JNH
Journal of Nutrition and Health

Research Article

Check for updates

Association between depression and eating behavior factors in Korean adults: the Korea National Health and Nutrition Examination Survey 2018

EunJung Lee (iD) [1] **and Ji-Myung Kim** (iD) [2]

[1]Food and Nutrition Major, School of Wellness Industry Convergence, Hankyong National University, Anseong 17579, Korea
[2]Food and Nutrition Major, Division of Food Science & Culinary Arts, Shinhan University, Uijeongbu 11644, Korea

OPEN ACCESS

Correspondence to
Ji-Myung Kim
Food and Nutrition Major, Division of Food Science & Culinary Arts, Shinhan University, 95 Hoam-ro, Uijeongbu 11644, Korea.
Tel: +82-31-870-3515
E-mail: kjm@shinhan.ac.kr

ORCID iDs
EunJung Lee (iD)
https://orcid.org/0000-0002-6064-7784
Ji-Myung Kim (iD)
https://orcid.org/0000-0002-5965-9681

Conflict of Interest
There are no financial or other issues that might lead to conflict of interest.

ABSTRACT

Purpose: This study aimed to examine the association between depression and eating behavior factors in Korean adults.
Methods: Study subjects were selected (n = 5,103) from the participants of the 7th Korea National Health and Nutrition Examination Survey 2018 and divided into depression (men, 59; women, 162) and normal groups (men, 2,083; women, 2,799). Subjects with a Patient Health Questionnaire 9 score ≥ 10 (out of 27 points) were defined as having depression.
Results: A higher prevalence of depression was observed in both men and women who were unemployed (p < 0.001, p = 0.008), had lower income (both p < 0.001), poorer subjective health (both p < 0.001), and poor food safety (both p < 0.001). The prevalence of depression was higher in women with lower education levels (p = 0.008), who were unmarried (p = 0.010), smokers (p < 0.001), and in a one-person household (p = 0.001). Obese men showed a higher prevalence of depression (p = 0.009). Men who were eating alone or skipping lunch had a high prevalence of depression (p = 0.009), while women who were eating breakfast (p = 0.012), lunch (p = 0.001), and dinner (p = 0.010) alone had a high prevalence of depression. The relationship analysis between men and women according to dietary habits using logistic regression showed that, in women, after variable adjustment, skipping lunch (odds ratio [OR], 2.677; 95% confidence interval [CI], 1.090–6.574), meal frequency of 2 times per day (OR, 1.658; 95% CI, 1.084–2.536), and lunch frequency of 3–4 times per week (OR, 3.143; 95% CI, 1.725–5.728) were significantly associated with a higher prevalence of depression.
Conclusion: Depression in women was not only affected by more sociodemographic variables but also associated with decreased frequency of lunch and dinner, especially with skipping lunch.

Keywords: depression, PHQ-9, eating behavior, dietary habits, adult

INTRODUCTION

Depression can simply refer to feelings of sadness for certain situations; however, clinically, it involves loss of interest, weariness, pessimism, gloomy look, and negative mood. One of the symptoms of severe depression is feeling miserable and unrealistic about the world [1]. Epidemiologic studies have indicated that depression increases the risk of all-cause mortality, especially cardiovascular-related mortality [2]. Depression is one of the main causes of

Generated by xmlinkpress

disability worldwide and a leading contributor to the overall global burden of disease [3]. The World Health Organization projected that the prevalence of depression in individuals aged 60 years would nearly double, rising from 12% in 2015 to > 20% in 2050 [4].

Eating behavior involves various patterns of food intake, which are affected by internal and external environmental factors, and the mental environment is closely related to eating behavior as it controls human life as a whole [5]. Eating behavior varies depending on the comfortable or uncomfortable mental state. While depression and eating behavior have been suggested as contributing factors to unhealthy dietary intake, they are also associated with each other [6]. Individuals with higher depression severity are shown to have less healthy dietary pattern, including lower intake of fruits, vegetables, whole grains, poultry, fish, and reduced-fat dairy products [7]. Additionally, higher depression severity is associated with higher total energy intake from saturated fat and sugars [8] and higher sweet food consumption [9].

A study by Park et al. [10] to analyze the association between stress, depression, binge eating, and eating behavior according to body mass index (BMI) in Korean high school girls showed that a higher level of stress and depression was related to a higher risk of meal irregularity and a higher level of binge eating was associated with lower meal frequency and worse meal regularity. A study conducted in Japan to determine the association between eating alone and depression in elderly individuals indicated that eating alone was one of the main factors of depression, and eating alone can be used as a predictor of the risk of depression [11]. In Korea, studies on the association between depression and eating behavior include comparisons of eating behavior and lifestyles between the depression and normal groups in Korean middle-aged women [12]; association between depression, quality of life and obesity [13]; and association between eating breakfast together and depression [14].

Although there are some studies on unhealthy eating behavior triggered by the symptoms of depression, no in-depth studies have been conducted so far on the associations between depression and eating behavior in men and women. Thus, this study was designed to identify the association between depression and eating behavior in men and women by investigating their depression status and eating behavior based on the 7th Korea National Health and Nutrition Examination Survey (KNHANES) 2018. The overall goal of this study was to help lead depression groups to healthy eating behavior by providing basic dietary data.

METHODS

Data collection
This study was based on the data from the 7th KNHANES 2018. KNHANES is a nationwide survey using a stratified multistage probability sampling design and consists of health interviews, behavioral and nutritional surveys, and medical examinations. A total of 7,064 individuals completed the health examination and nutrition survey. Participants aged < 19 years (n = 1,361), those who reported implausible daily energy intake (< 500 or ≥ 5,000 kcal/day) (n = 96), and those with missing values for depression (n = 504) were excluded from the study. Subsequently, 5,103 participants (2,142 men and 2,961 women) were analyzed in this study. This study was approved by the Institutional Review Board of the Korea Centers for Disease Control and Prevention (2018-01-03-P-A) for 2018. Written informed consent was obtained from all study participants.

Variables for demographic information on subjects

Age was categorized into 6 groups, from 20s to 70s; residential area into 3 groups, Seoul city, metropolitan city, and province; and educational level into 4 groups, less than elementary school, middle school, high school, and college. The occupational status, household income, marriage, alcohol consumption, and smoking were obtained. BMI was calculated as weight (in kg) divided by height in meters squared. Physical activity, family type, family size, and subjective health status were obtained during the health interviews according to the KNHANES standard operational procedures [15].

Depression measures

Subjects with depression were selected based on their answers to the Patient Health Questionnaire (PHQ)-9 part of the health survey in the KNHANES 2018 [16]. Participants were asked, "How often have you been bothered by any of the following symptoms over the last 2 weeks?" The PHQ-9 used 9 items to measure the severity of depression symptoms. Each of the 9 items was rated on a 4-point scale of 0 (not at all), 1 (several days), 2 (more than half the days), and 3 (every day), and the answers were summed to obtain the total PHQ-9 score. Based on previous studies, subjects with PHQ-9 score ≥ 10 (of 27 points) were defined as having depression in this study [17].

Dietary habits and intakes

Dietary habits were measured by determining participants' eating patterns, that is, eating together as a family or skipping meals (breakfast, lunch, dinner), frequency of eating alone per day, diet frequency a day, meal (breakfast, lunch, dinner) frequency, and food security. Dietary intake data were obtained by a trained nutritionist using a food frequency questionnaire and 24 recall from a nutritional survey. The total energy and nutrient intakes were calculated using a food composition table published by the Rural Development Administration of Korea [18]. The ratio of macronutrient intake was expressed as a percentage of total energy intake (% kcal), and nutrient density, nutrient amount per 1,000 kcal, was calculated.

Statistical analysis

All statistical analyses were performed using SAS software version 9.4 (SAS Institute, Cary, NC, USA). All analyses accounted for the complex survey design, which consisted of multistage, stratified, and clustered samples and survey weights to reflect the estimates of the entire Korean population and avoid biased results. The participants were categorized into 2 groups depending on the prevalence of depression: 1) depression group and 2) normal group. The analyses were conducted separately in men and women. The intake of total energy, nutrients, and energy distribution of macronutrients was expressed as mean ± SE. Dietary habit categories and categorical variables, including age, residential area, education level, occupation, household income, marital status, alcohol intake, smoking, BMI categories, physical activity, family size, and subjective health status, were expressed as frequencies with percentage and compared between the 2 groups using the chi-square test. In men, nutrient intakes according to the prevalence of depression were analyzed using the general linear model after adjusting for age, occupation, household income level, BMI categories, subjective health status, and total energy intake. In women, additional variable adjustments were made for residential area, education level, smoking, and family size. The odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using logistic regression analysis. Using multiple logistic regression analysis before (model 1) and after adjusting for variables (model 2), the prevalence of depression was compared according to their eating patterns, that is,

eating together as a family or skipping meals (breakfast, lunch, dinner), frequency of eating alone per day, diet frequency a day, meal (breakfast, lunch, dinner) frequency, and food security. The p-values < 0.05 were considered significant.

RESULTS

Demographic characteristics and depression

The prevalence of depression in Korean adults aged ≥ 19 years according to demographic characteristics by sex is shown in **Table 1**. The prevalence of depression in women showed a significant difference according to the residential area and education level: for residential area, urban areas (6.5%), rural areas (5.2%), and Seoul (3.0%) (p = 0.03); for education level, elementary school (7.7%), middle school (6.0%), high school (4.8%), and college (3.8%) (p = 0.008). Participants without occupation had a significantly higher prevalence of depression than those with occupation (p < 0.001 in men; p = 0.008 in women). Participants with low household income had a significantly higher prevalence of depression than those with high household income (p < 0.001 in men and women). Single women (7.8%) had a significantly higher prevalence of depression than married women (4.4%) (p = 0.010). In women, smokers (15.6%) had a significantly higher prevalence of depression than non-smokers (4.4%) (p < 0.001). The prevalence of depression in men was the highest in the obesity group (p = 0.009). The prevalence of depression in women (p = 0.001) showed a significant difference according to family size: one (9.5%), 2 (4.7%), and 3 or more (4.4%). Participants with poor subjective health had a significantly higher prevalence of depression than those with good subjective health (p < 0.001 in men and women).

Dietary habits and depression

Table 2 shows the prevalence of depression according to the dietary habits of Korean adults by sex. In men, the prevalence of depression showed a significant difference according to lunch intake patterns and food security: for lunch intake patterns, eating alone (4.3%), skipping meals (3.3%), and eating together as a family (1.6%) (p = 0.009); for food security, poor (17.1%), good (2.1%), and very good (2.0%) (p < 0.001).

In women, there was a significant difference in the prevalence of depression according to meal types (breakfast, lunch, and dinner): for breakfast, skipping meals (6.1%), eating alone (6.0%), and eating together as a family (3.5%) (p = 0.012); for lunch, skipping meals (13.8%), eating alone (5.2%), and eating together as a family (4.4%) (p = 0.001). For dinner, a significantly higher prevalence of depression was observed in skipping meals (7.2%) and eating alone (7.2%) than in eating with the family (4.3%) (p = 0.010). Participants eating alone 3 times a day had the highest prevalence of depression (9.6%) (p = 0.017). There was a significant difference in the prevalence of depression according to diet frequency per day (p < 0.001). In lunch frequency, 1–2 times per week (13.8%) and 3–4 times per week (11.3%) were associated with a significantly higher prevalence of depression than 5–7 times per week (4.1%) (p < 0.001). In dinner frequency, 3–4 times per week (9.4%) and 1–2 times per week (7.2%) were associated with a significantly higher prevalence of depression than 5–7 times per week (4.5%) (p = 0.005). The prevalence of depression showed a significant difference according to food security in the following order: poor (12.7%), good (6.7%), and very good (3.6%) (p < 0.001).

Table 1. Demographic characteristics and prevalence of depression

Demographic characteristics	Men (n = 2,142)			Women (n = 2,961)		
	No (n = 2,083)	Yes (n = 59)	p-value	No (n = 2,799)	Yes (n = 162)	p-value[1]
Age (yrs)			0.954			0.152
20s	271 (97.4)	7 (2.6)		295 (92.4)	26 (7.6)	
30s	329 (97.7)	8 (2.3)		412 (95.5)	23 (4.5)	
40s	347 (97.3)	9 (2.7)		547 (96.2)	23 (3.8)	
50s	368 (98.1)	7 (1.9)		556 (95.8)	27 (4.2)	
60s	394 (98.4)	11 (1.6)		484 (95.1)	29 (4.9)	
70s	374 (97.5)	17 (2.5)		505 (94.4)	34 (5.6)	
Residential area			0.165			0.030
Seoul city	400 (98.2)	6 (1.8)		584 (97.0)	17 (3.0)	
Metropolitan city	581 (96.5)	28 (3.5)		740 (93.5)	53 (6.5)	
Province	1,102 (98.1)	25 (1.9)		1,475 (94.8)	92 (5.2)	
Education level			0.479			0.008
Elementary	276 (97.1)	14 (2.9)		655 (92.3)	56 (7.7)	
Middle school	213 (99.2)	5 (0.8)		274 (94.0)	20 (6.0)	
High school	740 (97.6)	19 (2.4)		861 (95.2)	44 (4.8)	
College	854 (97.6)	21 (2.4)		1,009 (96.2)	42 (3.8)	
Occupation			< 0.001			0.008
No	565 (94.2)	38 (5.8)		1,277 (93.6)	94 (6.4)	
Yes	1,518 (98.9)	21 (1.1)		1,522 (96.1)	68 (3.9)	
Household income			< 0.001			< 0.001
Low	335 (93.7)	25 (6.3)		551 (92.1)	55 (7.9)	
Medium low	495 (97.8)	13 (2.2)		684 (94.4)	45 (5.6)	
Medium high	602 (97.9)	13 (2.1)		740 (94.7)	38 (5.3)	
High	647 (98.8)	8 (1.1)		818 (97.3)	24 (2.7)	
Marriage			0.894			0.010
Married	1,636 (97.7)	48 (2.3)		2,437 (95.6)	128 (4.4)	
Single	447 (97.6)	11 (2.4)		362 (92.2)	34 (7.8)	
Drinking			0.738			0.575
No	654 (97.9)	20 (2.1)		1,643 (94.7)	99 (5.3)	
Yes	1,428 (97.6)	39 (2.4)		1,153 (95.3)	62 (4.7)	
Smoking			0.605			< 0.001
No	1,424 (97.6)	40 (2.4)		2,675 (95.6)	135 (4.4)	
Yes	657 (97.9)	19 (2.1)		121 (84.4)	26 (15.6)	
BMI			0.009			0.792
Normal (BMI < 23)	665 (97.3)	25 (2.7)		1,386 (95.1)	80 (4.9)	
Overweight (23 ≤ BMI < 25)	545 (99.5)	6 (0.5)		567 (94.3)	36 (5.7)	
Obese (BMI ≥ 25)	873 (96.9)	28 (3.1)		846 (95.2)	46 (4.8)	
Physical activity			0.429			0.257
No	1,147 (97.4)	38 (2.6)		1,692 (95.4)	97 (4.6)	
Yes	933 (98.0)	21 (2.0)		1,103 (94.3)	65 (5.7)	
Family size			0.088			0.001
1	242 (95.6)	13 (4.4)		383 (90.5)	41 (9.5)	
2	658 (98.3)	18 (1.7)		797 (95.3)	45 (4.7)	
> 3	1,183 (97.8)	28 (2.2)		1,619 (95.6)	76 (4.4)	
Subjective health status			< 0.001			< 0.001
Good	1,743 (98.8)	23 (1.2)		2,275 (97.1)	69 (2.9)	
Poor	340 (91.5)	36 (8.5)		524 (85.3)	93 (14.7)	

Values are presented as number (%).
BMI, body mass index.
[1] p-values were obtained using PROC SURVEYFREQ.

Daily nutrient intakes and depression

Table 3 shows the participants' daily nutrient intake. In men, intake of phosphorus (p = 0.018) and potassium (p = 0.024) and nutritional density of potassium (p = 0.002) and vitamin A (p = 0.043) were significantly lower in the depression group than in the normal group. In women, only phosphorus intake was significantly lower in the depression group than in the normal group (p = 0.043).

Table 2. Dietary habits and prevalence of depression

Dietary habits	Men (n = 2,142)			Women (n = 2,961)		
	No (n = 2,083)	Yes (n = 59)	p-value[1]	No (n = 2,799)	Yes (n = 162)	p-value
Breakfast			0.652			0.012
With family	958 (98.0)	25 (2.0)		1,230 (96.6)	45 (3.5)	
Alone	638 (97.8)	19 (2.2)		916 (94.0)	66 (6.0)	
Skipping	487 (97.1)	15 (2.9)		653 (93.9)	51 (6.1)	
Lunch			0.009			0.001
With family	1,519 (98.4)	34 (1.6)		1,643 (95.6)	77 (4.4)	
Alone	487 (95.7)	23 (4.3)		1,053 (94.8)	70 (5.2)	
Skipping	77 (96.7)	2 (3.3)		103 (86.2)	15 (13.8)	
Dinner			0.113			0.010
With family	1,659 (98.1)	39 (1.9)		2,055 (95.7)	95 (4.3)	
Alone	398 (96.3)	18 (3.7)		680 (92.8)	61 (7.2)	
Skipping	26 (96.7)	2 (3.3)		64 (92.8)	6 (7.2)	
Eating alone frequency			0.096			0.017
0	1,081 (98.1)	26 (1.9)		1,168 (95.1)	61 (4.9)	
1	608 (98.1)	13 (1.9)		868 (96.2)	35 (3.8)	
2	267 (96.6)	13 (3.4)		508 (94.5)	36 (5.5)	
3	127 (94.5)	7 (5.5)		255 (90.4)	30 (9.6)	
Daily diet frequency			0.291			< 0.001
1	21 (93.3)	2 (6.7)		37 (97.4)	2 (2.6)	
2	548 (97.4)	15 (2.6)		746 (92.5)	68 (4.5)	
3	1,514 (97.9)	42 (2.1)		2,016 (96.1)	92 (3.9)	
Breakfast frequency (times/wk)			0.588			0.110
5–7	1,390 (98.0)	38 (2.0)		1,850 (95.7)	87 (4.3)	
3–4	206 (97.4)	6 (2.6)		296 (94.1)	24 (5.9)	
1–2	487 (97.1)	15 (2.9)		653 (93.9)	51 (6.1)	
Lunch frequency (times/wk)			0.381			< 0.001
5–7	1,915 (97.8)	52 (2.2)		2,514 (95.9)	120 (4.1)	
3–4	91 (95.8)	5 (4.2)		182 (88.7)	27 (11.3)	
1–2	77 (96.7)	2 (3.3)		103 (86.2)	15 (13.8)	
Dinner frequency (times/wk)			0.919			0.005
5–7	1,966 (97.7)	54 (2.3)		2,527 (95.5)	130 (4.5)	
3–4	91 (97.9)	3 (2.1)		208 (90.6)	26 (9.4)	
1–2	26 (96.7)	2 (3.3)		64 (92.8)	6 (7.2)	
Food security			< 0.001			< 0.001
Very good	1,217 (98.0)	28 (2.0)		1,606 (96.4)	60 (3.6)	
Good	822 (97.9)	23 (2.1)		1,140 (93.3)	92 (6.7)	
Poor	43 (82.9)	8 (17.1)		52 (87.3)	10 (12.7)	

Values are presented as number (%).
[1] p-values were obtained using PROC SURVEYFREQ.

Relationship between dietary habits and depression risk

Table 4 presents the ORs based on dietary habits. In men, using Model 1 without variable adjustments, eating lunch alone (OR, 2.660; 95% CI, 1.360–5.204; p = 0.005), eating alone 3 times a day (OR, 2.995; 95% CI, 1.048–8.559; p = 0.041), poor food security (OR, 10.045; 95% CI, 3.710–27.195; p < 0.001) were found to be significantly associated with a higher prevalence of depression compared to eating lunch with family, eating alone 0 time a day, and very good food security, respectively.

However, in Model 2, there was no significant association with the prevalence of depression. In women, without adjustment, meal eating patterns (breakfast, lunch, and dinner), eating alone frequency, diet frequency per day, lunch and dinner frequency, meal skipping (breakfast, lunch, and dinner), and food security were significantly associated with the prevalence of depression (model 1). With adjustment (model 2), skipping lunch (OR, 2.677; 95% CI, 1.090–6.574; p = 0.032) was significantly associated with a higher prevalence of depression compared to eating lunch with family. In diet frequency per day, 2 times per

Table 3. Nutrient intakes and prevalence of depression

Nutrient intakes	Men (n = 2,142)			Women (n = 2,961)		
	No (n = 2,083)	Yes (n = 59)	p-value[1]	No (n = 2,799)	Yes (n = 162)	p-value[2]
Energy (kcal)	2,291.3 ± 26.3	2,089.6 ± 113.8	0.399	1,670.6 ± 17.1	1,619.4 ± 72.0	0.910
Carbohydrate (g)	328.6 ± 3.4	309.0 ± 21.0	0.665	257.9 ± 2.4	249.5 ± 10.3	0.840
Carbohydrate (g/1,000 kcal)	147.7 ± 1.0	150.7 ± 4.5	0.962	157.4 ± 0.8	160.1 ± 3.8	0.638
Protein (g)	83.9 ± 1.1	77.5 ± 5.8	0.649	60.4 ± 0.8	55.9 ± 4.3	0.713
Protein (g/1,000 kcal)	36.7 ± 0.3	37.2 ± 2.0	0.733	36.2 ± 0.2	34.0 ± 1.3	0.349
Fat (g)	52.8 ± 1.0	46.0 ± 3.6	0.328	39.1 ± 0.8	35.2 ± 3.0	0.491
Fat (g/1,000 kcal)	22.3 ± 0.3	22.1 ± 1.6	0.936	22.6 ± 0.33	20.3 ± 1.2	0.263
Calcium (mg)	576.1 ± 9.5	567.8 ± 64.8	0.906	461.5 ± 7.3	432.2 ± 21.2	0.923
Calcium (mg/1,000 kcal)	259.0 ± 3.6	268.9 ± 26.3	0.778	282.8 ± 3.6	284.1 ± 14.3	0.400
Phosphorous (mg)	1,208.9 ± 13.7	1,117.8 ± 68.6	0.018	922.3 ± 10.0	824.9 ± 35.4	0.043
Phosphorous (mg/1,000 kcal)	536.2 ± 3.6	541.9 ± 26.2	0.755	558.9 ± 3.5	521.0 ± 11.0	0.097
Iron (mg)	13.6 ± 0.2	13.0 ± 1.1	0.378	10.4 ± 0.1	9.5 ± 0.6	0.468
Iron (mg/1,000 kcal)	6.1 ± 0.1	6.4 ± 0.5	0.766	6.4 ± 0.1	5.9 ± 0.2	0.275
Sodium (mg)	4,028.1 ± 54.2	3,934.4 ± 363.0	0.862	2,841.5 ± 40.1	2,509.7 ± 144.3	0.069
Sodium (mg/1,000 kcal)	1,789.7 ± 18.4	1,696.0 ± 103.4	0.549	1,729.8 ± 17.3	1,635.3 ± 77.0	0.320
Potassium (mg)	3,023.0 ± 37.0	2,448.7 ± 132.5	0.024	2,476.5 ± 26.9	2,263.1 ± 107.2	0.836
Potassium (mg/1,000 kcal)	1,352.3 ± 12.1	1,192.0 ± 50.1	0.002	1,518.3 ± 11.1	1,450.9 ± 46.9	0.801
Vitamin A (ug RAE)	647.8 ± 17.0	479.7 ± 54.2	0.906	556.1 ± 12.0	507.0 ± 48.6	0.997
Vitamin A (ug RAE/1,000 kcal)	290.6 ± 7.3	228.5 ± 22.4	0.043	341.4 ± 7.0	320.3 ± 25.9	0.959
Vitamin B$_1$ (mg)	1.6 ± 0.1	1.5 ± 0.1	0.362	1.1 ± 0.1	1.0 ± 0.1	0.260
Vitamin B$_1$ (mg/1,000 kcal)	0.7 ± 0.1	0.7 ± 0.1	0.598	0.7 ± 0.1	0.6 ± 0.1	0.143
Vitamin B$_2$ (mg)	1.8 ± 0.1	1.6 ± 0.1	0.749	1.4 ± 0.1	1.3 ± 0.1	0.688
Vitamin B$_2$ (mg/1,000 kcal)	0.8 ± 0.1	0.8 ± 0.1	0.853	0.8 ± 0.1	0.8 ± 0.1	0.411
Niacin (mg)	15.3 ± 0.2	13.1 ± 1.0	0.759	11.4 ± 0.2	10.9 ± 0.8	0.859
Niacin (mg/1,000 kcal)	6.8 ± 0.1	6.4 ± 0.4	0.238	6.9 ± 0.1	6.7 ± 0.4	0.914
Vitamin C (mg)	66.2 ± 2.7	63.3 ± 20.6	0.755	56.2 ± 1.5	51.6 ± 4.9	0.727
Vitamin C (mg/1,000 kcal)	30.2 ± 1.3	33.7 ± 11.8	0.772	34.6 ± 0.8	32.8 ± 3.0	0.743
Energy distribution (% carbohydrate)	62.7 ± 0.3	63.3 ± 1.6	0.951	64.3 ± 0.3	66.4 ± 1.5	0.379
Energy distribution (% protein)	15.8 ± 0.1	15.7 ± 0.8	0.800	14.9 ± 0.1	14.4 ± 0.5	0.626
Energy distribution (% fat)	21.5 ± 0.3	20.9 ± 1.4	0.820	20.9 ± 0.2	19.3 ± 1.2	0.423

Data are shown as mean ± SE.
RAE, retinol activity equivalent.
[1]p-values were calculated using a general linear model after adjusting for age, occupation, household income, body mass index, subjective health status, and energy intake in men. [2]p-values were calculated using a general linear model after adjusting for age, education, residence area, occupation, household income, smoking, family size, subjective health status, and energy intake in women.

day (OR, 1.658; 95% CI, 1.084–2.536; p = 0.020) was significantly associated with a higher prevalence of depression compared to 3 times per day. In meal frequency, 3–4 times per week in lunch (OR, 3.143; 95% CI, 1.725–5.728; p < 0.001) and dinner (OR, 1.957; 95% CI, 1.099–3.483; p = 0.023) and < 2 times per week in lunch (OR, 3.195; 95% CI, 1.326–7.697; p = 0.010) were significantly associated with a higher prevalence of depression compared to 5–7 times per week. Skipping dinner (OR, 2.510; 95% CI, 1.456–4.328; p = 0.001) was significantly associated with a higher prevalence of depression compared to no skipping (data not shown).

DISCUSSION

This study focused on identifying the association between eating behavior and depression in men and women using the 7th KNHANES 2018. The prevalence of depression in men and women was 2.8% and 5.5%, respectively. A higher prevalence of depression was observed in both men and women with unemployment, lower income, and poorer subjective health. The prevalence of depression was higher in women with lower education levels, who were unmarried, who were smokers, and with one-person households. Men with obesity showed a higher prevalence of depression.

Table 4. Odds ratio of depression

Dietary habits	Men		Women	
	Model 1[1)	Model 2[2)	Model 1	Model 2
Breakfast				
With family	1.000	1.000	1.000	1.000
Alone	1.086 (0.484–2.436)	0.923 (0.405–2.104)	1.797 (1.137–2.838)	1.389 (0.831–2.322)
Skipping	1.420 (0.662–3.050)	1.162 (0.476–2.841)	1.827 (1.130–2.956)	1.181 (0.652–2.142)
Lunch				
With family	1.000	1.000	1.000	1.000
Alone	2.660 (1.360–5.204)	1.681 (0.682–4.146)	1.213 (0.813–1.809)	0.987 (0.620–1.570)
Skipping	2.044 (0.437–9.555)	0.939 (0.205–4.295)	3.528 (1.712–7.271)	2.677 (1.090–6.574)
Dinner				
With family	1.000	1.000	1.000	1.000
Alone	1.955 (0.992–3.854)	1.213 (0.519–2.836)	1.725 (1.191–2.498)	1.461 (0.938–2.274)
Skipping	1.742 (0.236–12.871)	0.966 (0.062–14.968)	1.722 (0.666–4.449)	1.683 (0.560–5.057)
Eating alone frequency (times/day)				
0	1.000	1.000	1.000	1.000
1	1.012 (0.458–2.239)	0.837 (0.351–1.997)	0.779 (0.444–1.367)	0.741 (0.428–1.283)
2	1.820 (0.748–4.427)	1.239 (0.405–3.789)	1.143 (0.674–1.937)	0.989 (0.545–1.794)
3	2.995 (1.048–8.559)	1.529 (0.451–5.188)	2.094 (1.272–3.446)	1.677 (0.924–3.046)
Daily diet frequency (times/day)				
3	1.000	1.000	1.000	1.000
2	1.243 (0.627–2.464)	1.000 (0.458–2.184)	1.968 (1.393–2.781)	1.658 (1.084–2.536)
1	3.344 (0.701–15.946)	1.798 (0.185–17.488)	0.660 (0.153–2.834)	0.378 (0.065–2.204)
Breakfast frequency (times/wk)				
5–7	1.000	1.000	1.000	1.000
3–4	1.308 (0.476–3.591)	1.370 (0.444–4.225)	1.372 (0.853–2.208)	1.418 (0.763–2.637)
≤ 2	1.436 (0.702–2.938)	1.313 (0.571–3.023)	1.436 (0.982–2.099)	1.104 (0.640–1.904)
Lunch frequency (times/wk)				
5–7	1.000	1.000	1.000	1.000
3–4	1.952 (0.737–5.167)	1.832 (0.622–5.393)	2.959 (1.675–5.229)	3.143 (1.725–5.728)
≤ 2	1.529 (0.352–6.650)	0.762 (0.197–2.951)	3.734 (1.814–7.685)	3.195 (1.326–7.697)
Dinner frequency (times/wk)				
5–7	1.000	1.000	1.000	1.000
3–4	0.896 (0.234–3.424)	0.564 (0.169–1.885)	2.171 (1.300–3.625)	1.957 (1.099–3.483)
≤ 2	1.454 (0.199–10.625)	0.846 (0.052–13.662)	1.621 (0.639–4.109)	1.648 (0.555–4.890)
Food security				
Very good	1.000	1.000	1.000	1.000
Good	1.054 (0.521–2.131)	0.816 (0.416–1.601)	1.917 (1.253–2.932)	1.535 (0.985–2.390)
Poor	10.045 (3.710–27.195)	2.591 (0.458–14.646)	3.882 (1.578–9.549)	1.709 (0.638–4.581)

[1)Model 1: crude model. [2)Model 2: adjusted model, men: age, occupation, household income, body mass index, subjective health status, and energy intake; women: age, education, residential area, occupation, household income, smoking, family size, subjective health status, and energy intake.

These findings are in line with previous findings reported by Jung and Kim [14], suggesting that the prevalence of depression was higher in men, low income individuals, unmarried individuals, and those with the highest drinking frequency than in women, high income individuals, and married individuals. In this study, individuals with poor subjective health were found to have an extremely high prevalence of depression (8.5% for men and 14.7% for women). Overall, these findings are in accordance with previous findings by Ambresin et al. [19] that the risk of developing depression within 5 years is high in the poor subjective health group. Depression is largely affected by various social and economic factors, and it seems that women are particularly affected by more factors than men.

The association between depression and eating behavior has been found to be different between men and women. In men, a high prevalence of depression was shown only in eating lunch alone and skipping lunch. In contrast, the prevalence of depression in women varied according to eating patterns of breakfast, lunch, dinner, diet frequency per day, eating alone

frequency, frequency of lunch, and dinner; particularly, the prevalence of depression was extremely high in individuals who skip lunch. Additionally, lunch frequency of 1–2 times per week and 3–4 times per week had a high prevalence of depression.

Similar to the results of this study, Ju and Park [20] reported that, in adults aged > 19 years, there was a high rate of skipping lunch in the depression group compared to the non-depression group. Song et al. [21] reported that the prevalence of depression was 10.7% for eating alone compared to 5.2% for eating together. Moreover, Jung and Kim [14] reported that the frequency of breakfast in adults did not show a difference in the prevalence of depression, and that the prevalence of depression was 6.2% for eating alone compared to 3.2% for eating together. These findings were in agreement with the previous reports by Torres et al. [22], indicating that more severe depression encourages eating alone more and less appetite.

Jung and Kim [14] indicated that eating together with family or others counts more for breakfast eaters rather than breakfast frequency. The greatest risk factor for depression is living with family yet eating alone, and eating together increases emotional intimacy, while lack of communication at mealtimes could cause loneliness and depressed mood [11,23]. Our findings has shown that highly depressed women practice unhealthy eating, such as eating alone or meal skipping in all 3 meals a day, and it seems that dietary management is required more in women with depression.

Alaimo et al. [24] suggested that food insecurity is one of the factors that not only triggers but also continues gloomy feelings. Food insecurity results in emotional insecurity and worsening gloomy feelings. Similarly, this study has shown that poor food security causes a extremely high prevalence of depression in both men (17.1%) and women (12.7%); however, without influential variables, there seems to be no association between food insecurity and risk of depression. Therefore, it seems that food insecurity itself has no direct impact on depression or, rather, depression is associated with food insecurity affected by occupation and income level.

In this study, adjustments were made to several variables affecting the prevalence of depression to examine the participants' nutrient intake, and it showed that no difference was found in energy intake and proper nutrient-to-energy ratios. However, intakes of phosphorus and potassium and nutrient density of potassium and vitamin A were significantly low in men with depression, and phosphorus intake was significantly low in women with depression.

Several studies reporting the association between depression and nutrient intake showed that the vitamin B group, including folic acid [25,26], vitamin D [27], essential fatty acid [28], minerals (zinc, magnesium, selenium) [29,30], carotene, dietary fibers, and vitamin C [31], have effects on the symptoms of depression. In addition, Park et al. [32] reported that overall nutrient intake, including phosphorus, potassium, and vitamin A, was lower in individuals with depression than in those without depression, although there were some differences according to sex and age.

Women with depression are at risk of deficiency in vitamins and minerals due to irregular mealtime, and dietary management is required because continued unhealthy eating, such as overeating, binge eating after meal skipping, and eating alone, may result in malnutrition. Logistic regression analysis was used to identify the association between depression

and eating behavior. The results demonstrated that factors significantly associated with depression, such as eating lunch alone, eating alone 3 times a day, and poor food security, showed no association with the risk of depression after adjusting for influential variables. In women, even with variable adjustment, there was a significant increase in the risk of depression: 2.7 times by skipping lunch, 1.7 times by 2 meals a day, 3.1 times by lunch frequency of 3–4 times per week, 3.2 times by lunch frequency of ≤ 2 times per week, and double by dinner frequency of 3–4 times per week. This result indicates that lunch and dinner frequency and lunch skipping are associated with depression. In their study on nutritional status and mental health in the breakfast and dinner skipping groups in young women. Yi et al. [33] voiced concerns about the mental health of the dinner skipping group.

Meanwhile, in this study, there was no association between depression and eating alone. However, in the study of Ahn and Park [34] on the association between the daily frequency of eating alone and depression in adults, based on eating together, the prevalence of depression is 3 times higher when eating alone 3 times a day. Song et al. [21] reported that eating dinner alone was more associated with depression in men than in women. The difference in these results is believed to be due to differences in the study subjects' inclusion of those who were not eating dinner, differences in various factors related to depression in men and women used for adjustment, and differences in the study year. Further research is needed on this topic.

Taken together, depression is more prevalent in women than in men, and women's depression is affected by more social and economic variables and associated with decreased frequency of lunch and dinner, particularly highly associated with lunch skipping. Lee and Kim [35] suggested that food opportunities should be expanded through snacks and eating out in individuals with depression so that they can have access to foods they want according to their emotional status and condition. Lee et al. [36] suggested that skipping breakfast increased the risk of stress and depressive mood in adolescents and skipping meals more than once per day increased the risk of mental health problems, stress, depressive mood, and suicidal ideation in adolescents. Individuals with depression have poor appetite, skip meals, eat alone, and have worsened dietary lifestyles. Thus, they need to be educated to eat healthy and provided more opportunities to consume various foods by eating together as often as possible with family and co-workers. In combination with dietary education for individuals with depression, their caregivers should also be given dietary guidance and encouraged to practice healthy eating. As depression is highly associated with demographic characteristics, it is necessary to improve not only dietary habits but also the surrounding environment of each individual to decrease the symptoms of depression. The abovementioned results could be used as basic data for dietary guidelines to prevent and manage depression. Hence, active and effective interventions, such as systematic nutrition education, counseling, and meal provision, are necessary for the regular eating habits of individuals with depression and prevention of skipping meals.

The significance of this study lies in the use of the latest updates from the representative KNHANES to investigate depression in Korean men and women and its associations with their dietary habits. However, the sample size for depression status was limited, and the actual prevalence of depression might not have been properly reflected because the depression data were obtained through self-administered questionnaires. Nonetheless, the findings of this study can be generalized because they were obtained from a large number of samples, and this study has its significance in suggesting the association between depression and eating behavior of adults by adjusting confounders affecting depression.

SUMMARY

This study focused on identifying the association between eating behavior and depression in men and women using the 7th KNHANES 2018. The prevalence of depression in men and women was 2.8% and 5.5%, respectively. A higher prevalence of depression was observed in both men and women with unemployment, lower income, and poorer subjective health. The prevalence of depression was higher in women with lower education levels, who were unmarried, who were smokers, and with one-person households. Men with obesity showed a higher prevalence of depression. Men who were eating alone or skipping lunch had a high prevalence of depression, while women who were eating breakfast, lunch, and dinner alone had a high prevalence of depression. The relationship analysis between men and women according to dietary habits using logistic regression showed that, in women, after variable adjustment, skipping lunch (OR, 2.677), diet frequency of 2 times per day (OR, 1.658), and lunch frequency of 3–4 times per week in terms of meal frequency (OR, 3.143) were significantly associated with a higher prevalence of depression. In conclusion, women's depression was not only affected by more sociodemographic variables but also associated with decreased frequency of lunch and dinner, especially with skipping lunch. Therefore, the results of the study suggest that individuals with depression should be encouraged to pay attention to their diet and eat healthy.

REFERENCES

1. Gray H. Work and depression in economic organizations: the need for action. Dev Learn Organ 2008; 2(3): 9-11.
   CROSSREF

2. Chesney E, Goodwin GM, Fazel S. Risks of all-cause and suicide mortality in mental disorders: a meta-review. World Psychiatry 2014; 13(2): 153-160.
   PUBMED | **CROSSREF**

3. Charlson F, van Ommeren M, Flaxman A, Cornett J, Whiteford H, Saxena S. New WHO prevalence estimates of mental disorders in conflict settings: a systematic review and meta-analysis. Lancet 2019; 394(10194): 240-248.
   PUBMED | **CROSSREF**

4. World Health Organization. Mental health of older adults. Geneva: World Health Organization; 2017.

5. Yoon GA. Contribution of food behavior and psychological factors to perceived tiredness in adolescents. Korean J Nutr 2001; 34(1): 89-97.

6. Paans NPG, Gibson-Smith D, Bot M, van Strien T, Brouwer IA, Visser M, et al. Depression and eating styles are independently associated with dietary intake. Appetite 2019; 134: 103-110.
   PUBMED | **CROSSREF**

7. Lai JS, Hiles S, Bisquera A, Hure AJ, McEvoy M, Attia J. A systematic review and meta-analysis of dietary patterns and depression in community-dwelling adults. Am J Clin Nutr 2014; 99(1): 181-197.
   PUBMED | **CROSSREF**

8. Whitaker KM, Sharpe PA, Wilcox S, Hutto BE. Depressive symptoms are associated with dietary intake but not physical activity among overweight and obese women from disadvantaged neighborhoods. Nutr Res 2014; 34(4):294-301.
   PUBMED | **CROSSREF**

9. Jeffery RW, Linde JA, Simon GE, Ludman EJ, Rohde P, Ichikawa LE, et al. Reported food choices in older women in relation to body mass index and depressive symptoms. Appetite 2009; 52(1): 238-240.
   PUBMED | **CROSSREF**

10. Park JE, Kim SJ, Choue R. Study on stress, depression, binge eating, and food behavior of high school girls based on their BMI. Korean J Community Nutr 2009; 14(2): 175-181.

11. Kuroda A, Tanaka T, Hirano H, Ohara Y, Kikutani T, Furuya H, et al. Eating alone as social disengagement is strongly associated with depressive symptoms in Japanese community-dwelling older adults. J Am Med Dir Assoc 2015; 16(7): 578-585.
    PUBMED | **CROSSREF**

12. Oh JS, Kim JS, Lee BM, Lee SK, Chung MY. A comparative study on obesity-related eating habits and lifestyle behaviors of depressed and normal middle-aged female in Korea. Korean J Aesthet Cosmetol 2013; 11(2): 231-238.

13. Seo YB, Han AL, Shin SR. The association of health related quality of life and depression between obesity in Korean population. J Health Inform Stat 2019; 44(2): 117-124.
CROSSREF

14. Jung SH, Kim JH. The relationship between eating breakfast with someone and depression: based on Korean National Health and Nutrition Survey (2016). Health Soc Welf Rev 2019; 39(2): 580-601.
CROSSREF

15. Korean Center for Disease Control and Prevention. Guideline for the evaluation of the 7th Korea National Health and Nutrition Survey. Cheongju: Korean Center for Disease Control and Prevention; 2018.

16. Han C, Jo SA, Kwak JH, Pae CU, Steffens D, Jo I, et al. Validation of the Patient Health Questionnaire-9 Korean version in the elderly population: the Ansan Geriatric study. Compr Psychiatry 2008; 49(2): 218-223.
PUBMED | CROSSREF

17. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med 2001; 16(9): 606-613.
PUBMED | CROSSREF

18. National Rural Resources Development Institute. Korean food composition table, 8th ed. Jeonju: Rural Development Administration; 2011.

19. Ambresin G, Chondros P, Dowrick C, Herrman H, Gunn JM. Self-rated health and long-term prognosis of depression. Ann Fam Med 2014; 12(1): 57-65.
PUBMED | CROSSREF

20. Ju SY, Park YK. Low fruit and vegetable intake is associated with depression among Korean adults in data from the 2014 Korea National Health and Nutrition Examination Survey. J Health Popul Nutr 2019; 38(1): 39-48.
PUBMED | CROSSREF

21. Song EG, Yoon YS, Yang YJ, Lee ES, Lee JH, Lee JY, et al. Factors associated with eating alone in Korean adults: findings from the sixth Korea National Health and Nutrition Examination Survey, 2014. Korean J Fam Pract 2017; 7(5): 698-706.
CROSSREF

22. Torres SJ, McCabe M, Nowson CA. Depression, nutritional risk and eating behaviour in older caregivers. J Nutr Health Aging 2010; 14(6): 442-448.
PUBMED | CROSSREF

23. Kimura Y, Wada T, Okumiya K, Ishimoto Y, Fukutomi E, Kasahara Y, et al. Eating alone among community-dwelling Japanese elderly: association with depression and food diversity. J Nutr Health Aging 2012; 16(8): 728-731.
PUBMED | CROSSREF

24. Alaimo K, Olson CM, Frongillo EA. Family food insufficiency, but not low family income, is positively associated with dysthymia and suicide symptoms in adolescents. J Nutr 2002; 132(4): 719-725.
PUBMED | CROSSREF

25. Tolmunen T, Voutilainen S, Hintikka J, Rissanen T, Tanskanen A, Viinamäki H, et al. Dietary folate and depressive symptoms are associated in middle-aged Finnish men. J Nutr 2003; 133(10): 3233-3236.
PUBMED | CROSSREF

26. Mikkelsen K, Stojanovska L, Apostolopoulos V. The effects of vitamin B in depression. Curr Med Chem 2016; 23(38): 4317-4337.
PUBMED | CROSSREF

27. Penckofer S, Kouba J, Byrn M, Estwing Ferrans C. Vitamin D and depression: where is all the sunshine? Issues Ment Health Nurs 2010; 31(6): 385-393.
PUBMED | CROSSREF

28. Bruinsma KA, Taren DL. Dieting, essential fatty acid intake, and depression. Nutr Rev 2000; 58(4): 98-108.
PUBMED | CROSSREF

29. Wang J, Um P, Dickerman B, Liu J. Zinc, Magnesium, selenium and depression: a review of the evidence, potential mechanisms and implications. Nutrients 2018; 10(5): 584-602.
CROSSREF

30. Murakami K, Sasaki S. Dietary intake and depressive symptoms: a systematic review of observational studies. Mol Nutr Food Res 2010; 54(4): 471-488.
PUBMED | CROSSREF

31. Park SY, Han AL, Shin SR, Eo JE. Relationship between dietary intake and depression among Korean adults: Korea National Health and Nutrition Examination Survey 2014. Korean J Fam Pract 2019; 9(2): 139-146.
CROSSREF

32. Park HR, Youn HJ, Lee JH. Study on the relationship between the nutrient intake and level of depressive symptoms - using the data from the Korea National Health and Nutrition Examination Survey 2016 -. J Korean Diet Assoc 2018; 24(4): 283-297.

33. Yi YH, Kim YJ, Lee SY, Lee JG, Jeong DW, Cho YH, et al. The correlation of meal frequency and nutrition with mental health status in women aged 20–39 years: the 5th Korea National Health and Nutrition Examination Survey, 2010–2012. Korean J Obes 2015; 24(2): 101-107.
   CROSSREF

34. Ahn JH, Park YK. Frequency of eating alone and health related outcomes in Korean adults: based on the 2016 Korea National Health and Nutrition Examination Survey. J Korean Diet Assoc 2020; 26(2): 85-100.

35. Lee JW, Kim SA. A comparative study on eating habits and eating attitude of depressed and normal adults: based on 2008 Korean National Health and Nutrition Examination Survey. Korean J Community Nutr 2011; 16(5): 548-558.
   CROSSREF

36. Lee G, Han K, Kim H. Risk of mental health problems in adolescents skipping meals: The Korean National Health and Nutrition Examination Survey 2010 to 2012. Nurs Outlook 2017; 65(4): 411-419.
   PUBMED | CROSSREF