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ORIGINAL ARTICLE

Depression among Korean Adults with Type 2 Diabetes Mellitus: Ansan-Community-Based Epidemiological Study

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Abstract
Objectives: There are an increasing number of studies being carried out on depression in patients with diabetes. Individuals with diabetes have been reported as having a higher prevalence of depression compared to those without diabetes. However, only a few studies involving Korean patients have been conducted. The aims of this study were to examine the prevalence of depression and to find various risk factors according to the degree of depression among Korean patients with Type 2 diabetes mellitus (T2DM).
Methods: An Ansan-community-based epidemiological study was conducted from 2005 to 2012. The total number of participants in this study was 3,540, from which patients with diabetes ($n = 753$) have been selected. The presence of depression was evaluated using the Beck Depression Inventory total score.
Results: The prevalence of depression was 28.8%. The mean age of participants was 55.5 ± 8.2 years. We divided the participants into three groups (without-depression, moderate-depression, and severe-depression groups) to examine the depression prevalence among Korean T2DM patients. The unemployed participants had 2.40 [95% confidence interval (CI) 1.21–4.76], the low-income participants had 2.57 (95% CI 1.52–4.35), the participants using an oral diabetes medicine or insulin had 2.03 (95% CI 1.25–3.32), the participants who are currently smoking had 2.03 (95% CI 1.10–3.73), and those without regular exercise had 1.91 (95% CI 1.17–3.14) times higher odds of depression in the severe-depression group, compared with the without-depression group.

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Conclusion: There was a significant association between depression prevalence and diabetes, and we found various risk factors according to the degree of depression in Korean patients with T2DM.

1. Introduction

The World Health Organization has reported that about 350 million people have depression, and about one million people with depression worldwide commit suicide every year. Also, according to the latest cause-of-death statistics (2013) released by the National Statistical Office of Korea, 14,427 out of every 10 million deaths in Korea are attributable to suicide. Suicide is the fourth leading cause of death in Korea [1].

In the Sixth Korea National Health and Nutrition Examination Survey (2013), among people more than 19 years of age, 10.7% (men 6.6%, women 13.7%) experienced depression continuously for more than 2 weeks in a year (Korea age, standardization) [2]. It can be seen that women feel more depressed than men. A history of depression, a family history of depression, a major disease occurrence before the age of 40 years, postmenopausal status [3], body mass index, serum-protein concentration, hemoglobin concentration, smoking, exercise [4], and marital status in the elderly [5] have all been reported as risk factors for depression. Glycated hemoglobin (HbA1c), erectile dysfunction, blood pressure, and waist-to-hip ratio [6] have been reported to be relevant.

In recent years, studies on depression of patients with diabetes have been actively proceeding [7]. Individuals with diabetes have been reported as having a higher prevalence of depression compared to those without the condition. The prevalence of depression in people with diabetes is higher in women [8,9], unmarried people [5], those with more children [10], and those with low vitamin B6 [11,12]. Also, patients with both depression and diabetes have low adherence to diet and exercise instructions, which may contribute to the worsening of their quality of life and the deterioration of their diabetes [13]. One-third of individuals with their first diabetic foot ulcer suffer from clinical depression, and this has been reported to be associated with increased mortality [14]. Diabetes mellitus is also related to childhood obesity [15] and change of lifestyle in the middle-aged and the elderly in Korea [16,17] with metabolic change [18].

It has been reported that other factors affecting depression in a diabetic patient include age, body mass index, drug increases, neurological disease, retinopathy, sexual dysfunction [19], microvascular and macrovascular complications [20], incident end-stage renal disease [21], and systemic inflammation [10].

There are many previous studies on depression among participants with diabetes. However, studies for the Korean population [8,22] are rare. The aims of this study were to examine the prevalence of depression and to find various risk factors according to the degree of depression in patients with Type 2 diabetes mellitus (T2DM), especially Koreans.

2. Materials and methods

2.1. Study participants

An Ansan-community-based epidemiological study has been conducted by the Korea National Institute of Health. The participants were selected to reflect the gender and age of the Korean population after randomly extracting 40- to 69-year-old residents in Ansan City. The total number of participants from 2005 to 2012 was 3,540. Patients without diabetes and patients who did not respond to the depression survey items were excluded from the study. Therefore, the total number of study participants was reduced to 753.

2.2. Depression assessment tool

The presence of depression was evaluated using the Beck Depression Inventory (BDI) total score. The BDI, which measures the emotional, cognitive, motivational, and physiological items, is one of the most widely used measures of depression. The instrument consists of 21 items, and the score, which determines the possible degree of depression, ranges from 0 to 63. Higher scores indicate greater depression. There are many opinions regarding the most appropriate cutoff points. In the West, a score of 15 or more is generally considered to indicate depression. However, cutoff points from 16 to 21 may be more appropriate in other populations, including Koreans, because research has shown that the average value of the BDI is higher in these populations than in Westerners [23].

The Depression Clinical Research Center, specified by the Ministry of Health & Welfare, classifies BDI scores as follows: “nondepressed state: 0−9; mild depressive state: 10−15; moderate depressive state: 16−23; and severe depressive state: 24−63.”

The BDI was translated by Lee and Song [24], and it has been used in a number of papers [25−28] with cutoff scores of $\geq$16. Therefore, we used the most commonly used cutoff score for BDI of $\geq$16 to indicate clinical depression.

2.3. Definitions for diagnosing diabetes mellitus

The presence of T2DM is defined as fasting plasma glucose ≥126 mg/dL (7.0 mmol/L) or 2-hour plasma glucose ≥200 mg/dL (11.1 mmol/L), or HbA1c ≥ 6.5% [29]. These criteria are consistent with the Standards of Medical Care in Diabetes of the American Diabetes Association [30].

2.4. Other covariates

The clinical-examination items: low-density-lipoprotein (LDL) cholesterol, lifestyle-related items: alcohol consumption, smoking, and current exercise, and anthropometric-related items: obesity, abdominal obesity, etc., were selected for the analysis.

The cutoff point of the calculated LDL cholesterol [total cholesterol − high-density lipids − (0.2 × triglyceride)] was 130 mg/dL (Korea Society of Lipidology and Atherosclerosis, 2012).

As the minimum cost of living based on a four-person household in 2006 was 1.2 million won (through the announcement of the Department of Health and Human Services, 2006), low income was determined to be < 1.5 million won (the interval containing the 1.2 million won).

The obesity criterion was based on body mass index, ≥25 kg/m^2 is defined as Overweight or more (World Health Organization, 2000). The abdominal-obesity criterion was based on waist circumference: women ≥85 cm and men ≥90 cm [31,32].

2.5. Statistical analyses

Statistical analyses were performed with the aid of SAS software (version 9.3; SAS Institute). The dependent variable was the BDI total score. Statistical comparisons of general-characteristic variables between the without depression (16 < BDI) and with depression [moderate depression (16 ≤ BDI < 24), severe depression (BDI ≥ 24)] were conducted using Chi-square tests for categorical variables and the Kruskal−Wallis test for continuous variables comparing the three groups of participants. Also, according to the depressed state, the participants were divided into three groups, and an ordinal multiple logistic regressions analysis was performed for the three group comparisons. All tests were two tailed, with $p < 0.05$ considered to indicate statistical significance.

3. Results

Table 1 shows the general characteristics and the depression prevalence of the study participants with T2DM (n = 753). Of these participants, 28.82% had depression. The mean age of the participants analyzed was 55.48 ± 8.22 [without depression (54.77 ± 7.84) vs. with depression (57.22 ± 8.87)].

We divided participants into three groups [without depression (16 < BDI), moderate depression (16 ≤ BDI < 24), severe depression (BDI ≥ 24)] to determine the depression prevalence of the study participants with T2DM.

Depression (BDI score ≥16) was more prevalent in women than in men (p = 0.003), and in unmarried people than in married people (p = 0.006). Also, the prevalence of depression was higher in the lower-monthly-income participants ($p < 0.001$), in the lower-level-of-education participants ($p < 0.001$), in 60 years or older participants (p = 0.023), in people who are taking medicines for diabetes ($p < 0.001$), in people who are currently smoking (p = 0.082), in patients without regular exercise ($p < 0.001$), in patients with HbA1c ≥ 0.5 (p = 0.004), and in postmenopausal women ($p < 0.001$). The p between depression and dietary patterns is as follows: vitamin B6 ($p < 0.001$), vitamin B2 (p = 0.001), fiber ($p < 0.001$), and folate ($p < 0.001$).

In Table 2, the demographic-characteristic odds ratios (ORs) for the 753 participants with T2DM are summarized.

The participants with severe depression were women [OR 2.10, 95% confidence interval (CI) 1.33−3.32], 60 years or older people (OR 1.98, 95% CI 1.12−3.53), married people (OR 2.58, 95% CI 1.38−4.83), jobless people (OR 3.36, 95% CI 1.81−6.25), low-income participants (OR 3.65, 95% CI 2.29−5.84), people with low education level (OR 2.77, 95% CI 1.74−4.41), people using an oral diabetes medicine or insulin (OR 2.32, 95% CI 1.46−3.67), people who are currently smoking (OR 1.65, 95% CI 1.06−2.57), people who exercise regularly (OR 2.19, 95% CI 1.36−3.52), people with HbA1c ≥ 6.5 (OR 1.89, 95% CI 1.19−2.98), and menstrual status (in women) (OR 3.75, 95% CI 1.42−9.93). The ORs for the participants with severe depression linked to dietary patterns (adjusted gender and age) are vitamin B6 = 0.53 (95% CI 0.32−0.89), vitamin B2 = 0.46 (95% CI 0.22−0.93), fiber = 0.85 (95% CI 0.76−0.96), and folate = 0.996 (95% CI 0.993−0.999).

Table 3 shows the risk factors associated with depression among the participants with diabetes. To study depression among Korean Adults with T2DM, an adjusted variables were gender, age, marital status, current job status, monthly income, education duration, diabetes duration, medicine use, current drinking status, current smoking status, regular exercise, obesity, hypertension and HbA1c, comorbid chronic diseases (ordinal multivariate analysis according to the depression status), vitamin B6, vitamin B2, fiber, and folate.

The low-income participants had 2.07 (95% CI 1.23−3.48) times higher odds of depression in the moderate-depression group and 2.46 (95% CI 1.35−4.46) times in the severe-depression group than the without-depression group.

Table 1. General characteristics and the depression prevalence of study participants with Type 2 diabetes mellitus ($n = 753$).

Characteristics	Without depression 16 < BDI, *N* (%)	Moderate depression 16 ≤ BDI < 24, *N* (%)	Severe depression BDI≥24, *N* (%)	*p**
Overall	536 (71.18)	130 (17.26)	87 (11.55)	
Gender				
Male	332 (75.28)	71 (16.10)	38 (08.62)	0.003
Female	204 (65.38)	59 (18.91)	49 (15.71)	
Age (y)				
43−49	171 (73.71)	40 (17.24)	21 (09.05)	0.023
50−59	209 (75.72)	39 (14.13)	28 (10.14)	
60−73	156 (63.67)	51 (20.82)	38 (15.51)	
Marital status				
Married	493 (72.82)	113 (16.69)	71 (10.49)	0.006
Single/divorced/widowed	43 (56.58)	17 (22.37)	16 (21.05)	
Current job status				
Nonphysical labor	178 (82.79)	23 (10.70)	14 (06.51)	<0.001
Physical labor	150 (73.53)	36 (17.65)	18 (08.82)	
No occupation	208 (62.28)	71 (21.26)	55 (16.47)	
Monthly income				
≥1.5 million won	415 (78.01)	75 (14.10)	42 (07.89)	<0.001
<1.5 million won	119 (54.59)	55 (25.23)	44 (20.18)	
Education duration (y)				
>9	343 (76.91)	69 (15.47)	34 (07.62)	<0.001
≤9	193 (62.87)	61 (19.87)	53 (17.26)	
Diabetes duration (y)				
≤1	155 (73.11)	33 (15.57)	24 (11.32)	0.751
2−5	277 (70.66)	74 (18.88)	41 (10.46)	
6−9	50 (69.44)	11 (15.28)	11 (15.28)	
≥10	54 (71.05)	11 (14.47)	11 (14.47)	
Medicine use†				
No	387 (75.73)	78 (15.26)	46 (09.00)	<0.001
Yes	149 (61.57)	52 (21.49)	41 (16.94)	
Current drinking	285 (73.83)	64 (16.58)	37 (09.59)	0.161
Current smoking				
No	438 (72.88)	95 (15.81)	68 (11.31)	0.082
Yes	98 (64.47)	35 (23.03)	19 (12.50)	
Regular exercise				
Yes	298 (77.20)	73 (20.05)	54 (14.84)	<0.001
No	237 (65.11)	57 (14.77)	31 (08.03)	
Obesity‡	280 (72.16)	63 (16.24)	45 (11.60)	0.741
Abdominal obesity§	181 (69.62)	45 (17.31)	34 (13.08)	0.633
Hypertension (yes)	244 (68.73)	66 (18.59)	45 (12.68)	0.371
Comorbid chronic diseases‖	27 (60.00)	12 (26.67)	6 (13.33)	0.181
Glycated hemoglobin (%)				
<6.5	364 (75.21)	74 (15.29)	46 (09.50)	0.004
≥6.5	172 (63.94)	56 (20.82)	41 (15.24)	
LDL cholesterol				
<130	330 (71.43)	75 (16.23)	57 (12.34)	0.437
≥130	203 (70.73)	55 (19.16)	29 (10.10)	
Menstrual status (in women)				
Premenopausal	61 (85.92)	5 (07.04)	5 (07.04)	<0.001
Postmenopausal	143 (59.34)	54 (22.41)	44 (18.26)	
Dietary patterns¶				
Vitamin B6	1.64 ± 0.54	1.63 ± 0.49	1.44 ± 0.63	<0.001
Vitamin B2	0.98 ± 0.37	0.98 ± 0.42	0.85 ± 0.40	0.001
Fiber	6.21 ± 2.33	6.10 ± 2.07	5.33 ± 3.13	<0.001
Folate	224.48 ± 96.06	210.54 ± 80.87	188.53 ± 120.34	<0.001

*Chi-square test for categorical variables comparing three-group participants; †Use an oral diabetes medicine or insulin; ‡Defined as body mass index (calculated as weight in kilograms divided by height in meters squared) of ≥25 kg/m^2; §Defined as waist circumference (women) ≥85 cm; defined as waist circumference (men) ≥90 cm; ‖Defined as comorbid chronic diseases (cancer, kidney disease, hyperlipidemia, coronary disease, cerebrovascular diseases); ¶Values are presented as mean ± standard deviation, Kruskal−Wallis test for continuous variables comparing three-group participants. BDI = Beck Depression Inventory; LDL = low-density lipoprotein.

Table 2. Unadjusted odds ratios and 95% confidence interval for depression among participants with diabetes (n = 753).

Variable	Unadjusted odds ratio (95% confidence interval)*	
	Moderate depression†	Severe depression†
Gender		
Men	1	1
Women	1.35 (0.92−1.99)	2.10 (1.33−3.32)
Age (y)		
43−49	1	1
50−59	0.80 (0.49−1.30)	1.09 (0.60−1.99)
60−73	1.40 (0.88−2.23)	1.98 (1.12−3.53)
Marital status		
Married	1	1
Single/divorced/ widowed	1.73 (0.95−3.14)	2.58 (1.38−4.83)
Current job status		
Nonphysical labor	1	1
Physical labor	1.86 (1.05−3.27)	1.53 (0.73−3.17)
No occupation	2.64 (1.59−4.40)	3.36 (1.81−6.25)
Monthly income		
≥1.5 million won	1	1
<1.5 million won	2.56 (1.71−3.83)	3.65 (2.29−5.84)
Education duration (y)		
>9	1	1
≤9	1.57 (1.07−2.31)	2.77 (1.74−4.41)
Diabetes duration (y)		
≤1	1	1
2−5	1.26 (0.80−1.98)	0.96 (0.56−1.64)
6−9	1.03 (0.49−2.19)	1.42 (0.65−3.11)
≥10	0.96 (0.45−2.02)	1.32 (0.60−2.87)
Medicine use‡		
No	1	1
Yes	1.73 (1.16−2.58)	2.32 (1.46−3.67)
Current drinking		
No drinking	1	1
Current drinking	0.85 (0.58−1.25)	0.65 (0.41−1.03)
Current smoking		
No smoking	1	1
Current smoking	1.25 (0.72−2.17)	1.65 (1.06−2.57)
Regular exercise		
Yes	1	1
No	1.65 (1.10−2.37)	2.19 (1.36−3.52)
Obesity§		
Normal	1	1
Abnormal	0.86 (0.59−1.26)	0.98 (0.62−1.54)
Abdominal obesity‖		
Normal	1	1
Abnormal	1.05 (0.70−1.57)	1.26 (0.79−2.00)
Hypertension		
No	1	1
Yes	1.23 (0.84−1.81)	1.28 (0.82−2.02)
Comorbid chronic diseases¶		
No	1	1
Yes	1.92 (0.94−3.90)	1.40 (0.56−3.49)
Glycated hemoglobin (%)		
<6.5	1	1
≥6.5	1.60 (1.08−2.37)	1.89 (1.19−2.98)
Menstrual status(in women)		
Premenopausal	1	1

Table 2 (*Continued*)

Variable	Unadjusted odds ratio (95% confidence interval)*	
	Moderate depression†	Severe depression†
Postmenopausal	4.61 (1.76−12.07)	3.75 (1.42−9.93)
Dietary patterns**		
Vitamin B6	1.09 (0.76−1.55)	0.53 (0.32−0.89)
Vitamin B2	1.18 (0.71−1.96)	0.46 (0.22−0.93)
Fiber	1.00 (0.92−1.08)	0.85 (0.76−0.96)
Folate	1.00 (1.00−1.00)	1.00 (0.99−1.00)

*Ordinal logistic analysis according to the depression status compared to nondepression; †Nondepression <16, 16 ≤ moderate depression < 24, severe depression ≥24; ‡Using an oral diabetes medicine or insulin; §Defined as body mass index (calculated as weight in kilograms divided by height in meters squared) of ≥25 kg/m^2; ‖Defined as waist circumference (women) ≥85 cm; defined as waist circumference (men) ≥90 cm; ¶Defined as comorbid chronic diseases (cancer, kidney disease, hyperlipidemia, coronary disease, cerebrovascular diseases); **Adjusted gender, age.

The participants that were being treated with an oral diabetes medicine or insulin had 2.05 (95% CI 1.18−3.55) times higher odds of depression in the moderate-depression group and 2.20 (95% CI 1.13−4.29) times in the severe-depression group than the without-depression group.

Current smokers had 2.40 (95% CI 1.38−4.17) times higher odds of depression in the moderate-depression group and 2.46 (95% CI 1.23−4.90) times in the severe-depression group than the without-depression group.

Those without regular exercise had 1.70 (1.02−2.82) times higher odds of depression in the severe-depression group than the without-depression group.

4. Discussion

The causal relationship between diabetes and depression is controversial, but the high prevalence of depression in diabetic patients has been established in various studies. Therefore, a study to examine the prevalence of depression in Korean diabetic patients was conducted. As there are only a few studies involving Korean diabetic patients, it can be said that this study is worthy.

Many studies have reported a prevalence rate of depression among adult diabetic patients ranging from 3.8% to 41.3% [33−38], and the result (28.82%) of this study is within that range.

The assessment tools for depression used in other studies include the Geriatric Depression Scale [39], Patient Health Questionnaire-2 [8], Epidemiologic Studies Depression Scale [40], Center for Epidemiological Studies-Depression Scale, Hospital Anxiety and Depression Scale, Composite International Diagnostic Interview, Hamilton Depression Rating Scale, and Patient Health Questionnaire-9 [9,20,36,38]. Here, we used BDI because the assessment methods are easy to do and, due to its high objectivity, BDI is considered the most commonly used assessment tool for depression.

In some studies, LDL cholesterol, obesity [41], and diabetes duration significantly influenced depression, but that was not the case in this study. It seems that the ages of the participants were limited to 43−73 years, and diabetes duration was slightly shorter with 4.02 ± 4.60 years.

Also, comorbid chronic diseases (cancer, kidney disease, hyperlipidemia, coronary disease, and cerebrovascular diseases) were not significant in this study. The number of patients with these diseases seems too few.

The depression and dietary patterns of the diabetic group were studied based on a total of 21 nutrients by adjusting the gender and age. The results show that vitamin B6, vitamin B2, and fiber were found to be significant. Vitamin B6 is a material involved in neurotransmitter synthesis, immune metabolism, and lipid metabolism, and it has been reported in some studies that vitamin B6 deficiency is associated with depression [11,12]. Vitamin B2 enhances the immune system. To our knowledge, no studies have been conducted to show the relationship between depression and vitamin B2 deficiency. This could be a topic of future studies.

The incidence of smoking worldwide is currently high. In this study, the relationship between smoking and severe depression, as well as between the lack of exercise and severe depression, has been established.

The strengths of this study are as follows. (1) Through a review of several papers, items related to depression in the diabetic group have been identified. In particular, using the dietary patterns for the Koreans, there was not study depression in the diabetic group. (2) Study analyses were carried out by dividing participants into three groups to review in detail the risk factors of depression by depression degree. As a result, we found that more severe depression was linked to greater the exposure to risk factors.

The limitations of this study are as follows: (1) this is a cross-sectional study, in which the reason for the causal relationship is difficult to establish; and (2) the study was limited to the Ansan City area. However, participants may be representative of the Korean population because the sampling in Ansan reflects the ratio of the gender and age of the general population.

Table 3. Risk factors associated with depression among participants with diabetes ($n = 753$).

Variable	Adjusted odds ratio (95% confidence interval)*	
	Moderate depression†	Severe depression†
Gender		
Men	1	1
Women	1.25 (0.69−2.26)	1.36 (0.68−2.73)
Age (y)		
43−49	1	1
50−59	0.80 (0.47−1.36)	0.89 (0.46−1.72)
60−73	0.84 (0.45−1.55)	0.67 (0.31−1.45)
Marital status		
Married	1	1
Single/divorced/ widowed	0.85 (0.41−1.77)	1.14 (0.53−2.43)
Current job status		
Nonphysical labor	1	1
Physical labor	1.55 (0.84−2.86)	1.22 (0.56−2.65)
No occupation	2.31 (1.17−4.54)	1.95 (0.87−4.36)
Monthly income		
≥1.5 million won	1	1
<1.5 million won	2.07 (1.23−3.48)	2.46 (1.35−4.46)
Education duration (y)		
>9	1	1
≤9	1.04 (0.64−1.69)	1.62 (0.91−2.89)
Diabetes duration (y)		
≤1	1	1
2−5	0.89 (0.53−1.49)	0.67 (0.35−1.29)
6−9	0.46 (0.18−1.18)	0.61 (0.22−1.72)
≥10	0.33 (0.12−0.87)	0.42 (0.14−1.24)
Medicine use‡		
No	1	1
Yes	2.05 (1.18−3.55)	2.20 (1.13−4.29)
Current drinking		
No drinking	1	1
Current drinking	0.97 (0.59−1.59)	0.99 (0.551.78)
Current smoking		
No smoking	1	1
Current smoking	2.40 (1.384.17)	2.46 (1.23−4.90)
Regular exercise		
Yes	1	1
No	1.46 (0.96−2.23)	1.70 (1.02−2.82)
Obesity§		
Normal	1	1
Abnormal	0.77 (0.50−1.19)	0.89 (0.53−1.48)
Abdominal obesity‖		
Normal	1	1
Abnormal	0.98 (0.57−1.70)	1.01 (0.52−1.99)
Hypertension		
No	1	1
Yes	1.15 (0.74−1.78)	1.05 (0.63−1.77)
Comorbid chronic diseases¶		
No	1	1
Yes	1.50 (0.68−3.29)	0.88 (0.30−2.53)
Glycated hemoglobin (%)		
<6.5	1	1
≥6.5	1.38 (0.84−2.27)	1.68 (0.93−3.01)
Dietary patterns		
Vitamin B6	1.85 (0.64−5.39)	1.04 (0.28−3.92)

Table 3 (*Continued*)

Variable	Adjusted odds ratio (95% confidence interval)*	
	Moderate depression†	Severe depression†
Vitamin B2	1.90 (0.74−4.89)	1.11 (0.32−3.83)
Fiber	1.13 (0.91−1.42)	0.89 (0.67−1.19)
Folate	0.99 (0.99−1.00)	1.00 (0.99−1.01)

*Ordinal logistic analysis according to the depression status compared to nondepression. Adjustment for gender, age, marital status, current job status, monthly income, education duration, diabetes duration, medicine use, current drinking, current smoking, regular exercise, obesity, hypertension and glycated hemoglobin, comorbid chronic diseases (ordinal multivariate analysis according to the depression status), vitamin B_6, vitamin B_2, fiber, and folate; †Nondepression <16, 16 ≤ moderate depression < 24, severe depression ≥24; ‡Using an oral diabetes medicine or insulin; §Defined as body mass index (calculated as weight in kilograms divided by height in meters squared) of ≥25 kg/m^2; ‖Defined as waist circumference (women) ≥ 85 cm; defined as waist circumference (men) ≥ 90 cm; ¶Defined as comorbid chronic diseases (cancer, kidney disease, hyperlipidemia, coronary disease, cerebrovascular diseases).

In conclusion, when adjustments have been made for gender, age, marital status, current job status, monthly income, education duration, diabetes duration, medicine use, current drinking status, current smoking status, regular exercise, obesity, hypertension and HbA1c, comorbid chronic diseases (ordinal multiple logistic regression analysis according to the depression status), vitamin B6, vitamin B2, fiber, and folate, the risk factors of depression among adult diabetic patients were found to be: no occupation, low income, current smoking, oral diabetes medicine or insulin use, and without regular exercise. These results are similar to the findings of other studies.

According to previous studies, diabetes can cause an increase in the level of depression. Also, an increased level of depression promotes neglect of diabetes treatment. Because diabetes is a serious disease requiring lifelong management, avoiding depression is particularly important for people with diabetes [13].

In the future, depression should be recognized as a social problem, and patients should be equipped with a system to actively prevent depression.

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