aforementioned areas. The household income used the monthly household income, as in previous studies,^{27,34} which was based on the minimum cost of living annually, selected by the Ministry of Health and Welfare. Income was classified as 'low income' for a monthly household income less than 1.2 times the minimum cost

of living, 'middle income' for 1.2–2.5 times the cost of living, and 'high income' for more than 2.5 times the cost of living. Mother's education levels were classified as less than high school, high school graduate, and college or higher. Body shapes of the subjects were classified as underweight, normal, overweight, or obese. Underweight included responses of 'very skinny' and 'a little skinny', normal included 'normal', overweight included 'a little obese' and obesity included 'very obese'. Regarding nutrition education, those who answered 'Yes' to the question "Have you had nutritional education or consultation in a Health Office, Public institution, Welfare institutions, schools or hospitals in the past year?" were classified as the "yes" group, and those who answered no were classified as the "no" group. This study was approved by the institutional review board of the Korea Centers for Disease Control and Prevention (2011-02CON-06-C, 2012-01EXP-01-2C).

Cooking location and daily meals

To classify the cooking location and daily meals, we used information from the 24-hour recall survey for the children and youths who participated in this study. Cooking location classifications included home meal (prepared at home, lunch box prepared at home, or prepared by neighbors or relatives), meal cooked at commercial locations (meal prepared at a restaurant: Korean food restaurant, Western food restaurant, Chinese food restaurant, Japanese food restaurant, fastfood, snack bar and meals purchased outside the home: bread/cookie, street-stall/store, packed meal, or instant foods, including ramen and others), or a meal cooked at an institutional cafeteria (school, industry, nursery/kindergarten, senior citizen center, free-meal service, or meals from religious organizations), as in previous studies by Chung et al.³⁵ and Kwon et al.³⁶ Patterns according to the place where food was cooked were defined as follows: food prepared at home was classified as 'only home meal', food prepared in commercial locations was classified as 'only commercial location', and food prepared at public institutions, school canteens, or cafeterias was classified as 'only institution'. Additionally, when meals were prepared at home, commercial locations, and institutions they were categorized as 'H+C+I', those prepared at home and commercial locations were classified as 'H+C', those prepared at home and institutions were classified as 'H+I', and those prepared at commercial locations and institutions were classified as 'C+I'.

Daily meals were divided into breakfast, lunch, dinner, and snacks using meal variables included in the 24-hour recall survey. The pattern of daily meals was divided into 'B+L+D' when 3 meals were eaten during the day, 'B+L' when breakfast and lunch were eaten, 'B+D' when breakfast and dinner were eaten, 'L+D' when lunch and dinner were eaten, and 'others' when only one meal was eaten.

Fruit and vegetable consumption

Fruit and vegetable consumption was categorized using food code and food intake variables from the 24-hour recall data, based on a previous study.³² As reported by Kwon et al.,³² vegetable or fruit juices were excluded from the food intake because the accurate intake is unclear due

to the high water content. For vegetable intake, starchy vegetables such as potatoes and sweet potatoes were excluded according to the previous studies, but mushrooms and seaweed were included.^{15,16,32} Total vegetable intake was initially assessed and subdivided into salted vegetable intake [*kimchi*, *geotjeori* (a Korean fresh vegetable salad dressed with garlic and chili powder), pickles, and other salted vegetables] and unsalted vegetable intake. Fruit intake included all fruits, except for candied fruits and jams. Finally, unsalted vegetable intake and fruit intake were combined in order to compare with the guidelines on plant food intake by the WHO¹⁵ and WCRF.¹⁶

Statistical analysis

Because KNHANES data involves sampling by stratified multi-stage cluster sampling, the statistical analysis was performed with stratification weighting, using SUDAAN (version 10.01; Research Triangle Institute, Research Triangle Park, NC, USA) and SAS (version 9.2; SAS Institute, Cary, NC, USA). Frequency (n) and weighted % for categorical variables were obtained using frequency analysis, and the χ^2 -test was performed to assess significance. The mean and standard error (SE) of continuous variables were obtained for descriptive analysis. Additionally, significant differences among groups were verified by t-test and analysis of covariance (ANCOVA) adjusted for household income, energy intake, and mother's education level. When ANCOVA results revealed significant differences among groups at $\alpha=0.05$ level, Tukey's multiple range comparison was performed as a post-hoc test, using the Survey reg procedure in SAS. In addition,

to identify factors affecting intake of more than 400 g of vegetables and fruit, multiple logistic regression analysis was conducted separately on the data from three groups (all subjects, subjects 7–12 years old, and subjects 13–18 years old). The dependent variables were recorded, with 'intake higher than 400 g of unsalted vegetables and fruit' as one point and 'intake less than 400 g of vegetables and fruit' as zero points. General characteristics, daily meals, and cooking location were used as independent variables.

RESULTS

General participant characteristics

The general participant characteristics are shown in Table 1. The study population was 53.6% male and 46.4% female. The average age was 12.9 years, with an average of 9.6 years among subjects aged 7–12 years, and an average of 15.5 years among subjects aged 13–18 years ($p<0.001$). Most participants lived in large cities (43%), followed by middle & small cities (39%) and rural areas (16–17.5%). For household income, high income was the most common (42%), followed by middle income (38–42%) and low income (14–19%). Over 50% of participants listed high school graduate as their mothers' highest education level, while college or higher was listed by 31–45% and less than high school was listed by 8.8% for all subjects; 4.2% for those aged 7–12 years, and 12.7% for those aged 13–18 years ($p<0.001$). The subjective weight status was most often normal (37–42%), followed by underweight (26–35%), overweight (23–26%), and obese (5–6%) ($p=0.007$).

Table 1. General characteristics of study subjects

Variables	Total (n=2538)		7~12 y (Elementary school age, n=1443)		13~18 y (Middle & High school age, n=1095)		p-value [‡]
	n	% [†]	n	%	n	%	
Age (mean±SE)	12.9±0.1		9.6±0.1		15.5±0.1		<0.001 [§]
Sex							0.995
Boy	1341	53.6	769	53.6	572	53.6	
Girl	1197	46.4	674	46.4	523	46.4	
Region							0.933
Large city	1136	43.9	634	44.0	502	43.9	
Middle & Small city	1072	39.3	627	39.6	445	39.1	
Rural area	330	16.7	182	16.3	148	17.1	
Household income [¶]							0.086
Low	311	16.7	149	14.3	162	18.7	
Middle	918	39.8	550	41.2	368	38.6	
High	1278	43.5	727	44.6	551	42.7	
Mother's education level							<0.001
Less than graduate of high school	122	8.8	37	4.2	85	12.7	
Graduate of high school	1107	53.7	593	51.2	514	55.9	
College or higher	972	37.5	636	44.6	336	31.4	
Subjective weight status							0.007
Underweight	752	30.5	493	34.8	259	26.8	
Normal	913	39.5	501	37.1	412	41.5	
Overweight	575	24.5	314	23.1	261	25.7	
Obesity	125	5.6	65	5.0	60	6.0	

[†]Weighted %.

[‡]p-value by Chi-square.

[§]p-value by t-test.

[¶]Low income: monthly income < minimum cost of living × 1.2. Middle income: minimum cost of living × 1.2 ≤ monthly income < minimum cost of living × 2.5. High income: monthly income ≥ minimum cost of living × 2.5.

Table 2. Daily meal and dietary habits of the subjects

Variables	Total (n=2538)		7~12 y (Elementary school age, n=1443)		13~18 y (Middle & High school age, n=1095)		p-value [‡]
	n	% [†]	n	%	n	%	
Daily meal							
Breakfast							<0.001
Eaten	2061	77.1	1276	87.5	785	68.5	
Skipped	477	22.9	167	12.5	310	31.5	
Lunch							<0.001
Eaten	2431	94.2	1407	96.9	1024	92.0	
Skipped	108	5.8	36	3.1	71	8.0	
Dinner							<0.001
Eaten	2420	95.1	1404	97.4	1015	93.2	
Skipped	119	4.9	39	2.6	80	6.8	
Snack							0.017
Yes	2413	94.1	1385	95.7	1028	92.9	
No	125	5.9	58	4.3	67	7.1	
Pattern of daily meal							<0.001
B+L	81	2.7	32	2.0	49	3.0	
B+D	76	4.2	31	2.6	45	4.0	
L+D	418	19.1	157	11.7	261	19.6	
B+L+D	1900	70.9	1212	82.7	688	69.9	
Others	63	3.1	11	1.0	52	3.5	
Cooking location ^{§¶}							<0.001
Home	2331	50.4	1385	51.9	946	49.1	
Commercial location ^{††}	985	21.9	497	17.6	488	25.8	
Institution ^{†††}	1333	27.7	829	30.6	504	25.1	
Pattern of cooking location							<0.001
Only home	578	23.4	329	23.9	249	23.0	
Only commercial location	84	4.6	16	1.0	68	7.5	
Only institution	34	1.5	6	0.4	28	2.5	
H+C	543	22.3	269	18.1	274	25.7	
H+I	939	35.5	611	43.0	328	29.4	
H+C+I	269	9.4	174	11.5	95	9.4	
C+I	89	3.2	38	2.0	51	4.2	
Eating-out frequency							<0.001
≥1/day	639	29.7	215	14.7	424	42.2	
5~6 times a week	1845	67.4	1216	84.8	629	53.0	
<5/week	51	2.8	11	0.5	40	4.9	

B: breakfast; L: lunch; D: dinner; H: home; C: commercial location; I: institution.

[†]Weighted %.

[‡]p-value by Chi-square.

[§]Results by daily meal (Excluding Snack meal).

[¶]Multiple respondents.

^{††}Commercial location meal included Korean, Japanese, Chinese, Western, Fast food, Instant noodle, Instant food, Packed Meal and Bread/Cookie.

^{†††}Institution meal included Industry, School, Religious, Elderly and Free.

Daily meal and dietary life-related factors

Factors related to daily meals and dietary life are shown in Table 2. For breakfast, 77.1% of all subjects, 87.5% of subjects aged 7–12 years, and 68.5% of subjects aged 13–18 years ate breakfast ($p<0.001$), while over 92% of all subjects and all age groups ate lunch and dinner ($p<0.001$). Over 92% of all subjects (including subjects aged 7–12 years and aged 13–18 years) ate snacks ($p=0.017$). The pattern of daily meals was highest in the B+L+D (Breakfast+Lunch+Dinner) group for all subjects and all age groups, followed by the L+D group at 10~20%, and others at less than 5% ($p<0.001$).

Cooking location was most often the home (approximately 50%), followed by institutions (25–31%), and commercial locations (17–26%) ($p<0.001$). The daily pattern of using cooking location was highest at 29–43% for the H+I group among subjects aged 7–12 years, those aged 13–18 years, and all subjects, while it was 23–24%

for the only home group and 18–26% for the H+C group. In addition, the H+C+I (Home+Commercial location+Institution) group was at 9–12% ($p<0.001$).

From 53–85% of subjects ate out 5–6 times a week among subjects aged 7–12 years, those aged 13–18 years, and all subjects, and 14–43% ate out more than once a day, while less than 5% ate out less than 5 times a week ($p<0.001$).

Reportedly, 11–38% of subjects received nutrition education, with the remaining 73–89% receiving none ($p<0.001$).

Analysis of fruit and vegetable intake by cooking location

The intake and the intake ratios of total food, all vegetables, salted vegetables, unsalted vegetables, fruit, and combined fruit and unsalted vegetables according to cooking location are shown in Table 3.

The total vegetable intake for all subjects was 230 g. The combined fruit and unsalted vegetable intake was 300 g, with that of salted vegetables being 73.9 g, unsalted vegetables being 156 g, and fruit being 144 g. These values corresponded to percentages of total food intake of 16.9%, 20.7%, 5.7%, 11.2%, and 9.5%, respectively. Among them, the intake of fruit and unsalted vegetables according to cooking location was 159 g in home meals, 206 g in commercial locations, and 104 g in institutions, which were significantly different ($p < 0.001$). Both boys and girls had their highest intakes of fruit and unsalted vegetables in commercial locations (boys: 219 g; girls: 193 g) and their lowest in institutions ($p < 0.001$).

The total vegetable intake for subjects aged 7–12 years was 196 g. The combined fruit and unsalted vegetable intake was 280 g, with that of salted vegetables being 63.1 g, that of unsalted vegetables being 133 g, and that of fruit being 147 g. All intakes according to cooking location were significantly different ($p < 0.01$), among which combined fruit and unsalted vegetable intake was highest in commercial locations for all subjects (159 g, 23.7%), boys (159 g, 23.8%), and girls (160 g, 23.7%). The intake ratio was also highest in commercial locations.

The total vegetable intake of subjects aged 13–18 years was 258 g. The combined fruit and unsalted vegetable intake was 316 g, with that of salted vegetables being 82.7 g, that of unsalted vegetables being 175 g, and that of fruit being 141 g. All fruit and vegetable intakes according to cooking location were significantly different ($p < 0.05$). The intake and intake ratio of combined fruit and unsalted vegetables was highest in commercial locations for all subjects (234 g, 22.5%), boys (256 g, 21.5%), and girls (213 g, 23.4%).

Analysis of fruit and vegetable intake by daily meal and snack intake

The intakes and the intake ratios of total food, all vegetables, salted vegetables, unsalted vegetables, fruit, and combined fruit and unsalted vegetables according to daily meals and snack intakes are shown in Table 4.

The total food intake of all subjects was significantly different depending on daily meals ($p < 0.001$), among which the combined intake of fruit and unsalted vegetables was the highest in snacks (128 g). Additionally, the intake of total food, all vegetables, salted vegetables, unsalted vegetables, fruit, and combined fruit and unsalted vegetables by sex was significantly different in all daily meals and snacks ($p < 0.001$). Among them, the combined intake of fruit and unsalted vegetables was highest among snacks for all subjects (boys: 124 g, 18.3%; girls: 132 g, 24.3%).

All food intakes for subjects aged 7–12 years were significantly different according to daily meal and snack intake ($p < 0.001$), among which the combined intake of fruit and unsalted vegetables was highest in snacks (124 g, 21.6%) compared with those during breakfast (35.7 g, 14.0%), lunch (74.5 g, 21.2%), and dinner (58.7 g, 16.9%). Boys and girls aged 7–12 years also had food intakes that were significantly different according to daily meal and snack intake ($p < 0.001$), among which the combined intake of fruit and unsalted vegetables was highest in snacks (boys: 118 g, 19.1%; girls: 131 g, 24.6%).

Fruit and vegetable intakes in subjects aged 13–18 years were significantly different according to daily meal and snack intake ($p < 0.05$). The intake and the intake ratio of combined fruit and unsalted vegetables were highest in snacks for all subjects (130 g, 20.6%), boys (129 g, 17.6%), and girls (132 g, 24.0%).

Comparison with WHO and WCRF guidelines for plant food intake

Analysis of socioeconomic factors, daily meals, and meal patterns for subjects who consumed more than the recommended amount of plant food (more than 400 g of combined fruit and non-starchy vegetables), according to WHO¹⁵ and WCRF¹⁶ guidelines, is shown in Table 5.

Among all subjects, 24.9% of subjects satisfied the intake guidelines, with 22.6% of those aged 7–12 years and 26.8% of those aged 13–18 years meeting the requirements. Regarding region, subjects meeting intake guidelines most commonly lived in middle & small cities, had higher incomes, had mothers with higher education levels, and ate breakfast, lunch, and dinner. Regarding cooking location patterns, subjects who ate meals at home and commercial locations among all subjects, and those aged 13–18 years, most commonly satisfied the intake guidelines, and subjects who ate meals at commercial locations among those aged 7–12 years most commonly satisfied the intake guidelines.

Relationship between general characteristics and dietary factors in subjects with a daily combined fruit and non-starchy vegetable intake of 400 g or more

The relationship between socioeconomic factors and dietary factors of the subjects with a combined daily fruit and non-starchy vegetable intake of 400g or more is shown in Table 6.

For all subjects, girls were 1.4 times more likely to meet the suggested intake (OR=1.35; $p < 0.05$). Subjects who ate 400 g or more of combined fruit and vegetables were more likely to have higher household incomes (OR=1.67; $p < 0.05$). Regarding mother's education levels, intake among children whose mothers achieved college or higher was 2.3 times higher than those among children whose mothers did not graduate from high school (OR=2.26; $p < 0.01$). Regarding meal patterns, intake for subjects who only ate breakfast and dinner decreased by 59% compared with groups who ate breakfast, lunch, and dinner (OR=0.41; $p < 0.05$). Regarding cooking location, the intake ratio of the combined vegetables and fruit of 400 g or more decreased by 68% in groups with meals provided by institutions, compared with groups who ate meals at home (OR=0.32; $p < 0.05$), and groups who ate snacks were 2.2 times more likely to meet intake requirements than those who did not eat snacks (OR=2.17; $p < 0.05$).

In subjects aged 7–12 years, a daily intake of 400 g or more decreased by 12% (OR=0.88) each year as children aged, starting from 7 years of age ($p < 0.05$). The proportion of subjects with a daily intake of 400 g or more decreased by 60% (OR=0.40) in rural areas, compared with that in large cities ($p < 0.01$). Regarding household incomes, subjects with higher incomes were 2.3 times more likely to meet intake requirements, compared with those

Table 3. Vegetable and fruit intake according to cooking location[†]

Variables	Total									7~12 y									13~18 y								
	Total		Home		Commercial location		Institution		p-value [‡]	Total		Home		Commercial location		Institution		p-value	Total		Home		Commercial location		Institution		p-value
	mean	SE	mean	SE	mean	SE	mean	SE		mean	SE	mean	SE	mean	SE	mean	SE		mean	SE	mean	SE	mean	SE	mean	SE	
All (n)	2538		2331		985		1333			1443		1385		497		829			1095		946		488		504		
<i>Food intake (g/d)</i>																											
Total food	1385	21.6	651 ^b	19.2	880 ^a	40.3	427 ^c	12.3	<0.001	1273	18.6	586 ^b	15.0	644 ^a	28.7	336 ^c	8.5	<0.001	1478	34.2	711 ^{ab}	31.6	1,021 ^a	58.4	525 ^b	20.1	<0.001
All vegetable	230	5.3	55.0 ^b	3.6	129 ^a	8.0	121 ^a	4.1	<0.001	196	5.4	38.3 ^b	3.0	90.6 ^a	5.4	91.6 ^a	3.8	<0.001	258	8.1	70.5 ^b	6.1	153 ^a	11.7	152 ^a	6.6	<0.001
Non salted vegetable	156	4.3	43.9 ^c	2.9	105 ^a	6.8	89.7 ^b	3.6	<0.001	133	4.7	31.9 ^b	2.8	73.4 ^a	4.9	69.8 ^a	3.5	<0.001	175	6.3	55.1 ^b	4.8	125 ^a	9.8	111 ^a	5.9	<0.001
Salted vegetable	73.9	2.4	11.1 ^b	1.1	23.9 ^{ab}	2.2	31.1 ^a	1.2	<0.001	63.1	2.4	6.4 ^b	0.7	17.3 ^a	1.6	21.8 ^a	1.2	<0.001	82.7	3.7	15.5 ^b	2.1	27.9 ^{ab}	3.3	41.1 ^a	2.0	<0.001
Fruit	144	7.9	115 ^a	8.2	101 ^a	13.5	14.5 ^b	1.5	<0.001	147	7.7	108 ^a	6.8	85.7 ^a	9.6	19.3 ^b	2.7	<0.001	141	12.5	122 ^a	13.7	110 ^a	21.1	9.3 ^b	1.7	<0.001
V+F [§]	300	9.1	159 ^b	9.0	206 ^a	15.7	104 ^c	3.9	<0.001	280	9.0	140 ^a	7.4	159 ^a	11.1	89.1 ^b	4.3	<0.001	316	14.4	177 ^{ab}	15.0	234 ^a	24.1	121 ^b	6.0	<0.001
<i>Ratio (%)[¶]</i>																											
All vegetable	16.9	0.3	6.6 ^c	0.3	16.9 ^b	0.6	27.7 ^a	0.5	<0.001	15.8	0.4	5.1 ^c	0.3	17.0 ^b	0.9	26.8 ^a	0.7	<0.001	17.9	0.4	7.9	0.5	16.8 ^b	0.8	28.7 ^a	0.7	<0.001
Non salted vegetable	11.2	0.2	5.1 ^c	0.3	13.2 ^b	0.5	20.1 ^a	0.5	<0.001	10.5	0.3	4.1 ^c	0.3	13.3 ^b	0.8	20.1 ^a	0.7	<0.001	11.8	0.3	6.1	0.4	13.1 ^b	0.6	20.1 ^a	0.6	<0.001
Salted vegetable	5.7	0.2	1.5 ^b	0.1	3.7 ^{ab}	0.3	7.6 ^a	0.3	<0.001	5.3	0.2	1.0 ^c	0.1	3.7 ^a	0.3	6.7 ^a	0.3	<0.001	6.1	0.2	1.8	0.2	3.7 ^b	0.3	8.6 ^a	0.5	<0.001
Fruit	9.5	0.4	15.6 ^a	0.8	9.7 ^b	0.7	3.6 ^c	0.4	<0.001	10.5	0.5	16.5 ^a	0.9	10.4 ^b	1.1	5.2 ^c	0.7	<0.001	8.7	0.6	14.8 ^a	1.1	9.3 ^a	0.9	1.9 ^b	0.4	<0.001
V+F	20.7	0.4	20.7 ^b	0.8	22.9 ^{ab}	0.7	23.7 ^a	0.5	<0.001	21.0	0.5	20.6 ^b	0.9	23.7 ^{ab}	1.1	25.2 ^a	0.8	<0.001	20.5	0.6	20.8 ^b	1.1	22.5 ^a	0.9	22.0 ^a	0.7	<0.001
Boy (n)	1341		1246		483		710			769		737		254		440			572		509		229		270		
<i>Food intake (g/d)</i>																											
Total food	1528	32.8	700 ^{ab}	29.5	974 ^a	65.2	474 ^c	19.4	<0.001	1356	28.4	614 ^a	23.3	652 ^a	40.7	358 ^b	12.4	<0.001	1670	51.8	778 ^b	48.7	1,172 ^a	96.4	602 ^b	31.4	<0.001
All vegetable	252	6.9	57.1 ^b	4.8	148 ^a	11.3	135 ^a	6.3	<0.001	202	6.8	36.3	3.6	85.1 ^b	6.7	96.5 ^a	5.1	<0.001	293	10.8	76.1 ^b	8.3	187 ^a	16.9	178 ^a	9.7	<0.001
Non salted vegetable	168	5.5	44.1 ^c	3.6	120 ^a	9.9	100.9 ^{ab}	5.4	<0.001	137	6.0	30.1 ^b	3.4	71.0 ^a	6.0	74.1 ^a	4.6	<0.001	193	8.5	56.8 ^b	6.2	150 ^a	14.7	130 ^a	8.6	<0.001
Salted vegetable	84.4	3.7	13.1 ^b	1.9	28.5 ^a	3.7	34.4 ^a	1.9	<0.001	65.2	3.5	6.2 ^c	1.0	14.1 ^b	1.7	22.4 ^a	1.6	<0.001	100	5.9	19.3	3.5	37.4 ^b	5.9	47.5 ^a	3.0	<0.001
Fruit	139	11.4	1104 ^a	11.9	99.4 ^a	24.8	14.7 ^b	2.1	<0.001	142	10.8	103 ^a	9.4	87.7 ^b	14.8	20.7 ^c	3.7	<0.001	137	18.9	117 ^a	20.7	107 ^a	39.6	8.1 ^b	2.0	<0.001
V+F [§]	307	13.1	154 ^{bc}	13.2	219 ^a	27.4	116 ^c	6.0	<0.001	279	12.0	133 ^{ab}	10.4	159 ^a	16.5	94.8 ^b	5.9	<0.001	330	21.4	174 ^{ab}	22.7	256 ^a	43.5	138 ^b	9.1	0.003
<i>Ratio (%)[¶]</i>																											
All vegetable	16.9	0.4	6.3 ^c	0.4	17.2 ^b	0.8	27.7 ^a	0.7	<0.001	15.4	0.5	4.7 ^c	0.4	16.3 ^b	1.2	26.3 ^a	0.9	<0.001	18.1	0.5	7.8	0.6	17.8 ^b	1.1	29.3 ^a	0.9	<0.001
Non salted vegetable	10.9	0.3	4.8 ^c	0.3	13.6 ^b	0.7	20.3 ^a	0.6	<0.001	10.2	0.4	3.7 ^c	0.3	13.3 ^b	1.1	19.9 ^a	0.9	<0.001	11.4	0.4	5.8	0.5	13.8 ^b	1.0	20.8 ^a	0.9	<0.001
Salted vegetable	6.0	0.2	1.5 ^b	0.2	3.6 ^{ab}	0.3	7.4 ^a	0.4	<0.001	5.2	0.3	1.0 ^b	0.2	3.0 ^{ab}	0.4	6.4 ^a	0.5	<0.001	6.6	0.4	2.0 ^b	0.3	4.0 ^{ab}	0.5	8.5 ^a	0.5	<0.001
Fruit ratio	8.2	0.5	13.6 ^a	0.9	8.7 ^b	1.0	3.5 ^c	0.5	<0.001	9.4	0.6	14.9 ^a	1.2	10.5 ^b	1.7	5.4 ^c	0.9	<0.001	7.2	0.6	12.5 ^a	1.2	7.7	1.3	1.4	0.3	<0.001
V+F ratio	19.1	0.5	18.4 ^b	0.9	22.4 ^a	1.0	23.8 ^a	0.7	<0.001	19.7	0.6	18.6 ^b	1.2	23.8 ^{ab}	1.6	25.2 ^a	1.1	<0.001	18.6	0.7	18.3 ^b	1.2	21.5 ^{ab}	1.4	22.2 ^a	0.9	<0.001

[†]Adjusted for energy intake, household income and mother's education level.

[‡]p-value by ANCOVA.

[§]V+F intake=non salted vegetable intake + fruit intake.

[¶](Each food intake/Total food intake)*100.

^{abc}Different superscript letters mean significantly different among groups at $\alpha=0.05$ level by Tukey's multiple range comparison.

Table 3. Vegetable and fruit intake according to cooking location[†] (cont.)

Variables	Total								<i>p</i> -value [‡]	7~12 y								<i>p</i> -value	13~18 y								<i>p</i> -value	
	Total		Home		Commercial location		Institution			Total		Home		Commercial location		Institution			Total		Home		Commercial location		Institution			
	mean	SE	mean	SE	mean	SE	mean	SE		mean	SE	mean	SE	mean	SE	mean	SE		mean	SE	mean	SE	mean	SE	mean	SE		
Girl (n)	1197		1085		502		623			674		648		243		389		523		437		259		234				
<i>Food intake (g/d)</i>																												
Total food	1221	22.4	592 ^b	19.2	788 ^a	39.9	372 ^c	13.1	<0.001	1176	22.5	554 ^{ab}	18.6	635 ^a	37.9	310 ^b	10.6	<0.001	1257	34.1	629 ^b	30.3	877 ^a	53.6	437	22.0	<0.001	
All vegetable	205	6.2	52.4 ^b	4.6	111 ^a	9.6	104 ^a	4.3	<0.001	189	7.1	40.6 ^b	4.7	96.2 ^a	8.4	85.9 ^a	4.4	<0.001	217	9.3	63.7 ^b	7.0	119 ^a	13.1	123 ^a	7.4	0.001	
Non salted vegetable	143	5.4	43.7	4.1	91.2	8.8	76.7	3.8	0.057	129	5.8	34.0 ^b	4.4	75.8 ^a	7.7	64.7 ^{ab}	4.1	0.002	154	7.6	53.0	6.3	100 ^a	11.8	89.3 ^b	6.7	0.011	
Salted vegetable	61.7	2.4	8.7 ^c	1.0	19.4 ^b	2.1	27.4 ^a	1.4	<0.001	60.6	3.2	6.6 ^b	0.9	20.5 ^a	2.4	21.2 ^a	1.5	<0.001	62.6	3.6	10.7 ^b	1.7	18.8 ^{ab}	3.0	33.9 ^a	2.3	<0.001	
Fruit	149	9.0	121 ^a	8.6	102 ^a	12.1	14.3 ^b	2.2	<0.001	152	9.6	114 ^a	8.3	83.8 ^b	11.2	17.7 ^c	3.2	<0.001	147	13.6	127 ^a	13.8	113 ^a	17.4	10.7 ^b	3.0	<0.001	
V+F [§]	292	11.0	165 ^b	9.8	193 ^a	15.5	91.0 ^c	4.2	<0.001	281	12.0	148 ^a	9.6	160 ^a	14.1	82.4 ^b	5.3	<0.001	301	16.3	180 ^a	15.4	213 ^a	21.7	100 ^b	7.3	<0.001	
<i>Ratio (%)[¶]</i>																												
All vegetable	17.0	0.4	6.9 ^c	0.5	16.6 ^b	0.9	27.7 ^a	0.6	<0.001	16.1	0.5	5.6 ^c	0.5	17.8 ^b	1.2	27.3 ^a	0.8	<0.001	17.7	0.6	8.0 ^b	0.7	15.9 ^{ab}	1.2	28.0 ^a	1.0	<0.001	
Non salted vegetable	11.5	0.3	5.0 ^c	0.4	12.8 ^b	0.8	19.8 ^a	0.5	<0.001	10.7	0.4	4.5 ^c	0.5	13.4 ^b	1.0	20.3 ^a	0.7	<0.001	12.2	0.5	6.4 ^b	0.6	12.5 ^{ab}	1.0	19.3 ^a	0.9	<0.001	
Salted vegetable	5.4	0.2	1.4 ^c	0.2	3.8 ^b	0.4	7.8 ^a	0.4	<0.001	5.4	0.3	1.1 ^c	0.2	4.4 ^b	0.5	7.0 ^a	0.5	<0.001	5.5	0.3	1.6 ^b	0.3	3.4 ^{ab}	0.5	8.7 ^a	0.7	<0.001	
Fruit	11.0	0.5	18.0 ^a	1.0	10.7 ^b	1.0	3.7 ^b	0.5	<0.001	11.7	0.6	18.4 ^a	1.2	10.4 ^b	1.2	4.9 ^c	0.8	<0.001	10.4	0.8	17.5 ^a	1.7	10.9 ^a	1.4	2.5 ^b	0.7	<0.001	
V+F	22.6	0.6	23.4 ^b	1.0	23.5 ^{ab}	1.0	23.6 ^a	0.6	<0.001	22.5	0.7	22.9 ^b	1.2	23.7 ^{ab}	1.4	25.2 ^a	0.9	<0.001	22.6	0.9	24.0 ^a	1.7	23.4 ^{ab}	1.5	21.8 ^b	1.0	<0.001	

[†]Adjusted for energy intake, household income and mother's education level.

[‡]*p*-value by ANCOVA.

[§]V+F intake=non salted vegetable intake + fruit intake.

[¶](Each food intake/Total food intake)*100.

^{abc}Different superscript letters mean significantly different among groups at $\alpha=0.05$ level by Tukey's multiple range comparison.

Table 4. Vegetable and fruit intake according to daily meal and snack[†]

Variables (g/day)	Total								7~12y								13~18y											
	Breakfast		Lunch		Dinner		Snack		<i>p</i> -value [‡]	Breakfast		Lunch		Dinner		Snack		<i>p</i> -value	Breakfast		Lunch		Dinner		Snack		<i>p</i> -value	
	mean	SE	mean	SE	mean	SE	mean	SE		mean	SE	mean	SE	mean	SE	mean	SE		mean	SE	mean	SE	mean	SE	mean	SE		
All (n)	2061		2431		2419		2413			1276		1407		1404		1385			785		1024		1015		1028			
<i>Food intake (g/d)</i>																												
Total food	261 ^b	6.4	368 ^{ab}	8.0	380 ^{ab}	9.2	505 ^a	14.2	<0.001	230 ^b	7.6	313 ^{ab}	7.2	307 ^{ab}	8.0	491 ^a	12.8	<0.001	294 ^b	9.1	416 ^{ab}	12.2	443 ^{ab}	15.2	517 ^a	22.6	<0.001	
All vegetable	55.0 ^b	2.2	92.1 ^a	2.7	86.2 ^a	2.7	20.1 ^c	1.8	<0.001	44.5 ^{ab}	1.8	75.7 ^a	2.8	68.4 ^a	2.6	18.0 ^b	2.1	<0.001	65.9 ^{bc}	3.5	106 ^a	4.0	102 ^a	4.4	21.8 ^c	2.6	<0.001	
Non salted vegetable	29.5 ^{bc}	1.5	65.4 ^a	2.5	58.7 ^a	2.4	16.9 ^c	1.6	<0.001	24.2 ^{ab}	1.4	55.4 ^a	2.5	44.2 ^a	2.3	15.8 ^b	2.0	<0.001	35.2 ^{bc}	2.4	74.1 ^a	3.7	71.2 ^a	3.8	17.9 ^c	2.2	<0.001	
Salted vegetable	25.4 ^a	1.4	26.7 ^a	1.0	27.5 ^a	1.1	3.1 ^b	0.5	<0.001	20.3 ^a	1.2	20.3 ^a	0.9	24.2 ^a	1.4	2.2 ^b	0.4	<0.001	30.8 ^a	2.3	32.2 ^a	1.7	30.5 ^a	1.8	4.0 ^b	0.9	<0.001	
Fruit	14.4 ^b	1.7	15.9 ^b	1.6	14.1 ^b	1.6	111 ^a	7.7	<0.001	11.5 ^b	1.8	19.1 ^b	2.4	14.5 ^b	2.0	109 ^a	7.0	<0.001	17.4 ^b	2.6	13.1 ^b	2.0	13.7 ^b	2.2	113 ^a	12.5	<0.001	
V+F [§]	43.9 ^b	2.1	81.3 ^{ab}	3.0	72.8 ^{ab}	2.8	128	7.8	<0.001	35.7 ^c	2.2	74.5 ^{ab}	3.4	58.7 ^{bc}	3.0	124	7.3	<0.001	52.6 ^c	3.3	87.2 ^{bc}	4.2	84.8 ^{bc}	4.3	130 ^a	12.4	<0.001	
<i>Ratio (%)[¶]</i>																												
All vegetable	21.5 ^a	0.6	24.7 ^a	0.5	23.4 ^a	0.5	3.1 ^b	0.2	<0.001	20.4 ^a	0.7	23.9 ^a	0.6	23.0 ^a	0.6	2.8 ^b	0.3	<0.001	22.8 ^a	0.9	25.4 ^a	0.7	23.6 ^a	0.6	3.4 ^b	0.3	<0.001	
Non salted vegetable	11.2 ^a	0.4	16.6 ^a	0.4	14.6 ^a	0.4	2.6 ^b	0.2	<0.001	10.7 ^a	0.5	16.7 ^a	0.6	13.9 ^a	0.5	2.5 ^b	0.2	<0.001	11.7 ^a	0.6	16.4 ^a	0.6	15.2 ^a	0.5	2.7 ^b	0.3	<0.001	
Salted vegetable	10.3 ^a	0.4	8.1 ^a	0.3	8.8 ^a	0.3	0.5 ^b	0.1	<0.001	9.7 ^a	0.5	7.2 ^a	0.3	9.1 ^a	0.5	0.4 ^b	0.1	<0.001	11.1 ^a	0.7	9.0 ^a	0.4	8.5 ^a	0.5	0.6 ^b	0.1	<0.001	
Fruit	3.8 ^b	0.4	3.4 ^b	0.3	2.7 ^b	0.3	18.5 ^a	0.9	<0.001	3.3 ^b	0.4	4.5 ^b	0.5	3.0 ^b	0.4	19.2 ^a	1.0	<0.001	4.5 ^b	0.7	2.5 ^b	0.3	2.5 ^b	0.4	17.9 ^a	1.4	<0.001	
V+F	15.0 ^b	0.6	20.0 ^a	0.5	17.3 ^{ab}	0.4	21.1 ^a	0.9	<0.001	14.0 ^b	0.6	21.2 ^a	0.7	16.9 ^b	0.6	21.6 ^a	1.0	<0.001	16.2 ^b	0.9	19.0 ^a	0.6	17.7 ^{ab}	0.6	20.6 ^a	1.3	0.003	
Boy	1108		1289		1293		1264			687		751		749		736			421		538		544		528			
<i>Food intake (g/d)</i>																												
Total food	290 ^b	10.0	395 ^{ab}	10.3	432 ^{ab}	14.8	553 ^a	22.0	<0.001	254 ^b	12.6	322 ^{ab}	9.3	336 ^{ab}	11.6	516 ^a	20.5	<0.001	330 ^c	15.2	459 ^b	15.7	512 ^{ab}	25.3	585 ^a	35.9	<0.001	
All vegetable	58.2 ^b	2.9	100 ^a	3.4	95.5 ^a	3.9	22.1 ^c	2.4	<0.001	46.1 ^{ab}	2.3	77.8 ^a	3.6	71.8 ^a	3.7	16.4 ^b	2.3	<0.001	71.0 ^{ab}	5.1	119 ^a	5.3	116 ^a	6.3	27.1 ^c	4.1	<0.001	
Non salted vegetable	29.6 ^{bc}	1.9	70.4 ^a	3.3	63.6 ^a	3.5	18.2 ^c	2.0	<0.001	24.4 ^{ab}	1.7	57.7 ^a	3.1	46.5 ^a	3.4	14.4 ^b	2.1	<0.001	35.1 ^b	3.3	81.5 ^a	5.1	78.0 ^a	5.7	21.5 ^b	3.3	<0.001	
Salted vegetable	28.6 ^a	2.1	29.5 ^a	1.4	31.9 ^a	1.7	3.9 ^b	0.9	<0.001	21.7 ^a	1.7	20.0 ^a	1.2	25.3 ^a	1.9	2.0 ^b	0.6	<0.001	35.9	3.7	37.8 ^a	2.5	37.4	2.7	5.6	1.6	<0.001	
Fruit	13.9 ^b	2.2	15.6 ^b	2.1	15.6 ^b	2.4	106 ^a	11.5	<0.001	11.3 ^b	2.3	18.6 ^b	2.9	15.3 ^b	3.0	104 ^a	9.5	<0.001	16.7 ^b	3.7	12.9 ^b	3.2	15.9 ^b	3.6	108 ^a	19.8	<0.001	
V+F [§]	43.5 ^c	2.8	86.0 ^{bc}	3.9	79.2 ^{bc}	4.1	124 ^a	11.6	<0.001	35.6 ^c	2.7	76.3 ^{bc}	4.4	61.8 ^{bc}	4.0	118 ^a	9.9	<0.001	51.8 ^c	4.8	94.4 ^b	6.0	93.9 ^b	6.7	129 ^a	19.8	<0.001	
<i>Ratio (%)[¶]</i>																												
All vegetable	21.1 ^a	0.8	24.9 ^a	0.6	23.1 ^a	0.6	3.1 ^b	0.2	<0.001	19.7 ^a	0.9	23.6 ^a	0.8	22.5 ^a	0.8	2.5 ^b	0.3	<0.001	22.5 ^a	1.2	26.0 ^a	0.8	23.6 ^a	0.8	3.7 ^b	0.4	<0.001	
Non salted vegetable	10.3 ^a	0.5	16.7 ^a	0.6	13.8 ^a	0.5	2.6 ^b	0.2	<0.001	10.0 ^a	0.6	16.8 ^a	0.7	13.6 ^a	0.7	2.1 ^b	0.3	<0.001	10.6 ^a	0.8	16.5 ^a	0.8	13.9 ^a	0.6	2.9 ^b	0.4	<0.001	

[†] Adjusted for energy intake, household income and mother's education level.

[‡] *p*-value by ANCOVA

[§] V+F intake=non salted vegetable intake+fruit intake.

[¶] (Each food intake/Total food intake)*100.

^{abc} Different superscript letters mean significantly different among groups at $\alpha=0.05$ level by Tukey's multiple range comparison.

Table 4. Vegetable and fruit intake according to daily meal and snack[†] (cont.)

Variables (g/day)	Total									7~12y									13~18y									
	Breakfast		Lunch		Dinner		Snack		<i>p</i> -value [‡]	Breakfast		Lunch		Dinner		Snack		<i>p</i> -value	Breakfast		Lunch		Dinner		Snack		<i>p</i> -value	
	mean	SE	mean	SE	mean	SE	mean	SE		mean	SE	mean	SE	mean	SE	mean	SE		mean	SE	mean	SE	mean	SE	mean	SE		mean
Salted vegetable	10.7 ^a	0.6	8.2 ^a	0.4	9.3 ^a	0.5	0.6 ^b	0.1	<0.001	9.7 ^a	0.7	6.8 ^{ab}	0.4	8.9 ^a	0.6	0.4 ^c	0.1	<0.001	11.8 ^a	1.0	9.5 ^a	0.6	9.6 ^a	0.7	0.7 ^b	0.2	<0.001	
Fruit	3.5 ^b	0.6	3.2 ^b	0.4	2.7 ^b	0.4	15.7 ^a	1.1	<0.001	3.0 ^b	0.6	4.6 ^b	0.7	2.8 ^b	0.5	17.0 ^a	1.3	<0.001	4.0 ^b	1.0	2.0 ^b	0.4	2.6 ^b	0.6	14.6 ^a	1.5	<0.001	
V+F	13.8 ^b	0.8	19.8 ^a	0.6	16.5 ^{ab}	0.6	18.3 ^a	1.1	<0.001	13.0 ^b	0.8	21.4 ^a	0.9	16.4 ^{ab}	0.7	19.1 ^a	1.3	<0.001	14.6 ^b	1.2	18.5 ^a	0.9	16.5 ^{ab}	0.8	17.6 ^{ab}	1.4	0.042	
Girl	953		1142		1126		1149			589		656		655		649			364		486		471		500			
<i>Food intake (g/d)</i>																												
Total food	227 ^b	6.1	337 ^{ab}	11.2	319 ^{ab}	10.1	452 ^a	13.3	<0.001	203 ^b	7.7	303 ^{ab}	10.5	273 ^{ab}	9.3	463 ^a	14.7	<0.001	253 ^b	9.5	367 ^{ab}	17.0	360 ^{ab}	16.2	442 ^a	20.3	<0.001	
All vegetable	51.2 ^b	2.7	82.9 ^a	3.7	75.2 ^a	2.9	17.7 ^c	2.3	<0.001	42.7 ^{bc}	2.4	73.3 ^a	3.5	64.4 ^{ab}	2.9	19.8 ^c	3.6	<0.001	60.1 ^{ab}	4.5	91.2 ^a	5.3	84.8 ^a	4.7	15.9 ^c	2.4	<0.001	
Non salted vegetable	29.5 ^b	2.0	59.5 ^a	3.5	52.8 ^a	2.7	15.4 ^c	2.2	<0.001	24.0 ^{bc}	1.8	52.7 ^a	3.2	41.6 ^{ab}	2.6	17.4 ^c	3.6	<0.001	35.2 ^b	3.4	65.5 ^a	4.9	62.8 ^a	4.2	13.8 ^c	2.3	<0.001	
Salted vegetable	21.7 ^a	1.4	23.4 ^a	1.1	22.4 ^a	1.3	2.3 ^b	0.4	<0.001	18.7 ^a	1.4	20.7 ^a	1.2	22.9 ^a	1.8	2.4 ^b	0.7	<0.001	24.8 ^a	2.3	25.7 ^a	1.8	21.9 ^a	1.8	2.2 ^b	0.5	<0.001	
Fruit	15.0 ^b	2.5	16.3 ^b	2.1	12.2 ^b	1.7	116 ^a	8.5	<0.001	11.8 ^b	2.6	19.7 ^b	3.4	13.7 ^b	2.5	114 ^a	8.2	<0.001	18.3 ^b	3.8	13.3 ^b	2.7	11.0 ^b	2.3	118 ^a	13.2	<0.001	
V+F [§]	44.5 ^b	3.0	75.8 ^b	4.0	65.1 ^b	3.1	132 ^a	8.6	<0.001	35.8 ^c	3.4	72.4 ^b	4.5	55.2 ^{bc}	3.8	131 ^a	9.1	<0.001	53.6 ^c	4.6	78.8 ^{bc}	5.8	73.8 ^{bc}	4.8	132 ^a	13.0	<0.001	
<i>Ratio (%)[¶]</i>																												
All vegetable	22.1 ^a	0.9	24.5 ^a	0.6	23.7 ^a	0.6	3.1 ^b	0.3	<0.001	21.1 ^a	0.9	24.3 ^a	0.8	23.6 ^a	0.9	3.3 ^b	0.4	<0.001	23.1 ^a	1.4	24.7 ^a	1.0	23.7 ^a	0.9	3.0 ^b	0.4	<0.001	
Non salted vegetable	12.2 ^a	0.6	16.5 ^a	0.5	15.5 ^a	0.5	2.7 ^b	0.3	<0.001	11.5 ^a	0.7	16.6 ^a	0.7	14.3 ^a	0.7	2.8 ^b	0.4	<0.001	12.9 ^a	1.0	16.4 ^a	0.8	16.6 ^a	0.8	2.5 ^b	0.3	<0.001	
Salted vegetable	9.9 ^a	0.6	8.1 ^a	0.4	8.1 ^a	0.5	0.5 ^b	0.1	<0.001	9.6 ^a	0.7	7.7 ^a	0.5	9.3 ^a	0.7	0.4 ^b	0.1	<0.001	10.2 ^a	0.9	8.4 ^a	0.6	7.1 ^a	0.6	0.5 ^b	0.1	<0.001	
Fruit	4.3 ^b	0.6	3.8 ^b	0.4	2.8 ^b	0.3	21.6 ^a	1.3	<0.001	3.5 ^b	0.6	4.5 ^b	0.6	3.2 ^b	0.5	21.7 ^a	1.4	<0.001	5.0 ^b	1.0	3.2 ^b	0.6	2.5 ^b	0.5	21.5 ^a	2.0	<0.001	
V+F	16.4 ^b	0.8	20.3 ^{ab}	0.6	18.3 ^{ab}	0.6	24.3 ^a	1.3	<0.001	15.0 ^b	0.9	21.1 ^{ab}	0.9	17.5 ^b	0.8	24.6 ^a	1.4	<0.001	17.9 ^b	1.2	19.5 ^{ab}	0.9	19.1 ^{ab}	0.9	24.0 ^a	2.0	0.035	

[†]Adjusted for energy intake, household income and mother's education level.

[‡]*p*-value by ANCOVA

[§]V+F intake=non salted vegetable intake+fruit intake.

[¶](Each food intake/Total food intake)*100.

^{abc}Different superscript letters mean significantly different among groups at $\alpha=0.05$ level by Tukey's multiple range comparison.

Table 5. Frequency of survey subject with intake level satisfying the individual guidelines of the WHO and WCRF[†]

	Total			7~12y			13~18y		
	≥400 g/day [‡] (n=658)		<i>p</i> - value [¶]	≥400 g/day (n=362)		<i>p</i> - value	≥400 g/day (n=296)		<i>p</i> - value
	n	% [§]		n	%		n	%	
Total (n=2538)	658	24.9	-	362	22.6	-	296	26.8	-
Sex			0.889			0.854			0.971
Boy (n=1341)	354	25.1		192	22.8		162	27.0	
Girl (n=1197)	304	24.8		170	22.4		134	26.7	
Region			0.072			0.017			0.568
Large city (n=1136)	295	25.4		162	24.2		133	26.3	
Middle & Small city (n=1072)	291	27.1		166	25.5		125	28.5	
Rural area (n=330)	72	18.8		34	11.4		38	24.6	
Household income level			0.058			0.009			0.834
Low (n=311)	61	19.9		22	14.8		39	23.1	
Middle (n=918)	217	23.1		122	18.7		95	27.0	
High (n=1278)	376	28.9		215	28.9		161	28.8	
Mother's education level			0.002			0.022			0.028
Middle school or lower (n=122)	24	18.7		4	10.7		20	20.9	
High school graduate (n=1107)	255	21.4		131	20.0		124	22.5	
College of higher (n=972)	306	33.2		197	30.2		109	36.8	
Subjective weight status			0.748			0.361			0.359
Underweight (n=752)	202	26.3		131	24.6		71	28.3	
Normal (n=913)	245	26.3		122	22.4		123	29.3	
Overweight (n=575)	136	22.2		80	23.1		56	21.6	
Obesity (n=125)	31	27.1		14	17.3		17	34.1	
Pattern of daily meal			0.011			0.010			0.042
B+L (n=81)	15	14.5		5	14.3		10	14.5	
B+D (n=77)	15	19.7		6	13.6		9	22.2	
L+D (n=418)	98	23.1		29	13.4		69	26.6	
B+L+D (n=1900)	524	27.1		321	24.6		203	30.0	
Others (n=63)	6	7.2		1	10.0		5	6.8	
Eating-out frequency			0.597			0.093			0.839
≥1/day (n=639)	174	27.0		57	24.1		117	27.9	
5~6 times a week (n=1845)	469	24.1		298	22.2		171	26.7	
<5/week (n=51)	15	23.4		7	61.6		8	20.3	
Pattern of cooking location			0.466			0.602			0.417
Only home (n=578)	141	22.1		74	20.5		67	23.4	
Only commercial location (n=84)	21	28.0		6	46.8		15	25.8	
Only institution (n=34)	5	11.6		-	-		5	13.1	
H+C (n=543)	154	28.4		74	21.2		80	32.6	
H+I (n=939)	250	25.5		159	24.1		91	27.2	
H+C+I (n=269)	68	23.6		44	23.3		24	24.1	
C+I (n=89)	19	22.7		5	17.5		14	24.8	
Snack			0.014			0.021			0.069
Yes (n=2413)	643	25.6		356	23.2		287	27.7	
No (n=125)	15	13.7		6	9.6		9	15.8	

B: breakfast; L: lunch; D: dinner; H: home; C: commercial location; I: institution.

[†]WHO (World Health Organization) and WCRF (World Cancer Research Fund) recommended vegetable and fruit intake of 400 g/day or more.

[‡]<400g/day intake group not shown

[§]Weighted %.

[¶]*p*-value by Chi-square.

in the low income group (OR=2.31; $p<0.05$). Regarding meal patterns, the intake ratio of 400 g or more was 43% lower in subjects who ate only lunch and dinner, compared with those who ate breakfast, lunch, and dinner (OR=0.57; $p<0.05$). The eating-out frequency was increased 5.6 times (OR=5.63) in groups with eating-out less than five times a week, compared with groups with eating-out more than once a day ($p<0.01$). Additionally, the ratio of subjects with intakes of 400 g or more increased 2.8 times (OR=2.83) among subjects who ate snacks, compared with those who did not eat snacks ($p<0.05$).

Among subjects aged 13–18 years, the intake ratio of

400 g or more combined vegetables and fruit increased 1.6 times (OR=1.55) in girls compared with boys ($p<0.05$). Regarding meal patterns, intake decreased by 67% in groups who ate only breakfast and dinner, compared with those who ate breakfast, lunch, and dinner (OR=0.33; $p<0.05$). Regarding cooking location, subjects who ate meals provided only by institutions had rates of a combined intake 67% lower than those of subjects who ate meals only at home (OR=0.33; $p<0.05$).

DISCUSSION

This study analyzed the intake of fruits and vegetables for 2,538 children and adolescents aged 7–18 years, who had

Table 6. Factors related to vegetable and fruit intake (≥ 400 g/day) in children and adolescents[†]

Variables	Total	7~12 y	13~18 y
Sex (ref.=Boy)			
Girl	1.35 (1.07-1.72) ^{**}	1.15 (0.84-1.57)	1.55 (1.08-2.23) [*]
Age	1.00 (0.95-1.04)	0.88 (0.81-0.96) [*]	1.05 (0.95-1.16)
Region (ref.=Large city)			
Middle & Small city	1.11 (0.85-1.44)	1.09 (0.75-1.57)	1.12 (0.78-1.61)
Rural area	0.71 (0.42-1.20)	0.40 (0.23-0.72) ^{**}	1.00 (0.47-2.11)
Household income level (ref.=Low)			
Middle	1.28 (0.83-1.98)	1.38 (0.65-2.97)	1.27 (0.75-2.51)
High	1.67 (1.09-2.55) [*]	2.31 (1.08-4.95) [*]	1.36 (0.84-2.20)
Mother's education level (ref.=Less than graduate of high school)			
Graduate of high school	1.26 (0.70-2.24)	2.36 (0.57-9.74)	1.09 (0.58-2.06)
College of higher	2.26 (1.23-4.15) ^{**}	4.19 (1.00-17.58)	1.97 (0.99-3.94)
Subjective weight status (ref.=Underweight)			
Normal	1.10 (0.82-1.49)	0.87 (0.63-1.21)	1.36 (0.86-2.14)
Overweight	0.87 (0.64-1.19)	0.86 (0.57-1.30)	0.92 (0.56-1.50)
Obesity	1.24 (0.68-2.27)	0.66 (0.27-1.59)	1.93 (0.85-4.38)
Pattern of daily meal (ref.=B+L+D)			
B+L	0.41 (0.20-0.86) [*]	0.45 (0.15-1.30)	0.33 (0.15-0.95) [*]
B+D	0.64 (0.30-1.36)	0.37 (0.14-1.01)	0.71 (0.29-1.73)
L+D	0.87 (0.61-1.24)	0.57 (0.36-0.93) [*]	0.95 (0.60-1.49)
Others	0.23 (0.08-0.68) ^{**}	0.22 (0.03-1.91)	0.22 (0.07-0.72) [*]
Eating-out frequency (ref. ≥ 1 /day)			
5~6 times a week	1.00 (0.74-1.35)	0.98 (0.62-1.56)	1.04 (0.72-1.50)
<5/week	0.66 (0.30-1.46)	5.63 (1.57-20.24) ^{**}	0.50 (0.21-1.23)
Pattern of cooking location (ref.=Only home)			
Only commercial location	1.19 (0.63-2.26)	3.09 (0.90-10.58)	1.02 (0.49-2.15)
Only institution	0.32 (0.11-0.89) [*]	- [§]	0.33 (0.11-0.99) [*]
H+C	1.22 (0.86-1.72)	0.98 (0.60-1.61)	1.34 (0.86-2.10)
H+I	1.05 (0.76-1.43)	1.15 (0.75-1.77)	0.95 (0.61-1.48)
I+C	0.85 (0.43-1.70)	0.73 (0.20-2.70)	0.89 (0.39-2.00)
H+C+I	0.95 (0.55-1.64)	1.06 (0.51-2.22)	0.86 (0.40-1.85)
Snack (ref.=No)			
Yes	2.17 (1.15-4.08) [*]	2.83 (1.13-7.08) [*]	2.05 (0.93-4.49)

B: breakfast, L: lunch, D: dinner; H: home, C: commercial location, I: institution.

[†]Adjusted for energy intake.

^{*}Odds ratio (95% confidence interval).

[§]No data.

* $p < 0.05$, ** $p < 0.01$.

completed the 24-hour recall survey within the 2010 and 2011 KNHANES. Total food intake, all vegetables, salted vegetables, unsalted vegetables, fruit, and combined fruit and unsalted vegetables were analyzed for all subjects.

According to the study by Lee and Kim,²⁷ who analyzed vegetable intake in Koreans using 1998–2005 KNHANES data, the intake for children aged 7–12 years was 175 g in 1998 and 212 g in 2005. This statistic in the present study increased by about 21.5 g compared with 1998, but decreased by 15.9 g compared with 2005. Additionally, for subjects aged 13–18 years, intake was 264 g for those aged 13–15 years and 263 g for those aged 16–18 years in 2005. Thus, the results of the present study suggest a decreased intake of 4.7–6.5 g over the past five years. Kim et al²¹ analyzed the frequency of vegetable intake using 2006 and 2011 KYRBWS data and reported that the intake of vegetables other than *kimchi* more than once a day had decreased by approximately 10% over the 5-year period (58.2% in 2006 and 48.2% in 2011). As these study results have shown decreased vegetable intakes since the mid-2000s, in-depth measures are needed to increase vegetable intakes in children and adolescents.

Moreover, the combined intake of fruit and unsalted vegetables was 83.6–120 g short of the 400 g recom-

mended in the guidelines for plant food intake from previous studies.^{15,16} In this context, Lee et al²⁸ investigated the number of servings of fruits or vegetables in 8,502 subjects who participated in the 2008 KNHANES and reported that about 5.3% of the subjects received the recommended number of servings (6 to 10 servings/day). Additionally, 4.6% of children aged 7–12 years received the recommended number of servings of fruits and vegetables, which was lower than the value of adults over 40 years of age (40–59 years: 7.1%; over 60 years: 8.0%). However, that value was the highest among subjects under 40 years of age (2–6 years: 2.2%; 13–18 years: 2.2%; 19–39 years: 3.8%). According to results from previous studies and the present study, the intake of fruits and vegetables in Korean children and adolescents is insufficient compared with the daily recommendations. Thus, policy measures are needed for children and adolescents to recognize the importance of fruit and vegetable intake. In addition, it is necessary to develop educational programs with more concrete guidelines to encourage children to recognize the necessity of an increased intake of unsalted fruits and vegetables in the future.

Among the results of this study, the combined intake of unsalted vegetable and fruit in all subjects according to

cooking location was 159.0 g at home-made meal, 206.1 g at commercial location, and 104.2 g at institution, showing the highest at commercial location. However, in case of commercial location, previous studies have reported that when eating-out, foods have higher fat, cholesterol, and sodium contents compared with home-made meals, and the energy contribution from fats was higher than recommended, causing an imbalanced intake.^{35,37-39} Based on previous studies,^{35,40} increasing the intake of home meals with high quality nutrients, and the combined intake of unsalted vegetables and fruit at all cooking locations was suggested.

The results of the present study showed that the combined intake of fruit and unsalted vegetables was the highest in snacks (128 g). It is thought that this might be related to the higher intake ratio of fruits in snacks (fruit intake: 111 g for all subjects in snacks). This result may be explained by meal skipping, which had rates of 12.5% among subjects aged 7 to 12 years and 31.5% among those aged 13–18 years. However, over 90% of children and adolescents consumed snacks. In other words, when they did skip a meal, they seemed to have snacks instead. Further studies should analyze the relationship among these results and youth (adolescents and children) in Korea. Dietary and nutrition education programs with long-term goals and various menus with fruits should be developed to naturally increase the intake of fruit and unsalted vegetables, not only in snacks, but also in breakfast, lunch, and dinner. We found that subjects who consumed more than the suggested plant food intake (400 g of fruit and non-starchy vegetable combined), as recommended by the WHO¹⁵ and WCRF¹⁶, were more likely to have a higher household income level and a higher mother's education level. Previous studies have reported increased intake of fruits and vegetables in women with higher household incomes and education levels,⁴¹⁻⁴³ and studies on the relationship between food intake and socioeconomic factors in children and adolescents have reported that the frequency of fruit and vegetable intake increased with a higher mother's education level.^{21,44,45} Foreign studies have reported that social and environmental factors affecting the dietary behaviors of children and adolescents included the socioeconomic level of the household, parents' education levels, and family structure.⁴⁶⁻⁴⁸ This suggests that the education level of parents and household income influence the intake of fruits and vegetables in children and adolescents. Thus, development of policies for balanced meals through school meal programs is needed for children and adolescents from low-income households.

This study had a few limitations. First, the food intake survey of KNHANES has two dietary intake data: the food frequency questionnaire (FFQ) and 24-hour recall. Among these, this study examined food intake data recorded by 24-hour recall, which records foods that the subject consumed for 24 hours the day before the survey by interview.^{29,49} However, it is difficult to figure out the true daily food intake of an individual because this method describes information for only one day.^{29,49,50} Therefore, more diverse studies, such as comparative analyses between food intake from 24-hour recall data and those converted through the FFQ are needed in the

future. Secondly, analyzing the food intake of an individual with long-term aspects may be a limitation because KNHANES is a cross-sectional study. Thus, a long-term follow-up cohort study may be needed to investigate the influence of foods on children and adolescents as they become older in the future.

AUTHOR DISCLOSURES

The authors have no conflicts of interest to declare.

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