

The association between dietary pattern and depression in middle-aged Korean adults

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BACKGROUND/OBJECTIVES: The association between dietary patterns and depression has been reported but the results have been inconsistent. This study was conducted to investigate the association between dietary patterns and depression in middle-aged Korean adults.

SUBJECTS/METHODS: The participants were selected from a community-based cohort, a subset of the Korean Genome and Epidemiology Study. Depression was assessed using the Korean version of the Beck Depression Inventory (BDI) and those with a BDI score ≥ 16 were defined as having depression. The subjects' food intakes over the year preceding the survey were estimated by using a validated semi-quantitative food frequency questionnaire. Dietary patterns were identified by using factor analysis. Multiple logistic regression was used to assess the association of dietary pattern with depression.

RESULTS: Among 3,388 participants, 448 (13.2%) were identified as having depression. We identified two major dietary patterns: 'Healthy' dietary pattern was characterized by high intakes of vegetables, soybeans, mushroom, seaweeds, white fish, shellfish and fruits and a low intake of white rice. 'Unhealthy' dietary pattern was characterized by high intakes of white rice, meats, ramen, noodles, bread and coffee and a low intake of rice with other grains. Compared with subjects in the lowest quartiles, those in the highest quartiles of the healthy dietary pattern had a significantly lower odds ratio (OR = 0.59, 95% CI: 0.42-0.82, *P* for trend = 0.0037) after adjusting for potential confounders. In contrast, the unhealthy dietary pattern was negatively associated with depression (OR = 1.65, 95% CI: 1.19-2.28, *P* for trend = 0.0021).

CONCLUSION: This results suggest that a healthy dietary pattern (rich in vegetables, soybeans, mushroom, seaweeds, white fish, shellfish, and fruits) is associated with low risk of depression. Whereas an unhealthy dietary pattern (rich in white rice, meats, ramen, noodles, bread, and coffee) is associated with a high risk of depression in middle-aged Korean adults.

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INTRODUCTION

Depression is a psychiatric disorder and the burden of that disease is greater than any other single disease [1]. The World Health Organization has predicted that 300 million people have depressive symptoms [2]. In the 2014 Korea National Health and Nutrition Examination Survey, 6.7% of adults aged > 19 years had depression, as defined as a score on the Patient Health Questionnaire (PHQ)-9 of 10 or higher [3]. Depression is associated with a variety of social problems and is closely related to suicide, thus appropriate prevention strategies are needed [4].

To alleviate this health issue, studies have proposed that several nutrients, such as omega-3 fatty acid, folate, vitamin B₆, and vitamin B₁₂, may help prevent depressive symptoms [5-8]. However, since the effect of an individual nutrient on a disease is limited, a dietary pattern analysis method that evaluates the effect of the entire diet has been proposed [9,10]. In a review

paper, dietary patterns including the Mediterranean diet, the prudent diet pattern, and the pro-vegetarian diet pattern, were reported to reduce the risk of depression [11]. In an assessment of the individual dietary patterns and incidence of depression in middle-aged subjects, the Mediterranean diet was shown to be inversely associated with depression of middle-aged subjects in the PREDIMED randomized trial [12]. Also, the whole-food pattern (high intake of vegetables, fruits, and fish) was shown to be associated with decreased depression risk in middle-aged subjects [13]. On the other hand, dietary pattern and depression did not show any association in a large-scale cohort study of middle-aged US women [14]. To the best of our knowledge, there is only one study that conducted to examine the association between dietary pattern and depression in Korean adolescents [15]. Therefore, the objective of this study was to examine the association between dietary patterns and depression in Korean middle-aged adults.

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SUBJECTS AND METHODS

Participants

The participants were selected from a community-based cohort of Korean Genome and Epidemiology Study; the design of that study has been described in detail previously [16]. In brief, Korean adults aged 40-69 years who lived in rural (Ansung) and urban (Ansan) areas were recruited from 2001 to 2002. Among the 10,030 participants, we selected 3,388 men and women who had completed the dietary questionnaire, and underwent screening for depression. A total of 6,642 participants were excluded for following reasons: did not attend first follow up examination ($n = 2,515$); no dietary data ($n = 33$); no depression screening data ($n = 4,065$); history of mental disorder ($n = 7$); outside of the recommended calorie cut-off range (< 500 and < 800 kcal or $> 3,500$ and $> 4,000$ kcal in women and men, respectively) ($n = 22$) [17]. Informed consent was obtained from all study participants. The data was provided National Biobank of Korea, the Centers for Disease Control and Prevention, Republic of Korea (4845-301, 4851-302, and -307). The study protocol was approved by the Gachon University Institutional Review Board (1044396-201604-HR-028-01).

Screening for depression

For depression screening, the Beck Depression Inventory (BDI) was administered. The presence of depression was determined based on the BDI score: normal subjects (BDI score range: 0-15) and depression subjects (BDI score range: 16-63). The validity of the BDI has been previously verified and a BDI score of 16 is the optimal cut-off score for Koreans [18].

Dietary assessment

The subjects' food intakes over the year preceding the survey were assessed by using a validated semi-quantitative food frequency questionnaire (SQFFQ) containing a list of 106 food items. The intake frequency of each food items was presented

in nine categories: never or seldom, once a month, 2-3 times a month, 1-2 times a week, 3-4 times a week, 5-6 times a week, once a day, twice a day, and three or more times a day. The intake amount of each food items was classified into three categories: small, medium (1 serving), or large. The SQFFQ was previously validated by using 12-day diet record data of 124 subjects [19]. Nutrient intakes were calculated for each subject by using the seventh edition food composition tables provided by the Korean Nutrition Society [20].

Measurement of covariates

Information on various covariates such as general characteristics and lifestyle data were collected by using an interviewer-administered questionnaire. The following is the list of covariates: age, marital status (married or other), exercise (yes or no), alcohol drinking (no or ex/current drinker), smoking (no or ex/current smoker), educational level (graduated elementary school, middle school, high school, or college or higher degree), family history of mental disorder (yes or no), sleep hours (≤ 5 hours, 5-6 hours, 6-7 hours, or ≥ 7 hours), chronic disease status such as diabetes, hypertension, and cardiovascular diseases (yes or no).

Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively, by trained staff using a scale and a wall-mounted extensometer. Body mass index (BMI) was calculated as the weight in kilograms (kg)/ height in meters (m) squared.

Statistical analysis

The characteristics of subjects are expressed as a percentage (categorical variables) or as mean and standard deviation values (continuous variables). Differences between groups were tested using the t-test for continuous variables and the chi-square test for categorical variables.

To reduce the complexity of the data, the 106 food items were categorized into 36 groups. In general, the food grouping was based on food and nutrient composition similarity (Table 1). Dietary patterns were derived using factor analysis (principal

Table 1. Food grouping used in dietary pattern analysis¹⁾

Food or food group	Food items included
White rice	Well-milled cooked rice
Rice with grains	Cooked rice with soybean, Cooked rice with other cereals, Parched cereal powder
Ramen	Ramen
Noodles	Wheat noodles with soup
Other noodles	Chajangmyon/Jambbong, Buckwheat vermicelli/Buckwheat noodle
Dumplings	Dumpling/Dumpling with soup
Rice cake	Rice cake (plain rod shape)/rice cake with soup, Other rice cakes
Bread	Loaf bread/Sandwich/Toast, Bread with small red bean, Other breads
Pizza/Hamburger	Pizza/Hamburger
Flake	Corn flakes
Cakes	Cakes/Chocopie
Snacks/Sweets	Cookie/Cracker/Snack, Candy/Chocolate
Jam/Butter	Jam/Honey/Butter/Margarine
Potatoes	Starch jelly, Potatoes, Sweet potatoes, Starch vermicelli
Soybeans	Legumes, Soup, and Stew with soybean paste/soybean paste, Tofu, Soybean milk
Nuts	Nuts
Kimchi	Kimchi, Kkakduki/small radish Kimchi, Radish with water Kimchi, Other Kimchi
Green-yellow vegetables	Spinach, Lettuce, Perilla leaf, Vegetables wrap/Vegetable salad, Other green vegetables, Pepper leaves/Chamnamul/Asterscaber, Crown daisy/Leek/Water dropwort, Carrot/Carrot juice, Green pepper, immature pumpkin, Tomato/Cherry tomato/Tomato juice, Cucumber

Table 1. continued

Food or food group	Food items included
White vegetables	Radish/Salted radish, Korean cabbages/Korean cabbage soup, Deoduck/Doraji, bean sprouts, Bracken/Sweet potato stalk/Stem of taro, Onion
Pickle/Salt-fermented fish	Korean style pickles, Salt-fermented fish
Mushrooms	Oyster mushroom, Other mushrooms
Fruits	Strawberry, Muskmelon/Melon, Watermelon, Peach/Plum, Banana, Persimmon, Tangerine, Pear/Pear juice, Apple/Apple juice, Orange/Orange juice+;
Meats	Belly pork, Roasted pork, Braised pork, Ham/Sausage, Edible viscera, Beef steak, Dog meat, Fried chicken/Chicken stew, Beef soup, Beef soup with vegetables
Eggs	Eggs
White fish	Sushi, Hair tail, Yellow croaker/Sea bream/Flat fish, Alaska pollack
External blue-colored fish	Mackerel/Pacific saury/Spanish mackerel, Canned tuna, Eel
Anchovy	Dried anchovy
Cuttlefish/Octopus	Cuttlefish/Octopus
Fish cake	Fish paste/Crab flavored
Shellfish	Clam/Whelk, Oyster, Crab, Shrimp
Seaweeds	Dried laver, Kelp/Sea mustard
Milk	Milk
Dairy products	Yogurt, Ice cream, Cheese
Carbonated drinks	Carbonated drinks
Coffee	Coffee, Coffee cream, Coffee sugar
Green tea and other drinks	Green tea, Other drinks

¹⁾ Food items were from the semi-quantitative food frequency questionnaire

component) based on the 36 food groups of SQFFQ using PROC FACTOR. The factors were rotated via an orthogonal transformation to simplify the structure and to obtain greater interpretability. To determine the number of factors, we considered eigenvalues (> 2), scree test plots, and factor interpretability. The factor score for each pattern was calculated by summing intake of food groups weighted by factor loadings. Each subjects was then assigned a score for each of the identified patterns. Subjects were divided into quartiles based on the factor score of each dietary pattern. We computed odds ratio (OR) values and their 95% confidence intervals (CI) using logistic regression. Multivariate

models were adjusted for age, BMI, education level, smoking, alcohol drinking, exercise, sleep hours, chronic diseases status, marital status, family history of mental disorder, and total energy intake. Data were analyzed using SAS 9.4 (SAS Institute Inc. Cary, NC, USA) and statistical significance was accepted at $P < 0.05$.

RESULTS

Dietary patterns of subjects

We identified two major dietary patterns by using factor analysis:

Table 2. Factor loading matrix for the two dietary patterns identified from the responses to the Food Frequency Questionnaire

Food group ¹⁾	Total		Male		Female	
	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy
White rice	-0.33	0.56	-0.36	0.55	-0.24	0.45
Rice with grains	0.34	-0.60	0.39	-0.60	0.26	-0.54
Ramen		0.44		0.36		0.35
Noodles		0.35		0.32		0.34
Other noodles		0.47		0.42		0.39
Dumplings		0.36		0.36		0.34
Rice cake	0.22		0.20			
Bread		0.40		0.44		0.56
Pizza/Hamburger		0.29		0.38		0.30
Flake				0.25		0.23
Cakes		0.21				0.33
Snacks/Sweets		0.26		0.35		0.36
Jam/Butter		0.32		0.37		0.40
Potatoes	0.47		0.47		0.44	
Soybeans	0.52		0.54		0.52	
Nuts	0.28		0.27		0.27	
Kimchi	0.28		0.33		0.33	
Green-yellow vegetables	0.72		0.70		0.74	
White vegetables	0.62		0.64		0.60	
Pickle/Salt-fermented fish	0.25		0.31		0.23	

Table 2. continued

Food group ¹⁾	Total		Male		Female	
	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy
Mushrooms	0.54		0.51		0.55	
Fruits	0.45		0.43		0.42	
Meats	0.27	0.50	0.33	0.41	0.36	0.42
Eggs	0.25	0.23	0.26		0.24	0.30
White fish	0.49	0.24	0.48		0.56	
External blue-colored fish	0.44		0.41		0.49	
Anchovy	0.44		0.43		0.46	
Cuttlefish/Octopus	0.31	0.24	0.31	0.28	0.33	
Fish cake	0.23	0.31	0.23	0.34	0.24	0.27
Shellfish	0.45	0.22	0.44	0.22	0.48	
Seaweeds	0.49		0.46		0.50	
Milk	0.23				0.23	
Dairy products	0.32		0.25		0.34	
Carbonated drinks		0.31		0.34		0.20
Coffee		0.39		0.24		0.37
Green tea and other drinks	0.31		0.28		0.35	

¹⁾ Food groups with absolute values < 0.20 are not shown for simplicity.

Table 3. Characteristics of subjects with and without depression

	Total			Male			Female		
	Normal (n = 2,940)	Depression (n = 448)	P-value	Normal (n = 1,589)	Depression (n = 180)	P-value	Normal (n = 1,351)	Depression (n = 268)	P-value
Age (yrs) mean ± SD	52.2 ± 7.3	54.9 ± 8.5	< 0.0001	52.1 ± 7.1	54.2 ± 8.4	0.0015	52.4 ± 7.4	55.5 ± 8.5	< 0.0001
Marital status, n (%)									
Married	2,737 (93.2)	385 (85.9)	< 0.0001	1,546 (97.4)	168 (93.3)	0.003	1,191 (88.3)	217 (81.0)	0.0011
Others	200 (6.8)	63 (14.1)		42 (2.6)	12 (6.7)		158 (11.7)	51 (19.0)	
Education, n (%)									
Elementary school	414 (14.1)	114 (25.5)	< 0.0001	123 (7.8)	22 (12.2)	0.0026	291 (21.6)	92 (34.3)	< 0.0001
Middle school	553 (18.8)	103 (23.0)		260 (16.4)	39 (21.7)		293 (21.7)	64 (23.9)	
High school	1,221 (41.6)	170 (38.0)		646 (40.7)	78 (43.3)		575 (42.6)	92 (34.3)	
College or higher degree	750 (25.5)	61 (13.6)		559 (35.2)	41 (22.8)		191 (14.2)	20 (7.5)	
Sleep hours, n (%)									
≤ 5	604 (20.6)	159 (35.5)	< 0.0001	257 (16.2)	55 (30.6)	< 0.0001	347 (25.7)	104 (38.8)	0.0002
5 < ≤ 6	862 (29.3)	114 (25.5)		456 (28.7)	45 (25.0)		406 (30.1)	69 (25.8)	
6 < ≤ 7	902 (30.7)	109 (24.3)		521 (32.8)	46 (25.6)		381 (28.2)	63 (23.5)	
> 7	570 (19.4)	66 (14.7)		354 (22.3)	34 (18.9)		216 (16.0)	32 (11.9)	
Alcohol drinking, n (%)									
No	1,247 (42.4)	211 (47.1)	0.104	294 (18.5)	29 (16.1)	0.5229	953 (70.6)	182 (67.9)	0.4456
Ex-drinker	169 (5.8)	29 (6.5)		135 (8.5)	19 (10.6)		34 (2.5)	10 (3.7)	
Current drinker	1,523 (51.8)	208 (46.4)		1,160 (73.0)	132 (73.3)		363 (26.9)	76 (28.4)	
Smoking, n (%)									
No	1,702 (57.9)	292 (65.2)	0.0036	386 (24.3)	36 (20.0)	0.2004	1,316 (97.5)	256 (95.5)	0.078
Ex or current smoker	1,237 (42.1)	156 (34.8)		1,203 (75.7)	144 (80.0)		34 (2.5)	12 (4.5)	
Exercise, n (%)									
No	1,439 (49.0)	250 (56.2)	0.0049	749 (47.2)	97 (54.2)	0.0758	690 (51.2)	153 (57.5)	0.0588
Yes	1,496 (51.0)	195 (43.8)		838 (52.8)	82 (45.8)		658 (48.8)	113 (42.5)	
BMI, n (%)									
< 25	1,742 (59.3)	282 (63.0)	0.1374	921 (58.0)	114 (63.3)	0.1656	821 (60.8)	168 (62.7)	0.5566
≥ 25	1,198 (40.8)	166 (37.1)		668 (42.0)	66 (36.7)		530 (39.2)	100 (37.3)	
Chronic diseases ¹⁾ , n (%)									
No	2,305 (78.4)	306 (68.3)	< 0.0001	1,238 (77.9)	131 (72.8)	0.1187	1,067 (79.0)	175 (65.3)	< 0.0001
Yes	635 (21.6)	142 (31.7)		351 (22.1)	49 (27.2)		284 (21.0)	93 (34.7)	
Family history of mental disorder, n (%)									
No	2,920 (99.3)	446 (99.6)	0.5659	1,573 (99.0)	179 (99.4)	0.5563	1,347 (99.7)	267 (99.6)	0.8355
Yes	20 (0.7)	2 (0.5)		16 (1.0)	1 (0.6)		4 (0.3)	1 (0.4)	

¹⁾ Chronic diseases such as diabetes, hypertension, hyperlipidemia, congestive heart failure, coronary artery disease, and myocardial infarction
BMI: body mass index

healthy and unhealthy dietary patterns. The factor loadings associated with each of the 36 food groups for both of the dietary patterns in male and female subjects are presented in Table 2. A positive loading score means that the food group is positively associated with the dietary pattern whereas a negative loading score indicates an inverse association with the dietary pattern. On that basis, the healthy dietary pattern is characterized by high intakes of vegetables, soybeans, mushroom, seaweeds, white fish, shellfish and fruits and a low intake of refined rice. Similarly, the unhealthy dietary pattern was characterized by high factor loadings in refined rice, meats, ramen, other noodles, bread, and coffee and low factor loadings in rice with grains. Both male and female had similar dietary patterns.

Prevalence of depression and general characteristics

A summary of the sociodemographic characteristics, health behavior, marital status, sleep hours, and BMI of normal and depression subjects are shown in Table 3. Among the 3,388

subjects, 448 (13.2%) were identified as having depression. There was a significantly greater age, more 'others' marital status, lower education level, less sleep hours, less exercise, and more having chronic diseases in subjects with depression than in normal subjects. In male, there were significant differences in age, marital status, education, and sleep hours between depression and normal subjects. In female, age, marital status, education, sleep hours, and chronic disease status were significantly different between the normal and depression groups.

Dietary patterns and depression

Table 4 presents the OR and 95% CI of depression across quartiles of the healthy and unhealthy dietary patterns. Compared with the subjects in the lowest quartile of the healthy dietary pattern group, those in the highest quartile had a significantly lower odds ratio (OR = 0.59, 95% CI: 0.42-0.82, P for trend = 0.0037 for all subjects, OR = 0.59, 95% CI: 0.35-0.98, P for trend = 0.0359 for male, OR = 0.64, 95% CI: 0.42-0.99, P for trend =

Table 4. Association of dietary pattern with the risk of depression by multivariate-adjusted regression analysis

		No of total	No of Cases	Model 1	Model 2
				Odds ratio (95% CI)	Odds ratio (95% CI)
Total (n = 3,388)					
Healthy	Q1	847	151	1.00	1.00
	Q2	847	99	0.60 (0.46-0.80)	0.66 (0.49-0.88)
	Q3	847	108	0.66 (0.50-0.86)	0.70 (0.52-0.94)
	Q4	847	90	0.52 (0.39-0.69)	0.59 (0.42-0.82)
	<i>P</i> value for trend			< 0.0001	0.0037
Unhealthy	Q1	847	125	1.00	1.00
	Q2	847	104	1.06 (0.79-1.41)	1.18 (0.87-1.59)
	Q3	847	111	1.23 (0.92-1.64)	1.36 (1.00-1.83)
	Q4	847	108	1.39 (1.03-1.88)	1.65 (1.19-2.28)
	<i>P</i> value for trend			0.0198	0.0021
Male (n = 1,769)					
Healthy	Q1	442	55	1.00	1.00
	Q2	442	46	0.83 (0.55-1.27)	0.88 (0.57-1.36)
	Q3	443	44	0.77 (0.50-1.17)	0.78 (0.49-1.23)
	Q4	442	35	0.60 (0.38-0.94)	0.59 (0.35-0.98)
	<i>P</i> value for trend			0.0236	0.0359
Unhealthy	Q1	442	37	1.00	1.00
	Q2	442	49	1.50 (0.95-2.36)	1.53 (0.96-2.44)
	Q3	443	48	1.52 (0.96-2.41)	1.48 (0.92-2.38)
	Q4	442	46	1.51 (0.95-2.41)	1.70 (1.03-2.80)
	<i>P</i> value for trend			0.1182	0.0621
Female (n = 1,619)					
Healthy	Q1	404	96	1.00	1.00
	Q2	405	55	0.55 (0.38-0.79)	0.59 (0.40-0.87)
	Q3	405	66	0.71 (0.50-1.01)	0.81 (0.55-1.20)
	Q4	405	51	0.52 (0.36-0.76)	0.64 (0.42-0.99)
	<i>P</i> value for trend			0.0032	0.1179
Unhealthy	Q1	404	75	1.00	1.00
	Q2	405	55	0.78 (0.53-1.15)	0.80 (0.54-1.19)
	Q3	405	65	1.03 (0.71-1.50)	1.16 (0.78-1.71)
	Q4	405	73	1.27 (0.87-1.84)	1.50 (1.01-2.24)
	<i>P</i> value for trend			0.0742	0.0104

Model 1: adjusted for sex (total) and age, Model 2: adjusted for sex (total), age, body mass index, exercise, smoking, alcohol drinking, marital status, education, sleep hours, family history of mental disorder, chronic diseases status, and total energy intake
Q, quartile; CI, confidence interval.

0.1179 for female) after adjustment for age, BMI, exercise, smoking, alcohol drinking, marital status, education, sleep hours, family history of mental disorder, total energy intake and chronic disease status. In addition, the OR for the presence of depression in the highest quartile of the unhealthy dietary pattern group was significantly high compared to that in the lowest quartile as a reference (OR = 1.65, 95% CI: 1.19-2.28, *P* for trend = 0.0021 for all subjects, OR = 1.70, 95% CI: 1.03-2.80, *P* for trend = 0.0621 for male, OR = 1.50, 95% CI: 1.01-2.24, *P* for trend = 0.0104 for female).

DISCUSSION

We conducted this study to determine whether dietary patterns derived from food group intake are associated with the presence of depression in middle-aged Korean adults. In this study, a 'healthy' dietary pattern (high intakes of vegetables, soybeans, mushroom, seaweeds, white fish, shellfish, and fruits and a low intake of white rice) showed a lower risk of depression whereas the 'unhealthy' dietary pattern (high intakes of white rice, meats, ramen, noodles, bread, and coffee and a low intake of rice with grains) increased the risk of depression after controlling for various social, health, and dietary confounders. To the best of our knowledge, this is the first study to examine the association between dietary pattern and depression in middle-aged Korea adults.

Our findings are similar to the results of a study of Korean adolescent girls, which indicated that a high intake of instant and processed foods increased the risk of depression and that high intakes of green vegetables, fruits, and beans was negatively associated with the risk of depression [15].

The healthy Japanese dietary pattern, which is characterized by a high intakes of vegetables, fruit, mushrooms, and soy products, has been associated with a low incidence of depressive symptom in Japanese adults [21]. Also, maintaining a dietary pattern rich in vegetables, mushrooms, seaweeds, soybean products, green tea, potatoes, and fish was shown to lower the risk of depressive symptoms among Japanese employees [22].

Western studies have also reported associations between dietary patterns and depression. Typically, the Mediterranean dietary pattern, which is characterized by a high intakes of vegetables, nuts, legumes, fruit, and fish, and a moderate alcohol consumption, was reported to lower the incidence of depression in the Spanish SUN cohort [23]. Also, in an Australian prospective study, Mediterranean-like and fruit dietary pattern was associated with a lower risk of depression in middle-aged women [24]. A three-year intervention study revealed that a Mediterranean diet with nuts has a beneficial effect on depression risk in diabetes patients [12]. Similarly, a healthy dietary pattern characterized by a high intake of various vegetables and nuts was associated with a low prevalence of depression in an Iranian population [25]. The whole-food dietary pattern (high intake of vegetables, fruits, and fish) was associated with a lower risk of depression and a processed food dietary pattern increased the risk of depression among middle-aged Whitehall II cohort participants [13].

The Korean healthy food pattern represents the traditional Korean diet, which includes plenty of vegetables, a high intake

of legumes and fish, and a low intake of red meat. Also, the Korean diet generally includes *banchan* (small side dishes) mainly consisting of vegetables with various *jang* (fermented soy products or pepper paste), garlic, pepper powder, sesame oil, and perilla oil [26]. Our study revealed that a healthy dietary pattern of middle-aged Koreans was characterized by high intakes of vegetables, soybeans, mushroom, seaweeds, white fish, shellfish and fruits. Therefore, the healthy dietary pattern is rich in dietary fiber, omega-3 fatty acid, and various antioxidant nutrients. A systematic review reported that dietary n-3 PUFA and fish consumption are associated with a low risk of depression [27]. And it has been reported that fish or seafood intake, as well as omega-3 fatty acid intake, could prevent depression in a Korean population [28-30]. Taylor *et al.* [31] reported that a fiber and n-3 PUFA rich diet may reduce the risk of depression, anxiety, and stress. Also, dietary fiber intake from vegetables and fruits significantly reduced the depressive symptoms among Japanese workers [32]. Dietary fibers are transferred to the cecum and large bowel for anaerobic fermentation by gut microbiota into short chain fatty acids, such as acetic, propionic, and caproic acids, which has been reported to partially contribute to the prevention of depression [33].

Because this was a cross-sectional study, it is difficult to determine causal relationships between a healthy dietary pattern and a reduced risk of depression. Nonetheless, the results of this study may help to prevent middle-aged depression by reducing these unhealthy eating patterns and increasing healthy eating patterns. In conclusion, our findings suggest that a healthy dietary pattern is associated with a lower risk of depression whereas an unhealthy dietary pattern is associated with a high risk of depression in middle-aged Korean adults.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to report.

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