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Dietary Patterns Independent of Fast Food Are Associated with Obesity among Korean Adults: Korea National Health and Nutrition Examination Survey 2010–2014

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Running head: Dietary pattern excluding fast food and obesity

Abbreviation:

Korea National Health and Nutrition Examination Survey, KNHANES

Sugar sweetened beverages, SSBs

Body mass index, BMI

Fast-food, FF

Odds ratio, OR

Confidence interval, CI

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Abstract

Background: Few studies have examined multifaceted aspects of fast food consumption and dietary patterns for their effects on obesity. We examined the independent associations of obesity with fast food consumption and dietary pattern in Korean adults. **Methods:**A total of 19,017 adults aged 19–64y participated from KNHANES 2010-2014. Fast food items were removed from diet and then dietary patterns were generated. Multivariate logistic regression analysis was used to examine the odds for overweight/obesity and central obesity according to fast food consumption and dietary patterns. **Results**:Fast food consumers were about 10% of Korean adults. Both of White rice and kimchi pattern and Meat and alcohol pattern were associated with low intakes of fiber, calcium, vitamin C, grains, fruit, and milk($p<0.05$). Fast food consumers had higher the Meat and alcohol pattern and the Grains, fruit, and milk pattern, and they had lower the White rice and kimchi pattern than non-fast-food-consumers. Fast food consumer were not associated with overweight/obesity, whereas the participants with Meat and alcohol pattern had 14% higher overweight/obesity(95%CI:1.01,1.28) and 16% higher central obesity(95%CI:1.00,1.34). **Conclusions:**Fast food consumption was not directly associated with obesity, whereas the Meat and alcohol pattern had independent associations with overweight/obesity and central obesity among Korean adults.

Keyword: adults, dietary pattern, fast food, KNHANES, obesity

1. Introduction

Obesity is a predisposing factor for several chronic diseases, such as hypertension, type 2 diabetes, cardiovascular disease, and some cancers [1]. The prevalence of obesity has nearly tripled (men: 3.2% to 10.8%, women: 6.4% to 14.9%) worldwide from 1975 to 2014 [2]. In many lower- and middle-income countries in Asia, including South Korea [3], the rate of adult obesity has increased as a negative consequence of increasing economic development, supposedly due to a “nutrition transition,” i.e., the traditional dietary pattern high in grains, vegetables, and oil seeds is being replaced by a Western pattern high in fats, caloric sweeteners, and animal-sourced foods [4,5]. In line with that trend, fast food consumption doubled in South Korea from 1998 to 2009 [6].

Several researchers are concerned about the increasing consumption of fast food [7], which is characterized by high energy density [8], excessive portion sizes, high glycemic load [9], and low intakes of vegetables, fruits, and milk [10]. Some studies suggest association between fast food intake and poor health outcomes [9,11,12]. On the other hand, others reported that no significant associations between fast food intake and health outcomes such as obesity [7,13,14]. These inconsistent results may be because other factors that correlate with fast food consumption have been limited to assess dietary factor, such as access to fast food restaurants [15], dietary

preferences, and poor eating behaviors [16], including dietary patterns, rather than fast food consumption itself [10,14].

A study tested the independent association of obesity with dietary patterns and fast food items by collecting detailed food intake data among children in the US [10], but to our knowledge, no study exists for adults. In Asian countries, many studies have been conducted to investigate the association between dietary pattern and obesity [5,17,18], however, no study has examined for independent association of weight gain with fast food consumption and dietary pattern.

To fill this gap, we examine the independent associations of overweight/obesity with dietary pattern and fast food consumption in Korean adults using nationally representative survey data.

2. Materials and Methods

2.1. Participants and exclusion criteria

We used data from the fifth and sixth Korea National Health and Nutrition Examination Survey (KNHANES) in 2010 and 2014. The KNHANES is a nationally representative, cross-sectional survey of the South Korean population that uses a clustered, multistage, stratified, and rolling sampling design to represent non-institutionalized civilian Koreans [19]. The KNHANES V–VI protocols were approved by the Institutional Review Board of the Korean Center for Disease Control and Prevention (IRB No. 2010–02CON–21–C, 2011–02CON–06–C, 2012-01EXP-01-2C, 2013-07CON-03-4C, 2013-12EXP-03-5C).

We merged the 2010–2014 KNHANES data on a total of 41,102 participants and then sequentially excluded participants with extreme energy intake (< 500 kcal/day or > 5000 kcal/day) (n = 4,744) [20]; who were pregnant (n = 133); who were < 19 y or ≥65 y (n = 15,824); who were missing height or weight measurements (n = 62); or who had missing weight values (n = 1,322). After applying these exclusion criteria, the total number of participants for this analysis was 19,017 (7,516 men and 11,563 women).

2.2. Anthropometric measurements

Height (Seca 225; SECA, Hamburg, Germany), weight (GL-6000-20; CASKOREA Co., Ltd., Seoul, Korea), and waist circumference (Seca 200; SECA, Hamburg, Germany) were obtained using standardized techniques and calibrated equipment. Body mass index (BMI) was calculated from these measurements as weight (kg)

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divided by height squared (m^2). Overweight (BMI of 23–25 kg/m^2) and obesity (BMI ≥ 25 kg/m^2) were defined based on World Health Organization recommendations for Asians [21].

2.3. Dietary assessment and fast food consumption

Dietary data were assessed by trained dietary interviewers using the single 24-hour recall method in the homes of the participants one week after the health interview and health examination. Energy and nutrient intakes for each subject were calculated using the Korean Foods and Nutrients Database of the Rural Development Administration [22,23], which contains 3,095 food items.

Fast food consumption was defined as the intake of any of 48 Western fast food items (e.g., hamburgers, French fries, pizza, onion rings, fried chicken, sandwiches, apple pie, and cheese sticks). We classified adults as non-fast-food-consumers (non-consumers) if they consumed 0 kcal from fast food and as fast-food consumers (FF consumers) if they consumed more than 0.1 kcal of fast food.

2.4 Food grouping

We divided food data into 25 food groups from the 18 food groups in the Korean Nutrient Database [24] to simplify the interpretation of components. Intake of grains and their products is very high in the Korean population; therefore, we subdivided this food group into four subgroups based on nutrient profile: white rice, other grains, flour and bread, and noodles. Kimchi (traditional fermented cabbage) was also placed in a group separate from the vegetable group because it is a traditional side dish in Korea. The beverage group was disaggregated into soda, sugar sweetened beverages (SSBs), and non-sugar beverages based on sugar content [24,25].

2.5 Dietary pattern analysis excluding fast food

To identify dietary patterns excluding fast food, all fast food items were removed from the 25 food groups, and then dietary patterns were generated by a K-means cluster analysis using SAS FASTCLUS (SAS Institute Inc) based on the percentage of total energy contribution for each food group per day. This K-means procedure generates clusters by comparing the Euclidean distance between each subject and each cluster center. Two to five solutions were examined to assess which set of clusters was more meaningful in determining the dietary patterns. In the end, three clusters were identified as distinct patterns and labeled with descriptive names.

Almost half of the subjects (48%) were assigned to the White rice and kimchi dietary pattern, in which consumption of white rice accounted for about 50% of total energy intake, and consumption of kimchi was higher

than in the other two groups. A total of 40% of the subjects was assigned to the Grain, fruit, and milk dietary pattern, which was characterized by a variety of food groups, such as other grains, bread, noodles, potatoes, nuts, fruit, eggs, milk, and oils. The remaining 12% of subjects were assigned to the Meat and alcohol dietary pattern based on their predominant food groups.

2.6. Covariates

Information on socio-demographic characteristics and health-related behaviors was obtained using in-person interview by trained researcher. Household income was divided into quartiles. Education level was categorized into three groups: ≤ middle school, high school, and ≥ college degree. Region was divided into two groups: urban and rural. Smoking status was divided into three groups: non-smokers, former smokers, and current smokers. Physical activity was divided into three groups: inactive, active, and health enhancing. Total energy intake was divided into age and sex-specific quintiles. Weight status was categorized into three groups: non-overweight/obese, overweight, and obese.

2.7. Statistical analysis

The analysis was performed using PROC SURVEY in SAS 9.4 (SAS Institute, Cary, NC, USA) to take into account the complex sampling design and appropriate sampling weights for the national survey. Two-sided chi-square and t-tests ($P < 0.05$) were used to compare the sociodemographic characteristics according to fast food consumption and dietary pattern. We tested the associations between dietary pattern and dietary outcomes using the Grain, fruit, and milk pattern as reference, and the associations between fast food consumption and each dietary pattern using the non-consumer as reference. We adjusted for the age, sex, household income, education, region, smoking, physical activity, total energy intake, and weight status.

Then, we used multivariable-adjusted logistic regression models to estimate the odds of overweight/obesity for fast food consumption and each dietary pattern after adjusting for age, sex, household income, education, total energy intake, smoking, physical activity (model 1). Model 2 was adjusted for potential confounders and dietary pattern to determine the direct association between fast food consumption and weight status, and adjusted for confounders with fast food consumption to estimate the independent association between dietary pattern and weight status. Statistical significance was achieved when $P < 0.05$.

3. Results

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3.1. General characteristics

General characteristics according to fast food consumption and dietary pattern are shown in Table 1. A total of 9.7% of adults were categorized into the FF consumers. In general, FF consumers of all dietary patterns tended to be younger and more highly educated than non-consumers ($P < 0.0001$). According to dietary pattern, followers of the Grain, fruit, eggs, and milk pattern had a higher proportion of young, female, and highly educated individuals and fewer smokers regardless of fast food consumption ($P < 0.0001$). Those following the White rice and kimchi pattern were more likely to be older with a low education and those following the Meat and alcohol pattern were more likely to be male and current smokers regardless of fast food consumption ($P < 0.0001$).

- Table 1 about here -

3.2. Total intake and dietary intake excluding fast food

The findings for total intake and dietary intake excluding fast food according to fast food consumption are shown in Table 2. Greater intakes of meat and its products and soda and lower intakes of grain, legumes, nuts and seeds, vegetables, fruit were observed among FF consumers not only for total intake but also for dietary intake excluding fast food than non-consumers ($P < 0.05$). Also, FF consumers had higher total energy (2230±26 kcal/d) and fat intake (22.5±0.2%) than non-consumers (2048±9 kcal/d and 18.7±0.1%, respectively; $P < 0.05$) even in dietary intake excluding fast food.

- Table 2 about here -

3.3. Dietary intakes according to dietary pattern

A multivariable regression model of each dietary intake with dietary pattern is shown in Table 3. The White rice and kimchi pattern and the Meat and alcohol pattern were associated with lower consumption of healthful food and nutrient values than Grain, fruit, and milk pattern. Participants following the White rice and kimchi pattern consumed significantly lower amounts of grains (β = -60.5; 95% CI: -68.9, -52.1 g), milk and dairy products (β = -42.3; 95% CI: -47.5, -37.2 g), fruit (β = -33.0; 95% CI: -38.2, -27.7 g), oils (β = -10.3; 95% CI: -13.4, -7.1 g), nuts and seeds (β = -8.9; 95% CI: -11.8, -6.0 g), and protein (β = -5.4; 95% CI: -6.4, -4.3 g), fiber (β = -0.6; 95% CI: -0.8, -0.4 g), calcium (β = -51.4; 95% CI: -62.7, -40.1 g), and vitamin C (β = -11.1; 95% CI: -15.2, -7.0 g) than those following the Grain, fruit, and milk pattern. For those following the Meat and alcohol pattern, the consumption of grains (β = -86.3; 95% CI: -96.1, -76.5 g), fruit (β = -62.7; 95% CI: -70.4, -54.9 g),

milk and dairy products (β = -59.1; 95% CI: -65.7, -52.4 g), legumes (β = -18.0; 95% CI: -22.7, -13.2 g), nuts and seeds (β = -6.3; 95% CI: -10.4, -2.1 g), eggs (β = -11.8; 95% CI: -15.6, -8.0 g), oils (β = -11.3; 95% CI: -16.7, -5.8 g), and fiber (β = -1.7; 95% CI: -2.0, -1.4 g), calcium (β = -113.1; 95% CI: -130.5, -95.7 mg), vitamin A (β = -96.3; 95% CI: -167.2, -25.4 ugRE), and vitamin C (β = -33.2; 95% CI: -39.7, -26.6 mg) was lower, although total energy intake (β = 171.3; 95% CI: 137.8, 204.7 kcal) was higher than the Grain, fruit, and milk pattern.

- Table 3 about here -

3.4. Dietary pattern according to fast food consumption

Adjusted OR and 95% CI for the dietary pattern according to fast food consumption are showed in Table 4. The adjusted OR of following the Meat and alcohol pattern increased by 1.2-fold (OR: 1.21; 95% CI: 1.02, 1.43) and following the Grain, fruit, and milk pattern increased by 2-fold (OR: 2.00; 95% CI: 1.76, 2.27) among FF consumer compared with non-consumers after adjusting for potential confounders. On the other hand, FF consumers were 59% less likely than non-consumers to follow the White rice and kimchi pattern (OR: 0.41; 95% CI: 0.35, 0.47).

- Table 4 about here -

3.5. Overweight/obesity or central obesity according to fast food consumption and dietary pattern

Adjusted OR and 95% CI for overweight/obesity or central obesity according to fast food consumption and dietary pattern are shown in Table 5. Although fast food consumption was not associated with overweight/obesity or central obesity after adjusting for covariates and dietary patterns, those who followed the Meat and alcohol pattern had a 14% higher prevalence of overweight/obesity (OR: 1.14; 95% CI: 1.04, 1.28) and a 16% higher prevalence of central obesity (OR: 1.16; 95% CI: 1.00, 1.34) than those who followed the Grain, fruit, and milk pattern after adjusting for covariates and fast food consumption (Table 5). Furthermore, decreased odds of overweight/obesity were associated with the White rice and kimchi pattern (OR: 0.88; 95% CI: 0.81, 0.95), although central obesity was not associated after controlling for covariates and fast food consumption.

- Table 5 about here -

4. Discussion

This study contributes to the growing literature on unhealthy eating and overweight/obesity and is, to our knowledge, the first to examine independent associations among dietary patterns, fast food consumption, and

173 overweight/obesity within a nationally representative sample of Korean adults. We found that dietary pattern
174 associated with health outcomes when fast food consumption is controlled, in particular Meat and alcohol pattern,
175 and that fast food consumption did not associated with weight gain when dietary patterns and other covariates
176 were controlled.

177 Previous research showed that people who consume fast food have higher energy and fat intakes, which are
178 important contributors to overweight/obesity, suggesting that regulating the consumption of fast food might
179 improve diets and health [14,15,26], and our results also noted that FF consumers had higher total energy and fat
180 intakes than non-consumers even when fast food items were excluded in the diet. However, emerging evidence
181 suggests that obesity is associated with an individual's dietary preferences and poor eating behavior, and
182 sociodemographic characteristics, rather than directly related to fast food [6,16]. In the crude model without
183 adjustment in our results, fast food consumption was positively associated with overweight/obesity and central
184 obesity (data not shown), but the significance was disappear after adjustment for potential confounders, which
185 provides important information about the direct factors and prevalence of overweight/obesity.

186 Our results are of international significance because they contribute to an emerging evidence base that suggests
187 that dietary pattern is independently associated with overweight/obesity regardless of fast food consumption [10].
188 Furthermore, when we separated eating behavior into fast food consumption and dietary patterns with the fast
189 food items removed, we were able to compare the probability of overweight/obesity for different eating behaviors
190 at the same time. Our results are unique in showing that the Meat and alcohol pattern was positively associated
191 with overweight/obesity, whereas the White rice and kimchi pattern showed an opposite association. Previous
192 studies suggested that the consumption of red and processed meats was associated with risk of obesity [27]. With
193 respect to White rice and kimchi dietary pattern, a representative Korean study reported that a carbohydrate intake
194 that composes more than 60% of total energy intake and the White rice and kimchi pattern had a lowering effect
195 on BMI due to lower intakes of total fat. However, lowering HDL-cholesterol and increasing serum triglycerides
196 are negative effects of the White rice and kimchi pattern; thus, even though that pattern is not positively associated
197 with obesity, it does contribute to high intakes of carbohydrate and sodium and provides limited food composition
198 [28]. In agreement, we found that people following the White rice and kimchi pattern derived 69% of their energy
199 intake from carbohydrates (data not shown) and it may influence on lower prevalence of overweight/obesity.
200 In light of our findings, we suggest that dietary patterns are a more crucial factor in overweight/obesity than is
201 fast food consumption. Therefore, research is needed to determine what dietary patterns are healthy while

excluding fast food consumption. Combining previous evidence that healthy patterns are characterized by high intakes of whole grains, fruits, and legumes and are rich in nutrients such as antioxidants and associated with a reduction in metabolic risk factors [28,29], our results suggest that the Grains, fruit, and milk pattern could have preventive effects on weight gain through the combined influence of nutrients and food components comparing to Meat and alcohol pattern. Furthermore, for the first time to our knowledge, we showed that adult, Asian FF consumers were linked to the Meat and alcohol pattern or Grain, fruit, and milk pattern. Previous studies showed that FF consumers were associated with a Western dietary pattern, but those analyses were based on US children [10]. Previous studies and our results thus suggest that those who consume the healthy Grain, fruit, and milk pattern are less likely to be overweight/obese than those who eat the Meat and alcohol pattern regardless fast food consumption.

Our study has several limitations. First, dietary intake was estimated based on a 24-hour dietary recall, which might not have been representative of a subject's typical intake. However, at the population level, 24-hour recalls can be used as a measure of typical intake. Second, this was a cross-sectional study; therefore, our study precludes inferences of causation, and the possibility of reverse causation remains.

Despite those limitations, the present study has many strengths. First, we used data from a nationally representative sample and took into account the complex sampling design effects to provide representative estimates. Second, we sufficiently analyzed a considerable range of available fast food items to identify FF consumers, and we separated fast food items from the rest of their diet. Third, most previous studies have considered only dietary patterns or fast food consumption, but we investigated the participants' dietary patterns separate from the fast food items they ate and used fast food consumption to identify dietary factors associated with obesity in adults, which allowed us to find that fast food might be not solely responsible for obesity.

5. Conclusions

In conclusion, we found that fast food consumption was not directly associated with obesity, whereas the Meat and alcohol pattern had independent associations with overweight/obesity and central obesity independent of fast food. Even if fast food is high in calories, the unhealthy dietary pattern has a stronger correlation with overweight/obesity and central obesity than fast food consumption on its own. Our results indicate that more attention should be paid to dietary patterns to prevent and manage overweight/obesity and central obesity among adults in South Korea.

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The authors' responsibilities were as follows – JC and HJL conceived and designed research; DK and HSL collected, analyzed, interpreted the data; DK wrote the manuscript; AA, JC, and HJL interpreted the data and reviewed the manuscript; JC and HJL had primary responsibility for final content. All authors read and approved the final manuscript. Neither author declared any competing financial interests, conflicts of interests.

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Table 1. General characteristics according to fast food consumption and dietary patterns in adults when fast food items are excluded: KNHANES 10–14[1]

	Grains, fruit, and milk pattern[2]					White rice and kimchi pattern					Meat and alcohol pattern						
	Non-consumers[3] (n = 6541; 84.3%)		FF consumers (n =1085; 15.7%)		p-value[4]	Non-consumers (n = 8695; 94.5%)		FF consumers (n = 454; 5.5%)		p-value[4]	Non-consumers (n = 1937; 85.7%)		FF consumers (n = 305; 14.3%)		p-value[4]	p-value[5]	p-value[6]
Age					<.0001					<.0001					<.0001	<.0001	<.0001
19–39 y	48.0	(0.8)	72.6	(1.6)		37.9	(0.8)	59.6	(2.7)		43.0	(1.4)	71.7	(2.9)			
40–64 y	52.0	(0.8)	27.4	(1.6)		62.1	(0.8)	40.4	(2.7)		57.0	(1.4)	28.3	(2.9)			
Sex					0.0546					0.7924					0.9789	<.0001	<.0001
Male	40.3	(0.7)	44.0	(1.7)		51.9	(0.6)	52.6	(2.7)		73.9	(1.0)	73.8	(2.6)			
Female	59.7	(0.7)	56.0	(1.7)		48.1	(0.6)	47.4	(2.7)		26.1	(1.0)	26.2	(2.6)			
Education					<.0001					<.0001					<.0001	<.0001	<.0001
≤ Middle school	12.9	(0.6)	3.5	(0.5)		23.6	(0.7)	12.0	(1.7)		13.7	(0.9)	5.2	(1.4)			
High school	30.7	(0.8)	27.2	(1.6)		34.4	(0.7)	26.5	(2.6)		35.3	(1.4)	27.9	(3.1)			
≥ College degree	56.4	(0.9)	69.2	(1.6)		42.0	(0.8)	61.5	(3.0)		51.1	(1.5)	66.9	(3.1)			
Household income					0.3162					0.2808					0.2902	<.0001	0.0554
Low (Q1)	7.5	(0.5)	9.3	(1.3)		11.9	(0.5)	9.4	(1.9)		8.3	(0.8)	7.5	(1.7)			
Low middle (Q2)	24.5	(0.8)	22.5	(1.7)		29.2	(0.7)	27.4	(2.6)		25.7	(1.3)	28.1	(3.1)			
Middle-High (Q3)	32.0	(0.8)	32.9	(1.9)		31.1	(0.7)	36.1	(2.8)		32.9	(1.3)	27.1	(3.0)			
High (Q4)	36.1	(1.0)	35.2	(1.9)		27.8	(0.8)	27.1	(2.6)		33.1	(1.4)	37.3	(3.3)			
Region					0.1189					0.0539					0.0240	<.0001	0.1463
Urban	76.6	(1.1)	79.4	(1.9)		68.4	(1.1)	73.9	(2.7)		71.9	(1.6)	79.2	(2.9)			
Rural	23.4	(1.1)	20.6	(1.9)		31.6	(1.1)	26.1	(2.7)		28.1	(1.6)	20.8	(2.9)			
Smoking					0.3475					0.5807					0.6760	<.0001	<.0001
Current	20.1	(0.7)	22.3	(1.5)		25.9	(0.6)	24.1	(2.5)		45.8	(1.4)	48.7	(3.4)			
Past	16.5	(0.6)	17.0	(1.5)		19.1	(0.5)	17.7	(2.3)		24.0	(1.2)	21.8	(2.7)			
Never	63.4	(0.7)	60.7	(1.9)		55.1	(0.6)	58.2	(2.9)		30.1	(1.2)	29.5	(2.9)			
Physical activity																	
Inactive	35.5	(0.8)	36.7	(1.8)	0.4850	39.8	(0.7)	39.7	(2.7)	0.9953	33.2	(1.3)	34.3	(3.2)	0.1332	<.0001	0.7707
Active	44.3	(0.8)	42.0	(1.8)		39.5	(0.6)	39.8	(2.7)		39.1	(1.4)	44.1	(3.3)			
Health enhancing	20.1	(0.6)	21.3	(1.5)		20.7	(0.6)	20.6	(2.4)		27.7	(1.2)	21.6	(2.5)			

[1]Values are % (SE). Data were weighted to represent adults aged 19–64 y from KNHANES 2010–2014.
[2]Dietary patterns excluding fast food were determined by cluster analysis using dietary intake (kcal/day) minus any fast food items consumed.
[3]Fast food consumers are defined as those who consumed more than 0.1 kcal of fast food, and non-consumers are defined as those who consumed 0 kcal from fast food.
[4]P-values for differences between FF consumers and non-consumers in each cluster using chi-square test for proportions and analysis of variance for means.
[5]P-values for differences across clusters in non-consumers using chi-square test for proportions and analysis of variance for means.
[6]P-values for differences across clusters in FF consumers using chi-square test for proportions and analysis of variance for means.
KNHANES, Korea national health and nutrition examination Survey; FF, fast-food.

Table 2. Total dietary intake and dietary intake excluding fast food items according to fast food consumption among adults: KNHANES 10–14[1]

	Total intake							Intake minus FF[2]						
	Non-consumer[3] (*n*= 17173; 90.3%)			FF consumer (*n*=1844; 9.7%)				Non-consumer (*n*= 17173; 90.3%)			FF consumer (*n*=1844; 9.7%)			
Food group (% of energy)[4]														
White rice	31.90	±	0.21	17.91	±	0.37	*	31.90	±	0.21	21.56	±	0.42	*
Grains	6.06	±	0.10	3.34	±	0.15	*	6.06	±	0.10	3.98	±	0.18	*
Sweets	1.89	±	0.03	1.57	±	0.07	*	1.89	±	0.03	1.90	±	0.09	
Legumes	2.36	±	0.04	1.43	±	0.07	*	2.36	±	0.04	1.73	±	0.09	*
Nuts and seeds	1.02	±	0.03	0.64	±	0.06	*	1.02	±	0.03	0.76	±	0.07	*
Vegetables	3.16	±	0.03	2.36	±	0.08	*	3.16	±	0.03	2.84	±	0.09	*
Kimchi	1.43	±	0.02	0.81	±	0.03	*	1.43	±	0.02	0.98	±	0.03	*
Fruit	4.45	±	0.08	2.89	±	0.12	*	4.45	±	0.08	3.44	±	0.14	*
Meat and its products	8.81	±	0.11	10.63	±	0.23	*	8.81	±	0.11	12.93	±	0.28	*
Eggs	1.90	±	0.03	1.69	±	0.06	*	1.90	±	0.03	2.04	±	0.08	
Fish and shellfish	3.71	±	0.05	2.41	±	0.10	*	3.71	±	0.05	2.91	±	0.13	*
Milk and dairy products	3.53	±	0.07	3.46	±	0.14		3.53	±	0.07	4.42	±	0.21	*
Oils	3.27	±	0.03	4.50	±	0.10	*	3.27	±	0.03	5.49	±	0.13	*
Soda	0.56	±	0.02	2.40	±	0.11	*	0.56	±	0.02	3.30	±	0.16	*
SSBs	3.11	±	0.05	2.44	±	0.11	*	3.11	±	0.05	3.00	±	0.15	
Alcohol	4.22	±	0.11	4.30	±	0.25		4.22	±	0.11	5.02	±	0.29	*
Total energy, kcal/d	2047.99	±	8.85	2740.61	±	30.20	*	2047.99	±	8.85	2229.87	±	26.26	*
Total carbohydrate, % of energy	63.6	±	0.2	52.5	±	0.3	*	63.6	±	0.2	56.6	±	0.4	*
Total fat, % of energy	18.7	±	0.1	25.3	±	0.2	*	18.7	±	0.1	22.5	±	0.2	*

KNHANES, Korea national health and nutrition examination Survey; FF, fast-food; non-consumer, non-fast-food-consumers.

[1]Values are mean ± SE. Data were weighted to represent adults aged 19–64 y from KNHANES 2010–2014. *Statistically different from fast food non-consumers ($P < 0.05$ with t test).

[2]Dietary intake minus fast food items.

[3]Fast food consumers are defined as those who consumed more than 0.1 kcal of fast food, and non-consumers are defined as those who consumed 0 kcal from fast food.

[4]Percentage of total energy intake from each food group in total dietary intake and dietary intake minus fast food according to fast food consumption.

Table 3. Multiple linear regression analysis of the independent associations between dietary pattern minus fast food and dietary outcomes among adults: KNHANES 10–14[1]

	Dietary pattern[2]					
	White rice & kimchi pattern			Meat & alcohol pattern		
Food groups (kcal/d)						
White rice	**505.4**	**(494.8,**	**516.1)**	**36.8**	**(21.4,**	**52.2)**
Grains	**-60.5**	**(-68.9,**	**-52.1)**	**-86.3**	**(-96.1,**	**-76.5)**
Legumes	-3.2	(-6.6,	0.3)	**-18.0**	**(-22.7,**	**-13.2)**
Nuts and seeds	**-8.9**	**(-11.8,**	**-6.0)**	**-6.3**	**(-10.4,**	**-2.1)**
Vegetables	-1.0	(-3.0,	1.0)	**4.9**	**(1.7,**	**8.2)**
Kimchi	**5.0**	**(3.8,**	**6.1)**	-1.0	(-2.7,	0.6)
Fruit	**-33.0**	**(-38.2,**	**-27.7)**	**-62.7**	**(-70.4,**	**-54.9)**
Meat and its products	**-44.9**	**(-53.2,**	**-36.6)**	**232.6**	**(207.1,**	**258.1)**
Eggs	-1.5	(-3.8,	0.9)	**-11.8**	**(-15.6,**	**-8.0)**
Fish and shellfish	**9.1**	**(4.5,**	**13.6)**	**18.6**	**(10.1,**	**27.2)**
Milk and dairy products	**-42.3**	**(-47.5,**	**-37.2)**	**-59.1**	**(-65.7,**	**-52.4)**
Oils	**-10.3**	**(-13.4,**	**-7.1)**	**-11.3**	**(-16.7,**	**-5.8)**
Soda	**-9.5**	**(-11.9,**	**-7.1)**	**-12.4**	**(-16.4,**	**-8.4)**
SSBs	-0.7	(-4.3,	3.0)	**-18.2**	**(-23.6,**	**-12.7)**
Alcohol	-0.9	(-5.0,	3.2)	**594.7**	**(572.2,**	**617.2)**
Nutrients						
Total energy (kcal/d)	**-62.8**	**(-78.4,**	**-47.1)**	**171.3**	**(137.8,**	**204.7)**
Protein (g/d)	**-5.4**	**(-6.4,**	**-4.3)**	**8.3**	**(6.0,**	**10.6)**
Fat (g/d)	**-13.0**	**(-13.9,**	**-12.1)**	0.6	(-1.5,	2.8)
Carbohydrate (g/d)	**15.5**	**(12.1,**	**18.8)**	**-102.7**	**(-107.9,**	**-97.4)**
Fiber (g/d)	**-0.6**	**(-0.8,**	**-0.4)**	**-1.7**	**(-2.0,**	**-1.4)**
Calcium (mg/d)	**-51.4**	**(-62.7,**	**-40.1)**	**-113.1**	**(-130.5,**	**-95.7)**
Vitamin A (ugRE/d)	-15.8	(-58.9,	27.2)	**-96.3**	**(-167.2,**	**-25.4)**
Vitamin C (mg/d)	**-11.1**	**(-15.2,**	**-7.0)**	**-33.2**	**(-39.7,**	**-26.6)**

KNHANES, Korea national health and nutrition examination Survey; FF, fast-food; non-consumer, non-fast-food-consumers.

[1]Data were weighted to represent adults aged 19–64 y from KNHANES 2010–2014. Values are β coefficients (95% CIs) of dietary outcomes (food groups and nutrients), with dietary pattern (dummy variables for 'White rice and kimchi' and 'Meat and alcohol' dietary pattern) as the independent variable. The model was adjusted for age, sex, income, education, region, smoking, total energy intake, and weight status. Bold indicates significance at P-value < 0.05.

[2]Dietary patterns minus fast food were determined by cluster analysis using dietary intake (kcal/day) excluding any fast food items consumed.

Table 4. ORs (95% CIs) for dietary pattern minus fast food items by fast food consumption among adults: KNHANES 10–14[1]

	Fast food consumption[2]	
	Non-consumer (*n* = 17173; 90.3%)[3]	FF consumer (*n* =1844; 9.7%)
Fast food intake (% of energy)[3]	0	13.27 (0.03, 84.13)
Multivariable-adjusted OR		
Dietary pattern 1: Grain, fruit, and milk pattern		
Model 1[4]	1.0 (reference)	**2.08 (1.83,2.36)**
Model 2	1.0	**2.00 (1.76,2.27)**
Dietary pattern 2: White rice and kimchi pattern		
Model 1	1.0	**0.37 (0.32,0.42)**
Model 2	1.0	**0.41 (0.35,0.47)**
Dietary pattern 3: Meat and alcohol		
Model 1	1.0	**1.45 (1.23,1.71)**
Model 2	1.0	**1.21 (1.02,1.43)**

KNHANES, Korea national health and nutrition examination Survey; FF, fast-food; non-consumer, non-fast-food-consumers.

[1]Data were weighted to represent adults aged 19–64 y from KNHANES 2010–2014. Dietary patterns minus fast food were determined by cluster analysis using intake (kcal/day) and excluding any fast food items consumed.

[2]Fast food consumers are defined as those who consumed more than 0.1 kcal of fast food, and non-consumers are defined as those who consumed 0 kcal from fast food.

[3]Values are medians (ranges).

[4]ORs (95% CIs) for dietary patterns minus any fast food consumed by fast food consumption. Model 1 was adjusted for age, sex, income, education, region, physical activity, and smoking. Model 2 was adjusted for Model 1 plus total energy intake and weight status. Bold indicates significance at P-value < 0.05.

Table 5. ORs (95% CIs) for weight status with fast food consumption and dietary pattern minus any fast food items consumed among adults: KNHNES 10–14[1]

	FF consumption[2]			Dietary pattern[3]					
				White rice & kimchi pattern			Meat & alcohol pattern		
	OR	95%CI		OR	95%CI		OR	95%CI	
Overweight/obesity									
Model 1[4]	1.04	(0.92,	1.17)	**0.88**	**(0.82,**	**0.96)**	**1.14**	**(1.01,**	**1.28)**
Model 2	1.07	(0.94,	1.20)	**0.88**	**(0.81,**	**0.95)**	**1.14**	**(1.01,**	**1.28)**
Central obesity									
Model 1	1.15	(0.97,	1.36)	1.09	(0.99,	1.20)	**1.16**	**(1.01,**	**1.35)**
Model 2	1.14	(0.96,	1.34)	1.08	(0.98,	1.19)	**1.16**	**(1.00,**	**1.34)**

KNHANES, Korea national health and nutrition examination Survey; FF, fast-food; non-consumer, non-fast-food-consumers.

[1]Data were weighted to represent adults aged 19–64 y from KNHANES 2010–2014.

[2]Fast food consumers are defined as those who consumed more than 0.1 kcal of fast food, and non-consumers are defined as those who consumed 0 kcal from fast food.

[3]Dietary patterns minus fast food were determined by cluster analysis using intake (kcal/day) and excluding any fast food items consumed.

[4]ORs (95% CIs) for weight status (overweight/obesity and central obesity) with fast food consumption and dietary pattern minus fast food (reference: Grain, fruit, and milk pattern). Model 1 was adjusted for age, sex, income, education, region, smoking, total energy intake, and physical activity. Model 2 was adjusted for dietary pattern excluding fast food to find associations with fast food consumption and was adjusted for fast food consumption to find associations with dietary patterns excluding fast food. Bold indicates significance at P-value < 0.05.