

Factors Related to Dietary Fiber Intake Among Sixth Grade Elementary School Children in Daejeon City

Young-Jin Chung[§], Yangsoon Lee¹ and Yoon-Suk Suh

Department of Food and Nutrition, College of Human Ecology, Chungnam National University, Daejeon 305-764, Korea,
¹Department of Food and Nutrition, Daejeon Health Sciences College, Daejeon 300-711, Korea

This study was conducted to investigate variables related to dietary fiber intake among sixth grade children in an elementary school in Daejeon city. One hundred and forty-seven children completed a questionnaire for determining their socioeconomic background and their food habits. Anthropometric measurements were taken, and a 24-hour diet recall method was used to collect three-day food intakes. The socioeconomic status of the children's families belonged to the upper middle class; 53.0% of their fathers and 25.8% of their mothers had completed college or higher degrees. 27.9% of the mothers had jobs, including part-time jobs. Approximately 30% of the children skipped breakfast, 66.4% of the children preferred animal foods to plant foods, and 52.4% of the children preferred green vegetables to yellow or pale vegetables. Grilled meat dishes, such as Grilled beef rib with seasoning, Bulgogi, grilled pork belly and beef steaks, were the most popular types of food eaten outside home by the children. Daily dietary fiber intake was 14.5 g in boys and 14.5 g in girls, and these intakes are low compared to the standard guidelines. The average intakes of energy and protein of the children were 84.5% and 114.0% of the Korean Recommended Dietary Allowances (RDAs), respectively. Besides energy, riboflavin, iron and calcium intakes were below the RDAs, and especially calcium intake was only 50% of the RDAs. On the other hand, thiamin, niacin, ascorbic acid, protein and phosphorus intakes exceeded the Korean RDAs. Family income or the children's body mass index (BMI) was not directly related to dietary fiber intakes. However, higher dietary fiber intakes tended to be related to higher intakes of green vegetables and fruits. Children with higher dietary fiber intake tended to prefer plant foods to animal foods. Energy and most nutrients, except heme iron and retinol, showed positive relationships with dietary fiber intake. Especially potassium and plant origin protein and calcium were highly correlated with dietary fiber intakes ($r > 0.6$). From these results, it is concluded that dietary fiber intakes of these sixth grade elementary school children were less than the standard reference and it is anticipated to decrease further in the future with increased incomes. Therefore, increased intakes of dietary fiber by elementary school children should be promoted through nutrition education, together with the development of cooking methods and recipes utilizing green vegetables and fruits.

Key words : Dietary fiber intake, 6th elementary school children, Daejeon city

INTRODUCTION

The recent changes in food culture and in the food industry, influenced by globalization and acceptance of other cultures, prompted a rapid change in food consumption patterns among Koreans; the traditional vegetable-centered diet has changed to gradually incorporate more meat, and this has affected the dietary fiber intakes of Koreans. After the first appearance in 1979 of a foreign hamburger restaurant chain, many other fast food restaurants, both international and local, emerged. Accordingly, the consumption of fast food among Koreans has increased, accompanied by a reduction in cereal consumption, which has further reduced dietary fiber intakes.¹⁾ So far, there have not been many studies conducted on dietary fiber consumption among Koreans. The Korean average

intakes of dietary fiber were 24.4 g in 1969, 22.4 g in 1975, 19.2 g in 1979, 15.9g in 1987, and 17.31 g in 1990, which shows an overall decreasing trend over time, resulting in a 30% reduction in 22 years.²⁾ According to several regional reports issued since 1990, it is hardly to tell the trend of increase of dietary fiber intake. Some college students took 15.4g in male students and 15.1 g in female students in 1991,³⁾ 20.5g in male students in 1996,⁴⁾ 22.5 g in female students in 1997.⁵⁾ Some adults of twenties to forties living in Daejeon city took dietary fiber of 16.9-20.0 g in male and 17.5-18.0 g in female in 1999.⁶⁾ The intake of dietary fiber showed increase in some of college students, but no meaningful increase in adults. On the other hand, there have been consistent increases in deaths from coronary heart diseases, colon cancer, and breast cancer. Thus, researchers in preventive medicine and health management continue to attempt to find associations between increases in these diseases and the decreased dietary fiber intakes.

Accepted : May 1, 2004

[§] To whom correspondence should be addressed.

Despite a significantly heightened interest in dietary fiber, there are insufficient data on the composition and quantity of dietary fiber in foods, and recommended allowances have not yet been established for dietary fiber; there is still considerable controversy about the desirable amount of dietary fiber intake.⁷⁾ In the 1990's, the WHO recommended daily intakes of 16-24 g of non-starch polysaccharides or 27-40 g of total dietary fiber which includes lignin,⁸⁾ and the Korean Recommended Allowances were set at 25-30 g in 1995. However, the definition, methods of analysis, and standards for classification of dietary fibers, and the physiological functions of each dietary fiber, remain unclear.

In Korea, a limited number of studies have been carried out on dietary fiber intakes in different populations: the annual changes in the estimated dietary fiber intakes of Koreans by Hye-Sung Lee and Yun-Gyung Lee,²⁾ dietary fiber intakes among Korean university students by Sun-Hee Hwang,⁴⁾ and the estimated intakes of dietary fiber among urban and rural Koreans by Mi-Kyong Lee and Su-Rae Lee.⁹⁾ However, the problem of accurately estimating dietary fiber intakes and of studying the consumption trend among different populations remains a challenge due to the lack of data on food intake and on the dietary fiber composition of foods.

The results of the Nationwide Health and Nutrition Examination Survey (NHANES III) showed that the average daily intake of dietary fiber among children over 10 years old in the US was 12.4 g; this is below the 0.5 g dietary fiber per kg body weight level recommended by the American Academy of Pediatrics.¹⁰⁾ Compared to the US, we do not have a survey carried out on children regarding dietary fiber intakes, and research on the nutritional status of children measures only the amount of crude fiber intakes. As Koreans are eating out more, and fast food restaurants are now found everywhere, fast food consumption among children has also increased. Thus, a study of dietary fiber intakes among children is needed in order to serve as a baseline for future interventions in the nutrition education of children, focused on the choice of a healthy diet.

Hence, the present study was conducted to measure the dietary fiber intakes of elementary school children, and to evaluate factors that may influence dietary fiber intakes, such as anthropometry, the family's socioeconomic backgrounds, and food behavior. We hope that the data from our study can serve as a baseline for determining recommended dietary allowances for dietary fiber, and as an aid to establishing healthful food habits and nutrition education among children.

SURVEY CONTENTS AND METHODS

1. Subjects and the Time of Survey

This survey was carried out on 150 sixth grade school children attending the Seobu elementary school located in Nae-dong, Suh-gu, Daejon, Korea. Senior students from the Department of Food and Nutrition, Chungnam National University, were trained to carry out the survey. A questionnaire was administered and a 24-hour dietary recall method was used for food intake measurements. The survey was conducted for 3 days (February 10th, 11th and 13th, 1998). On the first day, the children were shown life-size food models and were taught to estimate the quantity and types of food they ate the day before the survey. For the second and the third day, the children recorded their food intakes without supervision. The reasons for choosing the 6th grade children were threefold: these children have more or less established food habits, they can understand instructions easily, and they can record their own food intakes. A total of 147 questionnaires (from 80 boys and 67 girls, after excluding three due to incomplete responses) were used for the final analysis.

2. Survey Contents and Methods

1) General family background

The respondents were asked to record the number of family members, mothers' employment status, education levels of parents, and total household income.

2) Anthropometric measurements

Height and body weight were measured using a height meter and a scale, respectively, and the mid-arm circumference was measured with a tape. A caliper was used to measure triceps skinfold thickness. Respondents' Body Mass Index (BMI), equivalent to $[\text{body weight (Kg)}/\text{height}^2(\text{m})^2]$, was calculated by using the height and weight measurements; respondents with a BMI of over 20 were considered as overweight and under 20 as of normal weight.

3) Determination of food habits

A questionnaire for determining food habits consisted of a self-evaluation of the individual's nutrient intakes, the individual's tendency to favor a limited variety of foods, the regularity of breakfast consumption, the preference for animal/plant foods, the consumption of green/yellow/pale vegetables, fruit intake, the frequency of regular bowel movements, and the frequency of eating out.

4) Dietary fiber and nutrient intakes

Each individual's food intakes from 24-hour diet recalls were converted to weights; the dietary fiber intake was calculated by using a food composition table¹¹⁾ and

the intakes of other nutrients were calculated using CAN-Pro. The nutrient intakes of the subjects were compared with the revised Recommended Dietary Allowances for Koreans.¹²⁾

3. Data Analysis

The data were analyzed using the Statistical Analysis System (SAS); frequency and percentage were expressed as appropriate depending on the questions, and the means and standard deviations of the continuous variables were compared.

In order to evaluate the effects of different factors such as family backgrounds and food habits, the means and standard deviations of the intakes of dietary fiber for each factor were tested by using the t-test and the ANOVA. Duncan's multiple range test was used to test for significance ($P < 0.05$). In addition, dietary fiber and other nutrient intakes were compared between the two groups of different weight status (BMI > 20 and BMI < 20) by using student's t-test. The relationships among BMI, energy intakes, nutrient intakes, and dietary fiber intakes were determined by using Pearson's correlation coefficient, and the significance of the differences was tested at $P < 0.05$.

RESULTS AND DISCUSSION

1. General Family Background and BMI

1) General family background

Table 1 summarizes the responses regarding the general family background of the subjects. The number of family members was on average 3 to 4 (65.0%), and 41 subjects (27.7%) had mothers who worked outside of the household (21.6% full time and 6.1% part time). Regarding the fathers' highest education levels, 53% had completed university, 41.5% had completed high school, and 4.8% had completed middle school. Regarding the mothers' highest education levels, 25.8% had completed university, 63.3% had completed high school, and 9.5% had completed middle school. Monthly family incomes were reported as follows: 34.7% with 500,000-1,500,000 won, 49.7% with 1,500,000-3,000,000 won, and 15.6% with over 3,000,000 won. These children were from middle- to high- income families. According to the 1995 National Nutrition Survey Report,¹³⁾ 40.4% of all subjects and 59.4% of the subjects living in big cities had an average monthly household income greater than 1,400,000 won. Therefore, our present subjects seemed to be from relatively high-income families.

2) BMI and weight status

Table 2 shows the BMI and body weight status of the

Table 1. General characteristics of the subjects

Item		N(%)
Family size	≤ 4	96(65.3)
	5-6	46(31.3)
	≥ 7	5(3.4)
Mother's occupation	Full time job	32(21.8)
	Part time job	9(6.1)
	No	106(72.1)
Father's education	≤ Elementary school	1(0.7)
	Middle school	7(4.8)
	High school	61(41.5)
	≥ College	78(53)
Mother's education	≤ Elementary school	2(1.4)
	Middle school	14(9.5)
	High school	93(63.3)
	≥ College	38(25.8)
Family income (10,000 won/month)	50-150	51(34.7)
	150-300	73(49.7)
	≥ 300	23(15.6)
Total		147(100)

N: Number of subjects

subjects. The average height of all subjects was 153.7 cm and the average weight was 45.3 kg; there was no significant difference between boys and girls. Mi-Soon Oh,¹⁴⁾ who undertook research in 1992 on the effects of a preference for animal food on physical development and obesity among sixth grade school children, reported that subjects had an average height of 146.4 cm and an average weight of 38.8 kg. Kyoung-Hee Shin *et al.*¹⁵⁾ in their 1996 research on the incidence of obesity and body fat, and on the methods used for determining obesity, reported an average height of 149.2±6.5 cm for boys and 149.8±7.4 cm for girls, and an average weight of 41.6±9.3 kg for boys and 39.2±7.1 kg for girls. Therefore, our present subjects of same age show a considerably elevated average height as well as weight.

The only significant differences between boys and girls were observed in the mid-upper arm circumferences, where the girls had lower levels compared with the boys, and in triceps skinfold thickness, where the girls had higher levels compared with the boys. The mid-upper arm circumferences were 24.5±4.7 cm for boys and 23.4±2.9 cm for girls, which are higher than the measurements taken by Kyoung-Hee Shin in 1996¹⁵⁾ who reported 20.2±3.8 cm for boys and 19.3±2.1 cm for girls. The average BMIs were 19.1±3.1 for all, 19.3±3.1 for boys and 18.8±2.9 for girls, and although there was no significant difference between the boys' and girls' levels, the girls tended to have a higher BMI than the boys. Since 1970, there has been a trend of increased incidence of children obesity in urban areas; the incidences of obesity were reported as follows: 2.0% among 4th grade children in a private school in Seoul in 1974;¹⁶⁾ 9.9% of second and third grade children in 1979;¹⁷⁾ 9.9% of

a sample of 4th grade children in 1988;¹⁸⁾ 12.9% of private school children in Seoul in 1988;¹⁹⁾ 18.3% of the children from high income families in Yeuido, Seoul in 1992;²⁰⁾ 18.6% of boys and 6.5% of girls in 1992,¹⁴⁾ in research where a preference for animal food on physical development and obesity was studied; and 22% in the study of Ji-Sook Han and Sook-Hee Lee²¹⁾ who studied dietary intakes and serum cholesterol levels of obese children in 1996. Thus, our present subjects showed even a higher rate of obesity compared to all previous studies.

Table 2. Height, weight, triceps skinfold thickness, upper arm circumference and body mass index(BMI) of the subjects

Item	Male	Female	Total	F-value
Height (cm)	153.7±9.6	153.6±7.6	153.6±6.9	1.54 ^{NS}
Weight (kg)	46.0±9.6	44.5±8.5	45.3±9.1	1.27 ^{NS}
Triceps skinfold thickness (mm)	13.7±7.9	16.3±7.0	14.9±7.6	1.28 ^{NS}
Upper arm circumference (mm)	24.5±4.7	23.4±2.9	24.0±4.0	2.53 ^{***}
BMI	19.3±3.1	18.8±2.9	19.12±3.0	1.17 ^{NS}

NS : Not significant, *** P<0.001

2. Food Habits

Table 3 shows food habits as reported by the subjects. Individuals assessed themselves in terms of quality of their nutrient intakes as follows: good 34.7%, average

Table 3. Dietary habit of the subjects

Dietary habit		N(%)
Self-assessed nutritional status	Bad	9(6.1)
	Normal	72(49)
	Good	51(34.7)
	Uncertain	15(10.2)
Intake frequency of unbalanced diet	Severe	9(6.1)
	Mild	89(60.5)
	Never	49(33.4)
Regularity of breakfast	Very irregular	14(9.5)
	Irregular	32(21.8)
	Regular	101(68.7)
Preference of food	Animal foods	96(66.4)
	Plant foods	49(33.6)
Preference of vegetables	Green	77(52.4)
	Yellow	33(22.4)
	White	37(25.2)
Daily fruit intake	None	4(2.7)
	A little	15(10.2)
	One	29(19.7)
	Over one	99(67.4)
Frequency of feces	Over once / Day	60(41.0)
	Once / 2Day	62(42.1)
	Once / 3Day	18(12.2)
	Once / 4Day	5(3.4)
	Once / Week	2(1.3)
Total		147(100)

49%, not good 6.1%, and do not know 10.2%. 60.5% of subjects reported that they ate only a very limited variety of foods, compared to 9.1% who felt that they ate a somewhat limited variety, and to 33.4% who felt that they ate sufficient variety. Therefore, 69.6% of the children felt that they were eating a limited selection of foods. Breakfast was eaten regularly by 68.7% of the children, was eaten irregularly by 21.8%, and was rarely eaten by 9.5%. It appears that almost 30% of the children tended to skip breakfast; this in itself could be a serious problem that would need to be corrected by nutrition education. Regarding the preference for animal/plant foods, 66.4% of the children preferred animal foods and 33.6% preferred plant foods.

Vegetables eaten in addition to gimchi were mainly green vegetables (52.4%) such as spinach, crown daisy, lettuce, perilla leaves and garlic leaves, with smaller amounts of pale vegetables such as soybean sprouts, cabbage, and onions. 87.2% of the children ate more than one fruit a day, 9.2% ate very little fruit, and 2.7% never ate fruit. In order to determine the dietary fiber intake indirectly, children were asked about their frequency of bowel movements, with the following results: 41% were once a day, 42.4% were once in two days, 11.7% were once in 3 days, 3.5% were once in 4 days, and 1.4% were once a week. Consequently, approximately 59% of the children did not have regular bowel movements.

3. Food Eaten Outside Home

Table 4 lists food eaten outside the home and these were mainly meats; 52.4% ate grilled beef rib, bulgogi, and grilled pork belly, 13.6% ate fast foods, 12.2% ate broiled beef steak, and less than 10% ate rice and side dishes, sashimi, or Chinese noodles.

Table 4. Kinds of food eating outside

Kinds of food	N(%)
Grilled Meat(Grilled beef rib with seasoning, Bulgogi, Grilled pork belly)	77(52.4)
Fast food(Hamburger, Chicken, Pizza)	20(13.6)
Broiled beef steak	18(12.2)
Cooked rice and side dishes	12(8.2)
Sashimi	8(5.4)
Chinese noodle	5(3.4)
Tangsuyuk	4(2.7)
Noodle	3(2.1)
Total	147(100)

4. Intakes of Dietary Fiber and Other Nutrients

Table 5 presents dietary fiber intakes derived from 24-hour dietary recall. The average intakes were 14.54±6.9 g for boys and 14.52±5.9 g for girls. If we accept the recommendation from the American Academy of pediatrics that children aged 3 to 18 years old need

0.5 g dietary fiber per kg body weight, our present subjects would need 22.5 g dietary fiber per day because their average body weight was 45k g. This suggests that our present subjects took only 2/3 of the recommended level of dietary fiber as a result of the westernization of their food habits, which have deviated from the traditional vegetable-centered diet.

The average daily energy intake of all children was 1744.5±574.1 kcal, which is only 84.5% of the RDA; however, protein intake was 68.8 g, which is 114% of the RDA. The nutrients whose intakes were above the level of the RDA were phosphorus, thiamin, niacin, and vitamin C. The nutrients whose intakes were below the level of the RDA were calcium, iron, and riboflavin. Calcium intake was only about 50% of the RDA. Boys and girls showed similar intake levels for almost all nutrients. For girls, in addition to inadequate calcium intake, the low iron intake is a concern as they are at an age of menarche; this suggests a need for nutrition education in order to improve iron intakes. Both boys and girls had sufficient intakes of vitamin C, especially 217% of the RDA in the case of girls. This result could be attributed to teenage girls being particularly interested in their appearance.

Table 5. Energy and nutrient intakes of the subjects

Item	Total (N=147)	Male(N=80)		Female(N=67)	
		intake	% RDA	Intake	% RDA
Energy(kcal)	1744.5±574.1	1825.2±627.4	82.5	1645.7±484.8	86.6
Protein(g)	68.80±23.2	72.3±26.1	119.7	64.5±18.1	107.6
Lipid(g)	41.1±20.0	44.2±21.4		37.3±17.5	
Carbohydrate(g)	275.7±94.7	285.0±102.3		264.4±83.4	
Calcium(mg)	398.9±208.8	403.9±228.8	50.1	392.8±181.7	49.1
Phosphorus(mg)	1024.4±339.5	1071.6±384.0	133	966.5±265.0	120.8
Iron(mg)	11.43±4.97	11.46±4.88	94.7	11.48±5.09	63.3
Sodium(mg)	3962.0±1695.0	4000.0±1835.0		3915.0±1510.0	
Potassium(mg)	2375.0±850.0	2403.0±901.0		2341.0±785.0	
Vitamin A(RE)	601.3±327.3	604.5±340.3	100.2	597.5±311.6	99.6
Retinol(ug)	113.7±114.2	119.9±112.6		106.1±116.0	
Carotene(ug)	2707.5±1747.4	2716.2±1831.8		2696.8±1644.1	
Thiamin(mg)	1.16±0.4	1.18±0.5	107.0	1.1±0.4	112.8
Riboflavin(mg)	0.95±0.45	0.98±0.43	74.9	0.91±0.47	76.0
Niacin(mg)	14.2±5.6	14.7±5.9	104.6	13.6±5.1	104.3
Vitamin C(mg)	90.9±86.2	76.4±70.3	152.3	108.5±99.7	217.1
Cholesterol(mg)	287.1±246.4	322.3±269.6		243.9±207.2	
Dietary fiber(g)	14.5±6.5	14.5±6.9		14.5±5.9	

5. Effects of General Environmental Factors, of Attitudes Towards Food, and of Nutrient Intakes on Dietary Fiber Intake

1) Dietary fiber intake and the general family environment

Table 6 illustrates the relationship between dietary fiber intakes and the general family environment.

Household income had no effect on dietary fiber intakes. However, dietary fiber intakes were higher in the group of children whose mothers had less than 9 years of schooling, compared with the group of children with mothers having more than 12 years of schooling.

Table 6. Dietary fiber intake by family income and mother's education

Variable	N	Dietary fiber(g)	F-value	
Family income (10,000 won/ month)	<50	3	15.1±2.7	
	50-100	3	17.4±3.5	0.43 ^{NS}
	100-150	21	14.6±4.8	
	150-200	43	14.0±5.9	
	200-300	51	15.2±4.8	
≥300	26	14.8±4.2		
Mother's education	≤Elementary school	3	15.1±2.6	
	Middle school	14	15.0±8.9	0.02 ^{NS}
	High school	93	14.7±4.5	
	≥College	37	14.8±4.5	

NS : Not significant

2) Dietary fiber intake and food habits

Table 7 lists estimated dietary fiber intakes and reported food habits. The group who assessed themselves to have good nutrient intakes had higher dietary fiber intakes compared to the group who considered themselves to have bad nutrient intakes. This may mean that the children who consider themselves as having good nutrient intakes pay more attention to their diet and consume more dietary fiber. The children who mainly take green vegetables had more dietary fiber intake compared to the children who prefer yellow and pale vegetables, even though the differences were not significant.

The extent to which subjects limited the variety of their food intake had no effect on dietary fiber intakes. The

Table 7. Relationship of food behavior and dietary fiber intake

Food behavior	N	Dietary fiber	F-value	
Self-assessed nutritional status	Bad	9	12.4±5.4	4.25 ^{***}
	Normal	72	13.7±4.6	
	Good	51	16.6±5.2	
Preferred vegetables	Uncertain	15	15.0±3.9	0.96
	Green	76	15.4±5.3	
	Yellow	33	13.8±5.0	
Frequency of unbalanced diet	White	37	14.1±4.2	NS
	Severe	9	15.8±5.1	
	Mild	89	14.2±5.2	
Daily fruit intake (/day)	Never	49	15.63±4.43	0.43
	None	4	11.8±3.6	
	Little	15	14.0±3.0	
	One	29	14.1±4.9	
Preferred Food	>One	99	15.2±5.2	NS
	Animal food	96	14.4±5.2	
	Plant food	49	15.5±4.4	

NS : Not significant *** P<0.001

Table 8. Actual nutrient intakes by BMI level

Item	Total			Male			Female		
	BMI<20	BMI≥20	F-value	BMI<20	BMI≥20	F-value	BMI<20	BMI≥20	F-value
Energy(Kcal)	1724.9±417.8	1832.0±523.8	1.57	1791.7±440.6	1873.1±524.3	1.42	1646.5±381.8	1769.1±532.5	1.86
Protein(g)	66.7±17.3	74.3±20.0	1.33	68.1±20.3	77.8±20.6	1.03	65.8±13.5	69.0±18.4	1.86
Lipid(g)	41.1±14.2	44.6±15.5	1.2	44.6±15.5	47.7±16.0	1.06	37.2±11.5	40.0±14.0	1.47
Carbohydrate(g)	273.6±67.3	284.2±85.6	1.62	282.7±67.7	284.2±81.6	1.45	263.8±66.1	284.3±94.1	2.02
Calcium(mg)	396.2±162.6	422.1±133.5	1.48	397.6±179.9	430.2±133.9	1.81	394.8±143.3	409.6±136.0	1.11
Phosphorus(mg)	1022.2±277.3	1118.6±306.2	1.22	1056.8±323.5	1189.7±312.0	1.07	984.7±213.9	1009.9±27.3	1.60
Iron(mg)	11.20±3.47	11.6±3.7	1.18	11.24±3.42	11.38±3.74	1.20	11.16±3.56	12.16±3.89	1.19
Sodium(mg)	3892.7±1268.1	4092.7±1221.5	1.08	3912.7±1365.3	4040.9±1200.4	1.29	3871.1±1167.5	4171.8±1286.2	1.21
Potassium(mg)	2376.6±690.1	2456.1±609.0	1.28	2381.2±747.3	2444.5±586.5	1.62	2371.6±630.1	2473.9±660.0	1.10
Vitamin A(RE)	587.2±216.0	661.3±261.9	1.47	598.9±253.1	624.1±211.9	1.43	574.7±168.8	718.2±322.7	3.65***
Retinol(mg)	106.2±63.5	133.1±69.6	1.20	112.4±61.0	136.4±55.7	1.20	96.4±65.2	128.0±88.4	1.84
Carotene(mg)	2654.4±116.5	2986.1±1475.1	1.78*	2692.2±1319.4	2779.4±1144.7	1.33	2613.6±829.3	3302.9±1867.7	5.07***
Thiamin(mg)	1.19±0.38	1.25±0.37	1.08	1.14±0.37	1.26±0.36	1.08	1.13±0.39	1.22±0.39	1.02
Riboflavin(mg)	0.94±0.36	1.05±0.33	1.20	0.97±0.41	1.06±0.29	1.98	0.89±0.30	1.05±0.39	1.74
Niacin(mg)	13.8±3.7	15.4±5.2	1.97**	14.2±4.0	15.9±5.4	1.77	13.5±3.2	14.7±4.8	2.28*
Vitamin C(mg)	91.1±61.8	85.9±49.6	1.56	78.5±52.8	69.5±35.6	2.20*	104.6±68.3	111.0±58.0	1.39
Cholesterol(mg)	276.0±143.8	322.7±143.9	1.00	312.0±151.3	344.4±123.8	1.49	237.2±125.4	289.5±168.7	1.81
Dietary fiber(g)	14.9±5.0	14.3±5.0	1.03	14.9±5.3	14.6±5.6	1.10	14.9±4.6	13.8±4.2	1.22

* P<0.05, ** P<0.01, *** P<0.001

preference for animal food or plant food had no significant effect on dietary fiber intakes; however, the group who had a preference for plant food had a tendency towards a higher dietary fiber intake. The amount of fruit consumption had no significant effect on dietary fiber intakes, but the group of children who did not eat fruits tended to have a lower dietary fiber intake. Dietary fiber intake was found to be higher in the group that took breakfast regularly.

3) Comparison of dietary fiber intakes between the normal weight group and the overweight group

Table 8 shows intakes of dietary fiber and other nutrients of the normal weight group (BMI<20) and the overweight group (BMI>20). Taking all the subjects, the overweight group had a higher intake of carotene and niacin compared to the normal weight group. In the boys, the normal weight group had higher intakes of vitamin C compared to the overweight group, but in girls the overweight group had higher intakes of vitamin A, carotene, and niacin. Overall, the BMI values were not significantly associated with different dietary fiber intakes, however, overweight girls showed lower dietary fiber intakes compared to the normal weight group. The dietary fiber intakes compared to the recommended levels were 85.1% and 81.4% in overweight boys and normal weight boys, respectively, and 91.9% and 87.2% in overweight girls and normal weight girls, respectively. It appears that overweight boys and girls have higher dietary fiber intakes compared to the normal weight groups.

4) Relationship between dietary fiber intakes and other nutrient intakes

Pearson's correlation was used to determine the relationship between dietary fiber intakes and other nutrient intakes. Energy and most nutrients, except heme iron and retinol, showed positive relationships with

Table 9. Correlation coefficients between dietary fiber intake and energy and nutrients intakes and BMI

Item	Pearson's Correlation Coefficients (r)
Energy	0.54***
Protein	0.56***
Animal	0.28***
Plant	0.65***
Fat	0.40***
Animal	0.12 ^{NS}
Plant	0.46***
Carbohydrate	0.54***
Calcium	0.57***
Animal	0.35***
Plant	0.64***
Phosphorus	0.52***
Iron	0.52***
Animal	-0.01 ^{NS}
Plant	0.51***
Sodium	0.53***
Potassium	0.71***
Vitamin A	0.36***
Retinol	0.13 ^{NS}
Carotene	0.32***
Thiamin	0.41***
Riboflavin	0.40***
Niacin	0.40***
Vitamin C	0.33***
Cholesterol	0.30**
BMI	0.01 ^{NS}

P<0.01, *P<0.001, NS: Not Significant

dietary fiber intake. Especially potassium and plant origin protein and calcium were highly correlated with dietary fiber intakes ($r > 0.6$). In addition, sodium intake also was relatively high correlated with dietary fiber intake. It can be explained by the result of adding salt to vegetable dishes and gimchi. There was no relationship found between children's BMI and dietary fiber intakes.

SUMMARY AND CONCLUSION

One hundred and forty-seven children (80 boys and 67 girls) from Seobu elementary school in Daejeon, Korea, completed a questionnaire on their individual food habits and on their families' socioeconomic backgrounds. Anthropometrics measurements were performed and three day 24-hour diet recalls were collected in order to study factors that could influence dietary fiber intakes. The results are summarized as follows:

1. 53% of fathers and 25.8% of mothers of the sampled population had completed university education. The total number of family members was 3 to 4 (65.3%), and the subjects were found to come from middle to high-income families. 27.9% of the mothers had full time or part-time jobs.

2. The mean height of the children was 153.7 cm and the mean body weight was 45.3 kg. The mean BMI values were 19.3 ± 3.1 for boys and 18.8 ± 2.9 for girls, and there were no significant differences between the genders. Mid-arm circumference was lower in the girls compared to the boys; however, triceps skinfold thickness was higher in the girls compared to the boys.

3. Self-assessment of the subjects' nutrient intakes revealed that 34.7% considered themselves to have good nutrient intakes and 49% considered themselves as average. Eighty-nine children (60.5%) stated that they have a strong tendency to favor a limited variety of foods. Approximately 30% of the children skipped breakfast. 66.4% preferred animal foods to plant foods. 52.4% of the children ate green/yellow vegetables rather than pale vegetables. 82.7% of the children ate more than one fruit per day. About 59% of the children did not have regular bowel movements.

4. When eating out, 64.6% of the children ate animal foods such as grilled beef rib, bulgogi, grilled pork belly, broiled beef steak, etc.

5. Daily dietary fiber intakes were 14.5 g for boys and 14.5 g for girls; these are both lower than the recommended levels, and no significant differences were found between boys and girls. Energy intake was 84.5% and protein intake was 114% of the recommended allowances. Nutrients whose intakes were higher than the RDA were phosphorus, thiamin, niacin, and vitamin C.

Nutrients whose intakes were lower than the RDA were calcium, iron, and riboflavin. Especially, calcium intake was only 50% of the recommended allowances.

6. Dietary fiber intakes were not related to household income; however, children of the mothers who had less than 9 years of schooling had higher dietary fiber intakes, compared with those of the mothers who had more than 12 years of schooling. There were no significant differences in dietary fiber intakes between the groups with $BMI \geq 20$ and $BMI < 20$. The overweight group had higher intakes of carotene and niacin compared to the normal weight group. Dietary fiber intakes were higher among children who considered their nutrient intakes to be good and also were higher among children who did not skip breakfast.

7. When the children were divided into a high dietary fiber intake group and low dietary fiber intake group, the former group preferred plant foods to animal foods, had higher intakes of green vegetables and fruits, and had a lower tendency to favor a limited variety in food choices, while the latter group had higher intakes of yellow vegetables.

8. Almost all the nutrients consumed-except heme iron and retinol-had a positive correlation with dietary fiber intakes.

The results of the present study showed that dietary fiber intake among children were lower than the standard guidelines, and we can assume that the intake will decrease further in the future with increasing incomes. Therefore, emphasis has to be placed on meal regularity of children, on developing appropriate cooking methods, and on encouraging intake of green vegetables and fruits. Further extensive and systematic studies on all age ranges of children need to be conducted to determine dietary fiber intake, in order to determine consumption patterns as well as the factors influencing dietary fiber intake.

Literature Cited

- 1) Park YH. Current status and prospective of Korean dining out business. Hanyang Woman's College. *J Food and Nutrition* 8:99-111, 1994
- 2) Lee HS, Lee YK, Seo YJ. Annual changes in the estimated dietary fiber intake of Korean during 1969-1990. *Korean J Nutrition* 27(1):59-70, 1994
- 3) Lee HS, Lee YK, Chen SC. Estimation of dietary fiber intake of college students. *Korean J Nutrition* 24(6):534-546, 1991
- 4) Hwang SH, Kim JI, Sung CJ. Assessment of dietary fiber intake in Korean college students. *J Korean Soc Food Nutr* 25(2):205-213, 1996
- 5) Sung CJ. A study on the dietary fiber intake and iron

- metabolism in Korean female collage students. *Korean J Nutrition* 30(2):147-154, 1997
- 6) Hyun WJ, Lee JW, Kwak CS. Dietary Fiber and Fat Intakes Related to Age in Adults Living in Daejeon City. *Korean Living Science Association* 8(3):477-486, 1999
 - 7) Chen H-L, Haack VS, Janecky CW et al. Mechanisms by which wheat bran and oat bran increase stool weight in humans. *Am J Clin Nutr* 68:711-9, 1998
 - 8) Song YJ, Hong HO. Effects of soluble dietary fiber on skeletal muscle GLUT4 protein contents in SHRSP fed a high-fat diet. *Korean J Nutr* 33:712-716, 2000
 - 9) Lee MG, Lee SR. Estimation of the dietary fiber intake by the Korean population according to urban and rural areas. *Korean J Nutrition* 30(7):848-853, 1997
 - 10) Lanza E, Jones D Y, Block G, Kessler L. Dietary fiber intake in the US population. *Am J Clin Nutr* 46:790-797, 1987
 - 11) Food composition table, 5th revision. National rural living science institute, Rural Development Administration. 1996
 - 12) Recommended dietary allowances for Koreans, 6th revision, The Korean Nutrition Society, Seoul, 1995
 - 13) Ministry of Health and Welfare: Report on 1995 national health and nutrition survey (dietary intake survey). Ministry of Health and Welfare, 1997
 - 14) Oh MS. Effect of preference for animal food on physical development and obesity in children. Graduate school of education, Hannam University, 1992
 - 15) Shin KH, Kwon CS, Jang HS. An investigation of the childhood obesity in Uisung, Kyungbuk and the correlation between percentage of body fat and criterions evaluation obesity. *J. Korean Soc Food Nutr* 25(6):1037-1044, 1996
 - 16) Go KS, Sung NE. Review of obesity of some elementary school children in Seoul. *Korean Public Health J* 11(2):163-168, 1974
 - 17) Choi WJ, Kim KY. A study on the physical growth and food habits of obese children. *Korean J Nutrition* 13(1):1-7, 1980
 - 18) Ha MJ. A study on the related factors affecting obesity of school children. *J Korean Public Health Assoc.* 11(2):29-52, 1985
 - 19) Kang YR, Paik HY. A study on the etiology of childhood obesity. *Korean J Nutrition* 21(5):283-294, 1988
 - 20) Kim JH, Kim BH, Kim HK, Son SM, Mo SM, Choi HM. A Study on Food Ecology According to Obesity Index of Elementary School Children in a High Socioeconomic Apartment Complex in Seoul. *Korean J Dietary Culture* 8(3):275-287, 1993
 - 21) Han JS, Rhee SH. The relationship between serum cholesterol level and dietary intake in obese children. *J Korean Soc Food Nutr* 25(3):433-440, 1996