

Relationship between Depression and Glycated Hemoglobin: Analysis Based on the 2019 Korea National Health and Nutrition Examination Survey

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Background: The goal of this study is to investigate the relationship between depression and glycated hemoglobin in the general Korean population.

Methods: Adults aged 19 to 80 years were surveyed as part of the 2019 Korea National Health and Nutrition Examination Survey. A total of 4,831 people were chosen to complete the health questionnaire, provide their body mass index, and get a HbA1c blood test. The general characteristics of groups with high and low glycated hemoglobin were identified. To find out the correlation between depression diagnosis and the general population with high glycated hemoglobin, a chi-square test was carried out. A t-test was also used to compare the means of glycated hemoglobin between the groups diagnosed with and not diagnosed with depression. In analyzing the relationship between depression and glycated hemoglobin, analysis of covariance was performed by adjusting the effects for demographic factors.

Results: Sex, age, income level, education level, drinking, smoking, exercise, and body mass index are all factors that influence glycated hemoglobin. The mean glycated hemoglobin was high in the group diagnosed with depression. The relationship between depression and glycated hemoglobin could not be confirmed using logistic regression after controlling for confounding variables.

Conclusion: There was no significant correlation between depression and glycated hemoglobin in the general population of Korea based on the results of this study.

Keywords Depression; Glucose; Hemoglobin; Korea National Health and Nutrition Examination Survey

INTRODUCTION

Depression is the largest part of mood disorders in Korean society [1] and is often accompanied by chronic diseases [2].

The major depressive disorder, commonly known as depression, is characterized by depressed mood for most of the day, loss of interest or pleasure for more than two

weeks. Other symptoms include weight loss or gain, sleep changes, fatigue, feelings of worthlessness, less concentration, and recurrent suicidal ideation [3].

According to 2016 survey on mental illness in Korea, the lifetime prevalence of major depressive disorders was 5.0% and the annual prevalence was 1.5% [1]. The prevalence rate is on the rise.

Diabetes is a disease characterized by high blood glu-

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cose levels. It is a metabolic disease such as insufficient insulin secretion or abnormal function, which determines the concentration of fasting plasma glucose and glycated hemoglobin [4].

Glycated hemoglobin is a test to determine how much hemoglobin in red blood cells has been glycated. It reflects changes in blood sugar over the past two to three months.

Of course, glucose is present in normal people, so hemoglobin in the blood is glycated to some extent. There is a difference in normal values depending on the method of examination, but about 5.6% is normal.

Diabetes and psychiatric problems affect each other in many ways. Diabetes and its complications can cause psychiatric problems such as affective disorders and anxiety disorders [5], and psychiatric symptoms can worsen diabetes [6,7]. Diabetes patients are about twice as likely to suffer from depression as those who have not been diagnosed with diabetes [8]. Diabetes patients with depressive symptoms are less likely to successfully control diabetes [9]. One study reported that in the group with moderate or higher depressive symptoms, the proportion of patients with poor glycemic control reached 55%. Compared to the group with mild depressive symptoms or without depression, the proportion of patients with poor blood sugar control was higher in the group with moderate or higher depressive symptoms [10]. Previous results on the relationship between blood sugar regulation and depression showed that depression had a negative effect on blood sugar regulation [11,12]. Some studies have concluded that there is no relationship between depression and blood sugar levels [13]. Diabetes patients with depression have poor glycated hemoglobin regulation and poor adaptation to diet, exercise, and medication [14]. A nine-year longitudinal study of depression and non-depressive symptoms in diabetic patients showed that glycated hemoglobin was continuously high in the group with depressive symptoms, and that depression and glycated hemoglobin were related [15]. Previous studies on depression, glycated hemoglobin and self-management in diabetic patients showed inconsistent correlation between depressive symptoms and glycated hemoglobin.

In this study, the relationship between depression and glycated hemoglobin was investigated in the general population in Korea.

MATERIALS AND METHODS

1. Method

This study was conducted using data from the 2019 Korea National Health and Nutrition Examination Survey (KNHANES). The KNHANES is a legal survey on the health behavior of the people, the prevalence of chronic diseases, and the status of food and nutrition intake conducted in accordance with Article 16 of the National Health Promotion Act enacted in 1995. Each survey from the first (1998) to the third (2005) was conducted every three years; subsequently, it was reorganized into a year-round survey system and has been conducted every year since 2007. This study utilized the original data of the 8th KNHANES conducted in 2019.

The KNHANES are conducted with the approval of the Research Ethics Review Committee of the Korea Centers for Disease Control and Prevention, and the results of the survey are announced through the distribution of press releases, publication of statistics, and disclosure of raw data from December of the following year. The Korea Centers for Disease Control and Prevention only provides information on non-identifiable measures so that individuals cannot be inferred, and the information can be downloaded from the KNHANES website. In the course of the KNHANES, the difference in the number of households and population, the imbalance rate, and the non-response error of those who did not participate in the survey were corrected.

In 2019, 10,859 people were surveyed, of whom 8,110 were engaged as participants of this study, and the participation rate was 74.7%. The original data are composed of three types: health questionnaire, medical examination survey, and nutrition survey. In this study, the results of health questionnaire and medical examination were used. The health questionnaire was conducted through interviews and self-entry surveys, including physical measurements, blood pressure and pulse measurements, blood and urine tests, etc.

This study was conducted after obtaining approval from the Inje University Haeundae Paik Hospital Institutional Review Board (IRB NO. 2021-09-016). This study was exempted from obtaining written informed consent.

2. Subjects

Inclusion criteria for this study were adults between

the ages of 19 and 80 among the subjects of the 2019 KNHANES. We excluded cases who omitted health survey data, body measurement, and blood test HbA1c. The total number of study subjects according to the criteria was 4,831 (Fig. 1).

3. Measurements

1) Depression

Diagnosis of depression was conducted in the health survey area of KNHANES. It was asked to respond as none in the current prevalence. Those who did not know or did not answer were excluded from the subjects.

2) Glycated hemoglobin

The glycated hemoglobin levels were investigated by blood tests. HbA1c was measured up to one digit below the decimal point. If blood tests were not carried out, they were excluded.

3) Demographic and confounding variables

Demographic characteristics included age, sex, education level, marital status, income level, exercise, drinking, and smoking. The level of education was divided by whether or not to graduate from college. Married status was classified as married status of spouse (living together), and married status of spouse (separate), bereavement, divorce, and people who were not equivalent to condition were classified as unmarried status. The household income levels were divided into above and below average. Exercise was classified into practice and non-practice according to medium-intensity physical activity in leisure time. Drinking alcohol was categorized as drinking more than once a month over the past year.

Smoking was considered a smoker of more than five packs in his life.

4) Statistical analyses

The demographic statistics of the subjects were compared by chi-square test for discrete variants. The mean glycated hemoglobin according to depression was t-tested. Finally, a logistic regression analysis was performed on the correlation between depression and glycated hemoglobin by applying covariates. Statistical significance of this study was defined as $p < 0.05$ in both directions, and IBM SPSS Statistics for Windows, Version 23.0 (IBM Corp., Armonk, NY, USA) was used for all statistical analysis.

RESULTS

1. Demographic data

Table 1 shows the difference in general characteristics of the subjects who divided into high glycated hemoglobin group and low glycated hemoglobin group. There were significant differences between two groups in age, sex, educational background, marital status, household income, exercise, alcohol consumption, and smoking ($p < 0.05$). In the high glycated hemoglobin group, the proportion of males was higher ($p < 0.001$), the age (65-79 y) was higher ($p < 0.001$), high average household income level was lower ($p < 0.001$), the percentage of married persons was higher ($p = 0.010$), the education level \geq college was lower ($p < 0.001$). In addition, in the group of high glycated hemoglobin group lifetime smoking was higher ($p < 0.001$), lower for exercise ($p = 0.003$), and higher with 25 kg/m^2 or higher of body mass index ($p < 0.001$). Low glycated hemoglobin group have tendency to drink more alcohol ($p = 0.011$). It was decided to apply all indicators with significant differences to covariate correction.

2. Glycated hemoglobin and depression

Table 2 shows the relationship between glycated hemoglobin level and depression. In the group not diagnosed with depression, 90.6% of them were low glycated hemoglobin group, and 9.4% were 6.5 or higher glycated hemoglobin level. In the group diagnosed with depression, the ratio of glycated hemoglobin less than

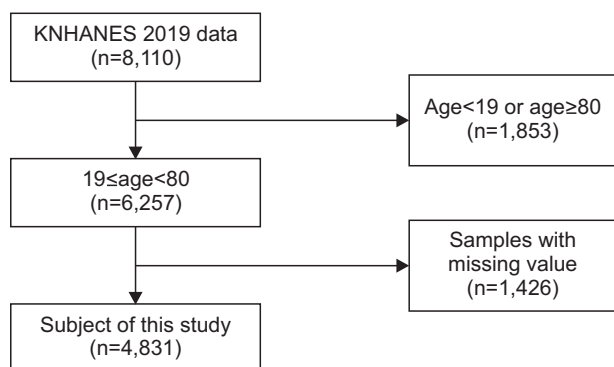


Fig. 1. Flowchart of study subject selection. KNHANES, Korea National Health and Nutrition Examination Survey.

Table 1. General characteristics of subjects according by HbA1c

Variable	Low HbA1c (<6.5%)	High HbA1c (≥6.5%)	p-value
Total	4,368 (90.4)	463 (9.6)	
Sex			
Male	1,986 (88.0)	271 (12.0)	<0.001
Female	2,382 (92.5)	192 (7.5)	
Age (y)			
19–44	1,903 (97.3)	52 (2.7)	<0.001
45–64	1,744 (88.6)	224 (11.4)	
65–79	721 (79.4)	187 (20.6)	
Household income			
High	2,686 (92.3)	225 (7.7)	<0.001
Low	1,682 (87.6)	238 (12.4)	
Marriage			
Yes	3,040 (89.7)	349 (10.3)	0.010
No	1,328 (92.1)	114 (7.9)	
Education			
≥College	1,967 (95.1)	101 (4.9)	<0.001
≤High school	2,401 (86.9)	362 (13.1)	
Occupation			
Employed	2,856 (91.0)	284 (9.0)	0.083
Unemployed	1,512 (89.4)	179 (10.6)	
Alcohol consumption			
Yes	2,697 (91.3)	258 (8.7)	0.011
No	1,671 (89.1)	205 (10.9)	
Smoking			
Yes	1,752 (87.5)	250 (12.5)	<0.001
No	2,616 (92.5)	213 (7.5)	
Exercise			
Yes	1,217 (92.5)	99 (7.5)	0.003
No	3,151 (89.6)	364 (10.4)	
BMI (kg/m ²)			
<25	2,990 (93.5)	207 (6.5)	<0.001
≥25	1,378 (84.3)	256 (15.7)	

Values are presented as number (%).

Table 2. Depression according by HbA1c

Variable	Low HbA1c (<6.5%)	High HbA1c (≥6.5%)	p-value
Not diagnosed with depression	4,178 (90.6)	431 (9.4)	0.012
Diagnosed with depression	190 (85.6)	32 (14.4)	

Values are presented as number (%).

6.5 was 85.6%, and the ratio of 6.5 or higher was 14.4% ($p=0.012$). It is likely to be different in the distribution of glycated hemoglobin level according to depression.

Table 3 shows the average values of glycated hemoglobin according to depression. In the group not diagnosed with depression, glycated hemoglobin was 5.749%. However in the group diagnosed with depression, gly-

cated hemoglobin was 5.946%. The average difference in glycated hemoglobin according to whether or not depression is diagnosed is significant ($p=0.007$).

In Model 1, which added sex, age, and BMI, the odd value is 1.500 and the p -value is 0.052, indicating that it is not statistically significant. In Model 2, which sex, age, BMI, income, education, and smoking are added,

Table 3. Comparison of the mean of HbA1c by diagnosis of depression

Variable	Not diagnosed with depression (n=4,609)	Diagnosed with depression (n=222)	p-value
HbA1c, mean %	5.749	5.946	0.007

Table 4. Corrected relationship between depression and HbA1c

Model	Low HbA1c (<6.5%)	High HbA1c (≥6.5%)	p-value
Model 1	1 (Ref.)	1.500 (0.996–2.258)	0.052
Model 2	1 (Ref.)	1.440 (0.954–2.172)	0.083
Model 3	1 (Ref.)	1.385 (0.916–2.093)	0.123

Values are presented as odds ratio (95% confidence interval).

Ref., reference; BMI, body mass index.

Model 1 adjusted for the effects of sex, age, and BMI. Model 2 adjusted for the effects of sex, age, BMI, household income, education, and smoking. Model 3 adjusted for the effects of sex, age, household income, education, marriage, alcohol consumption, smoking, exercise, and BMI.

the odd value is 1.440 and the p-value is 0.083, which is not significant. Finally, looking at Model 3 with sex, age, income, education, marriage, alcohol, smoking, exercise, and BMI, the odd value is 1.385, and the p-value is 0.123. The results showed that all model is not statistically significant. In other words, glycated hemoglobin is not affected by depression (Table 4).

DISCUSSION

Since there was no domestic study, we tried to investigate the relationship between depression and glycated hemoglobin using data from 2019 KNHANES.

Variables affecting glycated hemoglobin include sex, age, income level, education level, drinking, smoking, exercise, and BMI. Model 1, 2, and 3 could not confirm the relationship between depression and glycated hemoglobin.

As a result, the correlation between depression and glycated hemoglobin was not significant in the general population. According to a study conducted abroad, the results showed that glycated hemoglobin levels were not significantly correlated with depression in diabetic patients, and glycated hemoglobin level fluctuations were correlated [16].

In the general population, depression and glycated hemoglobin are not correlated, while if there is a correlation between depression and glycated hemoglobin in the diabetic group, genetic factors, psychological

factors, and diabetes-related negative perceptions may play a role. It is possible that in the general population depression may not be fully diagnosed, and diabetic patients may be more aware of depression because they visit hospitals regularly and for a long time. According to the World Health Organization, only 42% of major depression patients who visit primary care institutions are diagnosed by doctors [17].

The reason why we are interested in correlation between depression and glycated hemoglobin is because of whether self-management can be improved or complications can be reduced if depression is improved in diabetic patients.

It seems plausible that depression can interfere with the patient's ability to successfully manage diabetes self-management therapy [18], but there is no evidence that relieving depressive symptoms automatically improves self-management and compliance [19,20].

Meanwhile self-management behavior of diabetes itself may affect mood. If a patient has low self-efficacy for self-management of diabetes or has negative concern with the disease, it can worsen his or her mood [21,22].

This study has an advantage in that it used reliable and large data from the KNHANES conducted on adults in South Korea.

However, this data has limitations because it was not the result of a statistical survey designed for professional psychiatric evaluation. First, there may be patients who meet the criteria for diagnosing depression but have not been diagnosed because depression is classified by the

presence or absence of a diagnosis of depression. Second, it is an investigation made with only responses, not medical records. Third, details such as severity of depression, treatment after diagnosis were not reflected.

In the follow-up study, glycated hemoglobin can be measured at several points of time to confirm the correlation between fluctuations in glycated hemoglobin levels, and if only diabetic patients are checked, the relationship between depression and glycated hemoglobin can be further revealed.

CONCLUSION

In this study, we tried to investigate the relationship between depression and glycated hemoglobin in Korean adults using epidemiological surveys in 2019, but could not find any significant correlation. In previous studies, most studies have shown that depression is associated with glycated hemoglobin in diabetic patients, but there are also reports that there are no significant differences. If further studies can be done to complement the limitations of this study, the possibility of an integrated approach to depression in the management of glycated hemoglobin can be suggested.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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