Correlation between Intake of Dietary Fiber and Adherence to the Korean National Dietary Guidelines in Adolescents from Jeonju

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Abstract

This study surveyed dietary intake and adherence to the Korean national dietary guidelines in Korean adolescents. To elucidate basic data for use in nutrition education, which aims to improve adolescent compliance with the national dietary guidelines and to increase the intake of dietary fiber, we evaluated the sources of fiber in adolescent diets. This study included 182 male and 212 female students from 2 middle schools in the Jeonju province. From November 15∼20, 2011, we surveyed the students for general characteristics, adherence to the Korean national dietary guidelines, and dietary intake. Dietary fiber intake was 16.57 ± 6.95 g/day for male students and 16.14 ± 7.11 g/day for female students. The food groups that contributed most to dietary fiber intake were (in descending order) cereals, vegetables, seasoning, and fruits. The fiber-containing food items consumed most were cabbage-kimchi, cooked rice, instant noodles, and cabbage. Based on adherence to the Korean national dietary guidelines, the vegetable-based intake of dietary fiber in groups 1 (score 15∼45), 2 (score 46∼52), and 3 (score 53∼75) were 4.41 ± 2.595 g/day, 4.12 ± 2.692 g/day, and 5.49 ± 3.157 g/day, respectively ($p < 0.001$). In addition, the total intake of dietary fiber varied significantly among the three groups ($p < 0.001$) as follows: Group 1, 14.99 ± 6.374 g/day; Group 2, 15.32 ± 6.772 g/day; and Group 3, 18.79 ± 7.361 g/day. In this study, we discovered that adherence to the Korean national dietary guidelines correlates with improved intake of dietary fiber. Therefore, marketing and educational development is needed to promote adherence to the Korean national dietary guidelines. In addition, nutritional education is needed to improve dietary fiber consumption through the intake of vegetables and fruits other than kimchi.

Key words: adolescents, dietary fiber, guideline adherence

INTRODUCTION

Dietary habits are established early in life; habits and behaviors formed during the teenage years make a huge impact on adult nutritional status (1,2). Balanced dietary habits during this stage of life are important for physical and mental health as well as intellectual development and academic achievement (3,4). The dietary habits of young people are a growing problem worldwide; many countries have developed nutrition education programs or dietary guidelines targeted to this age group. Nutrition education has been reported as an effective means to help young people develop proper dietary habits (5,6); some countries have implemented school-based nutrition education programs. For example, the United States promotes a "5-a-day" strategy, which recommends young people to consume five servings of vegetables and fruits every day. In Australia, the "Go for 2 & 5" campaign suggests consumption of two servings of fruit and five servings of vegetables every day. These two examples demonstrate that improved intake of dietary fiber is a

vital nutrition education policy. Korea announced "dietary guidelines for Koreans" in 2002 and "national dietary guidelines" (based on the human life cycle) in 2003. In 2009, the national dietary guidelines were revised and included six major tenets: consume a variety of foods from each food group, use less salt and oil, be aware of individual healthy weight and adjust diet accordingly, drink fewer non-water beverages, do not skip meals or overeat, and choose hygienic food. For each tenet, the revised document also includes 3∼4 specific guidelines. However, the 3-year results from the fourth national nutrition survey revealed that only 31.2% of youths were aware of the national dietary guidelines (7). These dietary guidelines aim to maintain and improve national health and prevent diseases in citizens by promoting a healthy dietary lifestyle. To achieve this goal, a simple nutrition education program or policy is required to improve the awareness of and adherence to the guidelines.

The studies on the dietary lifestyles of Korean youths highlight dietary concerns related to dining outside of the home, consumption of "fast food" and soda (8-11),

and other dietary habits that may cause weight gain or obesity (12-15). Ultimately, these patterns may lead to chronic diseases such as hyperlipidemia, diabetes, and osteoporosis and thus, dietary habits should be corrected during adolescence. Sufficient intake of dietary fiber in adolescents decreases blood cholesterol concentration, controls obesity and constipation, and helps prevent or mitigate cardiovascular disease during adulthood. Currently, the Korean nutrient intake standards recommend a minimum dietary fiber intake of 12 g/1,000 kcal; however, for male and female individuals aged 15~18 years, the recommended amounts are 25 g and 20 g, respectively. Several studies have indicated that the significant lack of dietary fiber in Korean youth diets is due to either frequent consumption of processed and fast foods or poor weight loss strategies (16). Consequently, these habits can cause chronic diseases during adulthood.

Previous studies have examined Korean youths for intake of dietary fiber or adherence to the Korean national dietary guidelines. However, research on the intake of dietary fiber based on the Korean national dietary guidelines is lacking. Therefore, we surveyed Korean youths for dietary intake and adherence to the Korean national dietary guidelines and also evaluated the food sources for dietary fiber. This information will help elucidate basic data for use in the creation of a nutrition education program that will improve adolescent compliance with the Korean national dietary guidelines and increase dietary fiber intake among Korean adolescents.

SUBJECTS AND METHODS

Subjects

This study was conducted on 528 students (257 male and 269 female) from two middle schools in the Jeonju province from November 15~20, 2011. Respondents were excluded for insincere responses to survey questions related to ordinary matters, food/life guidance, and related topics. A total of 394 students (182 male and 212 female; 75% of the original respondent pool) were included in the final survey analysis.

Survey and methods

Subject characteristics and adherence to the national dietary guidelines: The subjects were asked to record general, personal information including sex, age, height, and weight. To evaluate adolescent adherence to the national dietary guidelines, we analyzed responses to the 15 questions (total, 17) relevant to nutrition. The survey questions used the Likert 5-point scale: 5, strongly agree; 4, agree; 3, neutral; 2, disagree; and 1, strongly disagree. Higher scores indicated greater adherence to the national dietary guidelines.

Dietary intake survey: A survey professional provided each participant with photos of food before initiating the 24-h remembrance procedure to investigate daily average nutrition intake. The surveyor explained to each participant how to record food intake in terms of time, place, type, and amount. Next, the subjects were shown food models and asked to use them to compare and clarify their intake types and amounts. Finally, the surveyor asked participants questions for final clarification on the intake types and amounts further. A nutrition management program, CAN-Pro (Computer Aided Nutritional analysis Program, version 4.0, The Korean Nutrition Society, Seoul, Korea) was used to conduct statistical analyses on nutrient intake.

After completing the nutrient intake analysis, we calculated caloric intake as the percentage of estimated requirements. We also calculated calcium, phosphorous, iron, zinc, vitamins A, B_1, B_2, and C, and niacin as percentages of the recommended daily intake. Finally, we calculated dietary fiber consumption as the percentage of adequate intake.

To evaluate the sources of dietary fiber, we classified foods into 14 groups: cereals, potatoes and starches, pulses, seeds and nuts, vegetables, mushrooms, fruits, meat and poultry, eggs, seaweed, dairy, beverages and alcohol, seasonings, and oils. We determined the content of dietary fiber in each category before we selected the top 25 foods that contributed to dietary fiber intake.

Statistical analysis

We used SPSS (Statistical Package for Social Sciences, version 14.0) to analyze the collected data. Participants were grouped according to sex and general characteristics, such as height, weight, body mass index (BMI), and dietary practices, and subjected to the t-test and χ^2-test analyses. Sex-based nutrient intake status was calculated as percentages of both the estimated energy requirements and recommended daily intake of each nutrient. In addition, subjects were classified into three groups based on adherence to the Korean national dietary guidelines: Group 1, 15~45 points; Group 2, 46~52 points; and Group 3, 53~75 points. Analysis of variance (ANOVA) was used to compare dietary fiber intake among groups. For intergroup comparisons, the post-hoc, Tukey's test analysis was performed. Significance was set at $p < 0.05$.

RESULTS

General characteristics of subjects

The general characteristics of the subjects are shown in Table 1. The average subject was 13.9 years old. The

Table 1. Subject characteristics

Variables	Total (n=395)	Sex		t or χ^2
		Male (n=182)	Female (n=213)	
	Mean±SD	Mean±SD	Mean±SD	
Age (years)	13.96±0.44	13.95±0.43	13.97±0.44	-0.59
Height (cm)	164.21±6.95	168.95±5.89	160.15±4.95	16.11*
Weight (kg)	53.12±9.01	56.65±9.76	50.11±7.05	7.69*
BMI (kg/m^2)[1]	19.64±2.70	19.80±3.00	19.51±2.42	1.03
BMI percentiles[2,3]				
Underweight	29 (7.3)	16 (4.1)	13 (3.3)	1.46
Normal	342 (86.6)	154 (39.0)	188 (47.6)	
Overweight	17 (4.3)	9 (2.3)	8 (2.0)	
Obese	7 (1.8)	3 (0.8)	4 (1.0)	

SD, standard deviation; BMI, body mass index.
*Significant at p<0.001, t-test and χ^2 test.
[1]BMI: weight (kg)/ height (m)^2.
[2]Assessed by comparing subject BMI to BMI percentile averages for age (KCDCP and KPS 2007); underweight, <5%; normal, 5~85%; overweight, 85~95%; and obese, ≤5%.
[3]n (%).

average heights of male and female subjects were 168.95 cm and 160.15 cm, respectively. The average weights of male and female subjects were 56.65 kg and 50.11 kg, respectively. Thus, significant differences were evident in height and weight based on sex. For both sexes, the average BMI was 19.64 kg/m^2 (no differences were detected between male and female students). Obesity rate analysis based on the BMI guidelines set for Korean Children and Adolescents in 2007 (KCDCP, Korea center for disease control and prevention; and KPS, the Korean pediatric society) indicated 342 (86.6%) normal weight, 29 (7.3%) underweight, 17 (4.3%) overweight, and 7 (1.8%) obese subjects. No significant differences

in weight status were evident between male and female subjects within any of the groups.

Nutrient intake status

The subjects' calorie and nutrient intake status are shown in Table 2. The total caloric intakes of male and female students were 1,933.9 kcal and 1,695.4 kcal, respectively. The percentage of estimated energy requirements according to the Korean nutrient intake standards were 71.6% and 84.8% for male and female subjects, respectively. The carbohydrates : protein : fat ratio of total intake for both sexes was 60:15:25 (percentages). Based on the recommended nutrient intake (RNI) values for important minerals and vitamins, the intake status

Table 2. Nutrient intake

Variables (per day)	Male (n=182)	EER (%)	Female (n=213)	EER (%)
	Mean±SD		Mean±SD	
Energy (kcal)	1933.90±757.45	71.6	1695.40±596.54	84.8
Protein (g)	70.12±35.16		61.58±28.26	
Fat (g)	57.01±33.95		49.44±28.84	
Carbohydrates (g)	286.38±100.21		255.59±93.58	
C:P:F (%)	60:15:25		60:15:25	
	Mean±SD	RNI (%)	Mean±SD	RNI (%)
Ca (mg)	399.07±262.80	44.3	364.14±182.06	45.5
P (mg)	955.93±459.45	95.6	858.52±349.85	107.3
Fe (mg)	12.20±5.76	81.3	11.40±4.85	67.1
Zinc (μg)	10.07±4.76	100.7	8.89±3.74	98.8
Vitamin A (μg RE)	632.72±435.47	84.4	678.14±519.61	113.0
Vitamin B$_1$ (mg)	1.52±0.75	116.9	1.31±0.61	131.0
Vitamin B$_2$ (mg)	1.14±0.57	67.1	1.07±0.53	89.2
Niacin (mg)	16.36±8.85	96.3	14.29±6.58	102.1
Vitamin C (mg)	80.48±79.11	80.5	92.62±76.56	92.6
	Mean±SD	AI (%)	Mean±SD	AI (%)
Fiber (g)	16.57±6.95	66.3	16.14±7.11	80.7

EER, estimated energy requirements; SD, standard deviation; C, carbohydrate; P, protein; F, fat; RNI, recommended nutrient intake; AI, adequate intake; RE, retinol equivalents.

Table 3. Food group composition of dietary fiber

Food group	Contribution to dietary fiber intake (%)
Total plant food products	98.62
Grains and cereals	33.97
Vegetables	33.45
Fruits	7.48
Pulses	5.16
Seaweeds	4.78
Potatoes and starches	4.19
Mushrooms	1.04
Seeds and nuts	0.35
Oils and fats	0.02
Seasonings	8.18
Total animal food products	1.38
Milk and dairy	0.68
Meats and poultry	0.65
Eggs	0.05
Total fiber intake	100.0

in male and female students were 44.3% and 45.5% for calcium, 81.3% and 67.1% for iron, and 67.1% and 89.2% for vitamin B_2. Adequate intake (AI) values for fiber in male and female students were 66.3% and 80.7%, respectively.

Food group sources of dietary fiber in adolescents

The dietary fiber intake for each food group is shown in Table 3. Cereals contributed most to dietary fiber in-

Table 4. Major sources of dietary fiber based on 24-h recall

Raking	Daily fiber sources	Contribution to dietary fiber intake (%)	Cumulative contribution (%)
1	Cabbage kimchi	12.72	12.72
2	White rice	10.26	22.99
3	Ramyeon	5.62	28.61
4	Cabbage	5.36	33.96
5	Citrus fruit	3.71	37.67
6	Bean sprouts	3.11	40.79
7	Laver	2.83	43.62
8	Sweet potato	2.79	46.41
9	Green onion	1.90	48.31
10	Seaweed	1.50	49.81
11	White radish	1.47	51.28
12	Popcorn	1.47	52.75
13	Pepper	1.40	54.15
14	Flour	1.38	55.54
15	Carrot	1.38	56.91
16	Spinach	1.30	58.21
17	Brown rice	1.17	59.38
18	Apple	1.10	60.48
19	Persimmon	1.09	61.57
20	Tofu	1.08	62.64
21	Bread	1.06	63.70
22	Potato	0.99	64.69
23	Red beans	0.90	65.59
24	Soybean	0.89	66.48
25	Udon	0.82	67.29

take (33.97 %), followed by vegetables (33.45%), fruits (7.48%), pulses (5.16%), seaweed (4.78%), potatoes (4.19%), mushrooms (1.04%), seeds and nuts (0.35%), oils (0.02%), and seasonings (8.18%). From animal product sources, milk contained the most fiber (0.68%), followed by meat (0.65%), and eggs (0.05%).

Major food sources of dietary fiber in adolescents

The main consumed food sources of dietary fiber were evaluated using a 24-h recall method. Cabbage-kimchi contributed the most fiber (12.72%), followed by white rice (10.26%), instant noodles (5.62%), cabbage (5.36 %), mandarins (3.71%), and bean sprouts (3.11%) (Table 4).

Adherence to the national dietary guidelines

A comparison between the male and female students in terms of adherence to the Korean national dietary guidelines is shown in Table 5. Based on the evaluation of responses using the 5-point Likert-type scale, the overall adherence was 3.23 ± 0.607 points. Male students scored 3.28 ± 0.585 points; and female students scored 3.19 ± 0.623 points; no significant differences were apparent between male and female students. With regard to the guideline to consume a variety of foods from each food group every day, male and female students scored 3.24 ± 0.831 and 2.95 ± 0.904 points, respectively; male scores were significantly higher ($p < 0.001$). With regard to the guideline to be aware of healthy weight and adjust dietary intake accordingly, male and female students scored 3.41 ± 0.803 and 3.19 ± 0.781 points, respectively; again, male scores were significantly higher ($p < 0.01$).

Association between dietary fiber intake from each food group and adherence to the national dietary guidelines

The fiber intake for each food group is shown in Table 6. Study subjects were categorized into three groups, (Group 1, 15~45 points; Group 2, 46~52 points; and Group 3, 53~75 points), according to adherence to the national dietary guidelines. A significant difference in dietary fiber intake through the consumption of vegetables was observed. The vegetable intake scores based on the national dietary guidelines were: Group 1, 4.41 ± 2.595 g; Group 2, 4.12 ± 2.692 g; and Group 3, 5.49 ± 3.157 g. Thus, significant differences were seen in the intake of dietary fiber based on vegetable consumption according to the level of adherence ($p < 0.001$). Furthermore, overall dietary fiber intake was 14.99 ± 6.374 g for Group 1, 15.32 ± 6.772 g for Group 2, and 18.79 ± 7.361 g for Group 3. Thus, a greater adherence to the Korean national dietary guidelines resulted in significantly higher levels of overall dietary fiber intake ($p < 0.001$). No significant differences in fiber consumption were observed in any of the food groups, except for potatoes,

Table 5. Adherence to the Korean national dietary guidelines based on sex

Dietary tenets	Total (n＝394) Mean±SD	Male (n＝182) Mean±SD	Female (n＝212) Mean±SD	t
Consume many types of food from each food group everyday	3.08±0.88	3.24±0.83	2.95±0.90	3.28[**]
Use less salt and oil	2.97±0.86	2.97±0.82	2.98±0.90	-0.14
Be aware of healthy weight and eat accordingly	3.29±0.79	3.41±0.80	3.19±0.78	2.72[*]
Drink fewer non-water beverages	3.79±0.86	3.70±0.92	3.86±0.79	-1.74
Do not skip meals or overeat	3.22±0.89	3.22±0.86	3.23±0.92	-0.08
Total	3.23±0.60	3.28±0.58	3.19±0.62	1.48

[*]$p < 0.05$, [**]$p < 0.01$, significantly different between male and female group by t-test.

mushrooms, seasonings, and meats, for which lower adherences to the Korean national dietary guidelines led to decreased intake of dietary fiber. In contrast, the consumption of cereals, fruits, and pulses in combination with greater adherence to the Korean national dietary guidelines resulted in the higher intake of dietary fiber.

DISCUSSION

Studies on adolescent diets have reported that the intake of fast food and beverages are continuously increasing (9,10). Previous studies on potential insufficiencies of dietary fiber intake have been limited to intake status. To our knowledge, the adherence to the national dietary guidelines by adolescents has not been conducted. In this study, we investigated adolescent adherence to these guidelines by assessing their diets and surveying dietary fiber intake. We also tried to determine the food group sources of and overall dietary fiber intake in adolescents compared to guideline recommendations. Our results indicate that adolescents consume insufficient amounts of dietary fiber. Moreover, the major food groups that contributed to dietary fiber intake, in descending order of contribution, were cereals, vegetables, and fruits. The major food sources of dietary fiber, in order of greatest to least, were cabbage-kimchi, white rice, and instant noodles. We discovered that adolescents whom consumed most of their dietary fiber through vegetable intake exhibited the healthiest eating habits.

Dietary fiber intake status

Our survey on the intake of dietary fiber in adolescents revealed that the intake among male and female students was 16.57±6.65 g and 16.14±7.11 g, respectively, both of which fall below the recommended daily intake of dietary fiber (20～25 g) for adolescents in Korea. A previous study on youth dietary fiber intake (16) indicated that the intake in male and female students from urban areas was 9.22±3.90 g and 10.66±51.11 g, respectively, and in rural areas was 10.43±5.40 g and 10.60±5.21 g, respectively. In 2008, Yu et al. (17) analyzed dietary fiber intake according to age by substituting the dietary

fiber database in the results of the 2001 Korean National Health and Nutrition Examination Survey. Their results indicated that the average dietary fiber intake of teenagers (ages 13～19) is 18.33 g. Despite differences in these figures, these studies on the intake of dietary fiber in adolescents reveal that the intake is insufficient. Therefore, nutrition education should be improved to increase the intake of dietary fiber in this age group. In the present study, the vegetarian foodstuffs that contributed most to dietary fiber intake, in descending order of contribution, were cereals, vegetables, seasonings, fruits, pulses, seaweed, potatoes and starches, mushrooms, and seeds and nuts. The animal foods that contributed most to dietary fiber intake, in descending order of contribution, were dairy products, meats, and eggs. According to Lee et al. (18), vegetables contributed most to the intake of dietary fiber, followed by cereals, fruits, seasonings, pulses, seaweed, potatoes and starches, mushrooms, seeds and nuts, and oils; differences from our study for fiber amounts were apparent for vegetables, cereals, fruits, and seasonings. Lee's study subjects were youth of the age between 13～19, which is different than this research where the subjects were middle school students. Also, in contribution of dietary fiber consumption, vegetable and cereal group were ranked first. This is due to change in eating habits with increasing age, where consumption of vegetable group tend to increase while the ratio of dietary fiber within vegetable group did not show significant increase. Therefore, going forward, researches on food group that contributes to consumption of dietary fiber on high school students are needed.

In this study, the top ten food sources of dietary fiber were cabbage-kimchi, white rice, instant noodles, cabbage, citrus fruit, bean sprouts, laver, sweet potatoes, spring onion, and brown seaweed. In a previous study (18), the highest sources of fiber were, from most to least, cabbage-kimchi, instant noodles, mandarin, barley, radishes, powdered red pepper, bean sprouts, persimmons, and garlic. Compared to the foods in this study, cabbage-kimchi and instant noodles were the only high

Table 6. Dietary fiber intake in each food group based on adherence to the Korean national dietary guidelines, according to sex

Item (g)	Total (n=394) Mean±SD	T1[1] (n=145) Mean±SD	T2 (n=120) Mean±SD	T3 (n=129) Mean±SD	F	Male (n=182) Mean±SD	T1 (n=67) Mean±SD	T2 (n=48) Mean±SD	T3 (n=67) Mean±SD	F	Female (n=212) Mean±SD	T1 (n=78) Mean±SD	T2 (n=72) Mean±SD	T3 (n=62) Mean±SD	F
Vegetables	4.68±2.87	4.41±2.59[a]	4.12±2.69[a]	5.49±3.15[b]	8.33[***]	4.93±2.94	4.58±2.68[b]	4.01±2.74[a]	5.94±3.08[b]	7.22[***]	4.48±2.78	4.27±2.52	4.19±2.67	5.08±3.15	2.08
Cabbage kimchi	2.82±2.12	2.74±2.02[a]	2.31±1.80[a]	3.36±2.38[b]	8.02[***]	1.63±1.68	1.59±1.38	1.40±1.77	1.83±1.89	0.86	2.44±1.47	2.60±1.58	2.33±1.44	2.36±1.37	0.75
Other vegetables	1.81±1.52	1.70±1.53	1.73±1.41	2.01±1.60	1.65	1.08±0.93	1.00±0.93	1.02±0.81	1.19±1.01	0.81	1.70±1.25	1.65±1.38	1.59±1.08	1.92±1.25	1.31
Cereals	4.90±4.01	4.54±3.60	4.72±4.42	5.48±4.00	2.09	5.57±4.41	5.44±3.85	5.07±5.36	6.06±4.19	0.74	4.35±3.53	3.76±3.19	4.48±3.68	4.94±3.70	2.02
Pulses	0.61±1.39	0.56±1.12	0.53±1.27	0.75±1.72	0.98	0.58±1.49	0.61±1.17	0.43±1.10	0.65±1.96	0.31	0.67±1.30	0.51±1.08	0.59±1.38	0.88±1.43	1.45
Fruits	0.95±2.28	0.77±1.85	0.84±1.77	1.25±3.00	1.73	0.68±1.99	0.51±1.17	0.29±0.79	1.13±2.94	2.94	1.18±2.49	0.99±2.26	1.20±2.12	1.40±3.09	0.46
Potatoes and starches	0.56±1.95	0.49±11.62	0.67±2.50	0.56±1.73	0.19	0.20±0.92	0.29±1.34	0.06±0.14	0.19±0.70	0.87	0.76±2.49	0.56±1.83	0.94±3.18	0.81±2.33	0.45
Seaweed	0.49±0.92	0.55±1.00	0.46±1.02	0.46±0.72	0.37	0.45±0.96	0.60±1.00	0.33±1.26	0.38±0.61	1.32	0.53±0.89	0.49±1.00	0.55±0.83	0.54±0.83	0.08
Mushroom	0.10±0.51	0.16±0.66	0.02±0.16	0.11±0.52	2.42	0.10±0.53	0.16±0.62	0.01±0.11	0.10±0.60	1.06	0.11±0.49	0.17±0.70	0.04±0.19	0.12±0.42	1.38
Beverages	0.00±0.09	0.00±0.04	0.00±0.09	0.01±0.12	0.50	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00	0.07±0.12	0.01±0.06	0.02±0.12	0.03±0.17	0.66
Seasoning	0.97±1.36	0.93±1.73	0.81±0.84	1.16±1.26	2.11	0.99±1.69	1.08±2.34	0.72±0.88	1.08±1.33	0.79	0.96±0.99	0.79±0.92[a]	0.88±0.82[ab]	1.25±1.20[b]	4.05[*]
Meat	0.08±0.50	0.10±0.53	0.09±0.58	0.05±0.37	0.37	0.04±0.37	0.12±0.60	0.00±0.00	0.00±0.00	2.35	0.10±0.56	0.08±0.46	0.16±0.75	0.06±0.38	0.61
Dairy products	0.06±0.27	0.06±0.06	0.08±0.35	0.04±0.19	0.85	0.06±0.28	0.06±0.23	0.10±0.39	0.02±0.12	1.21	0.06±0.26	0.06±0.23	0.07±0.32	0.61±0.25[b]	0.06
Total	16.34±7.02	14.99±6.37	15.32±6.77	18.79±7.36[b]	12.1[***]	16.57±6.94	15.31±6.67[a]	15.10±6.91[a]	18.89±6.72[b]	6.24[**]	16.18±7.10	14.71±6.13[a]	15.47±6.72[a]	18.86±7.98[b]	6.77[***]

[*]p<0.05, [**]p<0.01, [***]p<0.001, significance determined by ANOVA test.
[a,b]Values with different letters within the same line are significantly different from each other by Tukey's test.
[1]Dietary action guide for adolescence: first tertile 15~45; second tertile 46~52; third tertile 53~75.

fiber food sources consumed at similar levels.

The food groups investigated most for contributions to dietary fiber intake in our study were cereals and vegetables. However, the specific food sources of dietary fiber intake were white rice and ramyeon, which differ from cereals, brown rice and barley that are high in dietary fiber content. Cereals are thought to be a major cause of high intake of dietary fiber because consumption amounts are simply high.

Furthermore, cabbage-kimchi, which contributed to intake the most, can be classified as a vegetable preparation. However, this dish can increase sodium intake because of its high salt content; therefore, cabbage-kimchi is an inappropriate primary source of dietary fiber. Dietary fiber intake is promoted to prevent chronic diseases such as obesity, hyperlipidemia, and hypertension, and nutrition education must aim to increase dietary fiber intake by promoting consumption of vegetables and fruits other than cabbage-kimchi.

In this study, dietary fiber obtained from processed foods comprised approximately 10% of the total intake among Korean adolescents; popcorn ranked 12th among the top foods contributing to dietary fiber intake; bread and udon ranked 21st and 25th, respectively. The three-year results of the fourth national nutrition survey revealed that adolescents 12~18 years of age consume more bread, cereals, confectionaries, meats, eggs, hamburgers, pizzas, and fried foods than any other age group. Ideally, nutrition education will help guide adolescents in replacing processed foods with healthier snacks.

Adherence to the Korean national dietary guidelines and sources of dietary fiber intake

Other analyses that did not consider subject adherence to the national dietary guidelines showed that the least practiced guideline was consumption of fewer fatty and salty foods, and the most practiced guideline was the drinking of fewer non-water beverages. A study by Park (19) also found similar findings, in that Korean youths view sodas and processed beverages as unhealthy (10).

In the present study, the sources of dietary fiber intake were dependent on the level of adherence to the Korean national dietary guidelines. A study by Kim et al. (20) on nutrient intake in children indicated that greater adherence to the Korean national dietary guidelines resulted in increased levels of nutrient intake. In addition, Park (21) investigated the preference for bean-based foods based on scores of adherence to the national dietary guidelines and reported that people with high adherence scores tended to have stronger preferences for beans. These results demonstrate that people can maintain proper nutritional status simply by following the na-

tional dietary guidelines. However, according to previous reports, youths have insufficient awareness of the guidelines. Thus, the guidelines should be promoted and nutrition education should be developed to aid adolescent understanding of the guidelines.

In this study, we showed that dietary fiber intake increased with adherence to Korean national dietary guidelines and that the amount of dietary fiber intake derived from vegetables significantly increased depending on the degree of adherence to Korean national dietary guidelines. However, the increase of dietary fiber intake due to increased cabbage-kimchi consumption also increased sodium intake, which indicates that nutrition education is needed to promote adequate food selection, and that overall, Korean national dietary guidelines are needed. An important finding of this study is that the relatively low adherence to the practice of consuming fewer salty and fatty foods should be strengthened in education and other areas to increase awareness of food and lifestyle choices in adolescents.

This study was conducted on youths from a single region of Korea; therefore, the results do not reflect adolescent dietary habits throughout the country. However, the study highlighted issues related to the primary food sources of dietary fiber intake, and made suggestions for improvement. The result that food group with high sodium consumption, e.g., kimchi, contributed to increase in dietary fiber consumption in vegetable groups points to the necessity of providing education on sodium intake amount contained in kimchi for dietary fiber intake in order to better inform them of nutritional consequences. Also, dietary guideline for youth proved to have a positive effect on dietary fiber consumption in practice, but the awareness of guideline itself seem to be insufficient. Therefore, there should be more active promotion of dietary guidelines through school-based or community-based campaign in order to guarantee healthy dietary practice of youth.

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