

RESEARCH ARTICLE

Association between self-reported medical diagnosis of depression and metabolic syndrome in a population-based study: A propensity score-matched analysis

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Abstract

The aim was to compare the metabolic syndrome in adults with and without depression in Korea using the 2013–2015 Korea National Health and Nutrition Examination Survey. A cross-sectional study was conducted involving secondary data analysis. National survey data on the self-reported medical diagnosis of depression and metabolic syndrome were collected between 2013 and 2015 and released for research purposes in 2017. We conducted a propensity score-matched study that included adults ($n = 494$) with and without depression at a 1:1 ratio, to reduce the impact of potential confounding factors between groups. Depression was not significantly associated with changes in metabolic syndrome. However, participants with depression had significantly higher triglycerides than those without depression ($p = .008$), highlighting the importance of periodically checking triglycerides in depressed patients. Nurses need to check the subcomponents of metabolic syndrome in depressed patients periodically, especially regarding the management of triglycerides.

KEYWORDS

depression, metabolic syndrome, nursing, propensity score, triglycerides

1 | INTRODUCTION

Depression is a prevalent health problem of increasing global importance. The World Health Organization (WHO) reported that depression would contribute to increasing the world's leading disease burden by 2030 (World Health Organization [WHO], 2008). Approximately 4.4% of the world's population is living with depression; however, its prevalence has risen dramatically (20% increase rate) in the last decade (GBD 2015 Disease and Injury Incidence and Prevalence Collaborators, 2016). Various factors are associated with depression in terms of biological, psychological and social characteristics, such as heredity, physical illness, emotional distress and lifestyle factors (Lopresti et al., 2013). Thus, depression may reflect

both the overall health status of an individual and their health behaviours.

The metabolic syndrome (MetS) is a clustering of risk markers related to physical health, which reflect the likelihood an individual has of developing a chronic disease. In other words, individuals with MetS have a higher risk of becoming ill; conversely, chronic diseases have also been shown to increase the risk of MetS (National Cholesterol Education Program [NCEP], 2002). Some risk factors of MetS and depression overlap. Particularly, lifestyle factors, such as lack of sleep, low activity, lack of motivation, changes in eating patterns and sedentary lifestyle, have an important effect on depression (Lopresti et al., 2013) as well as the MetS. Simultaneously, health-related behavioural factors, such as poor diet, neurogenic hyperphagia, bulimia

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and smoking, are also common risk factors for depression and MetS (Marazziti et al., 2014). For example, one of the most common symptoms of depression is sleep problems (Pandi-Perumal et al., 2020). According to a systematic review and meta-analysis, poor quality of sleep was secondary to difficulty in falling asleep, maintaining sleep and insufficient sleep and had a significantly positive association with MetS (Lian et al., 2019). Various meta-analysis studies have reported that inadequate sleep increases MetS subcomponents such as obesity, hypertension, type-2 diabetes mellitus and dyslipidemia (Fatima et al., 2016; Kruisbrink et al., 2017; Lee et al., 2017; Lian et al., 2019; Lo et al., 2018). Functional hypercortisolism is caused by the chronic activation of the hypothalamic-pituitary-adrenal axis, and it usually leads to diverse complications involving specific components of MetS (Tirabassi et al., 2014).

2 | BACKGROUND

Among the diverse issues associated with depression, MetS is one of the factors associated with this mental health condition (Kim & Park, 2020; Rethorst et al., 2014). According to the 2009–2010 US National Health and Nutrition Examination Survey (NHANES), 112 of 272 individuals with depression (41.2%) were identified as high-risk for MetS (Rethorst et al., 2014). In Korea, according to the 2008–2013 Korea National Health and Nutrition Examination Survey (KNHANES), the prevalence of MetS was 3.2% in depressed patients, and participants with depression were more likely to have a larger waist circumference and lower high-density lipoprotein (HDL) cholesterol (Kim & Park, 2020). Obesity, a risk factor for MetS, was reported in 43% of individuals with depression, which was significantly higher than the 33% reported in no-depression individuals (Pratt & Brody, 2014). Thus, individuals living with depression may need an effective intervention to improve their overall health status (Thabrew et al., 2018).

Previous studies emphasized the importance of identifying and preventing the risk factors of MetS in individuals with depression, as they are a high-risk group for MetS (Pratt & Brody, 2014; Rethorst et al., 2014). However, comparing individuals within a group with similar characteristics is insufficient for an accurate comparison between the depressed group and the non-depressed group. Propensity score matching (PSM) helps to control selection bias (Lee, Yoo, et al., 2007) and is employed to reduce the impact of potential confounding factors on intergroup differences based on depression. The propensity score converts many variables into a single variable, which is useful to show an effect by controlling for differences between groups using multiple variables (Lunt et al., 2009). As employing PSM can identify the relationship between depression and MetS and yield more realistic results for clinically depressed patients, PSM has the same effect as a pseudo-random assignment without the need for conducting an experimental study, thereby minimizing selection bias (Lee, Yoo, et al., 2007). Therefore, we performed a secondary analysis of the KNHANES data, which includes useful, structured information from a representative sample. This study provides basic

data for the development of integrated nursing interventions for the prevention of MetS and health screening tools to identify physical and psychiatric problems in patients with depression.

This study aimed to compare MetS in adults with and without depression in Korea, using PSM analysis. Our research question was whether MetS is associated with depression.

3 | THE STUDY

3.1 | Design

A cross-sectional study was conducted involving a secondary data analysis of the sixth wave of KNHANES (2013–2015). The KNHANES's contents consist of a health interview, health examination and nutrition survey of non-institutionalized individuals in the Republic of Korea. Specifically, the nutrition survey was conducted on adults aged 19–64 years (Korea Centers for Disease Control & Prevention [KCDC], 2015).

3.2 | Participants

To represent the population of the Republic of Korea, KNHANES used a stratified, multi-stage and clustered probability sampling design (KCDC, 2015). A total of 22,948 participants completed the sixth wave of KNHANES, selected from 576 regions and 11,520 households. Before PSM, the sample size was 5,383, after excluding the missing data ($n = 17,565$). Participants were defined as individuals diagnosed with depression by a physician (KCDC, 2015) and were identified by analysing the answer to the question "Have you been diagnosed with depression by a doctor?" on the KNHANES. After PSM, the final sample size was 494, consisting of 247 participants with a self-reported medical diagnosis of depression and 247 who did not report a diagnosis of depression (Figure 1).

3.3 | Method

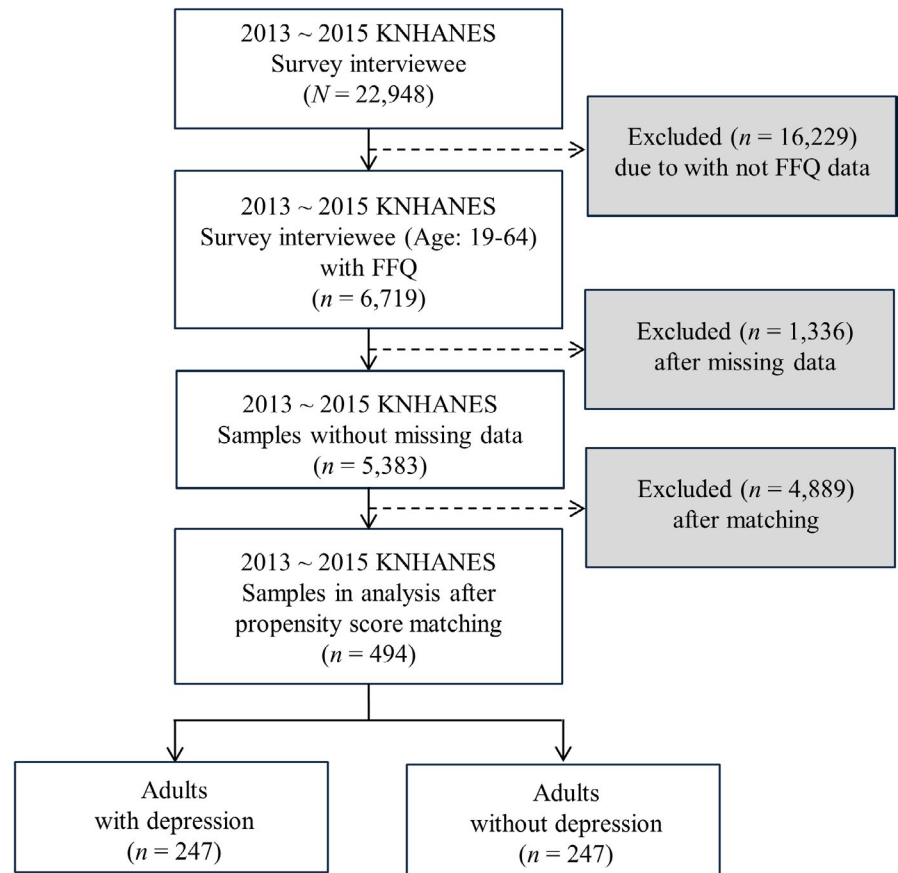
3.3.1 | Data collection

The KNHANES, which is performed by the Korea Centers for Disease Control and Prevention (KCDC), was conducted between 2013 and 2015. Data were released for research purposes in 2017.

3.3.2 | Variables

The study variables were extracted from the health interview and the examination of KNHANES (KCDC, 2015) and operationalized based on previous studies (Grundy et al., 2005; KCDC, 2015; Korean Ministry of Health & Welfare [KMHW], 2013; Korean Society of Sleep Medicine [KSSM], 2008; Lee, Park, et al., 2007; National Heart,

FIGURE 1 Flowchart of study samples



Lung, & Blood Institute [NHLBI], 2013; National Law Information Center [NLIC], 2017; Wilsnack et al., 2009).

Dependent variable

The dependent variable was the index of MetS. In this study, MetS was defined according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) (Grundy et al., 2005), and the waist circumference was based on the abdominal obesity recommendation standard suitable for Koreans (Lee, Park, et al., 2007). Individuals are considered to have MetS when they meet at least three of the following criteria: (1) waist circumference: ≥ 90 cm in men or ≥ 85 cm in women (Lee, Park, et al., 2007); (2) high level of triglycerides (TG; i.e., ≥ 150 mg/dl) or pharmacological treatment for hypertriglyceridemia; (3) low level of HDL cholesterol: < 40 mg/dl in men or < 50 mg/dl in women, or pharmacological treatment for abnormal level of HDL cholesterol; (4) high blood pressure (BP): ≥ 130 mmHg in systolic BP, ≥ 85 mmHg in diastolic BP or pharmacological treatment for hypertension; and (5) high level of fasting plasma glucose (≥ 100 mg/dl) or pharmacological treatment for diabetes mellitus.

Independent variables

Independent variables consisted of sociodemographic and health-related characteristics. The sociodemographic features comprised age, gender, living arrangement, marital status, current employment and education level. Age groups were 19–34, 35–49 and 50–64 years

(Wilsnack et al., 2009). Gender was dichotomized as male and female, and the living arrangement was classified as living with others and living alone (KCDC, 2015). Marital status was categorized as single, married, separated, widowed or divorced (KCDC, 2015). Current employment was categorized as either current (i.e., employed) and none or past (i.e., unemployed or economically inactive population) (KCDC, 2015). Education level was categorized as middle school or less, high school and some college or higher (KCDC, 2015; NLIC, 2017).

Body mass index (BMI), chronic disease, sleep, smoking, drinking and regular exercise were included as health-related characteristics. BMI was categorized as follows: underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$), normal ($18.5 \leq \text{BMI} \leq 24.9 \text{ kg/m}^2$), overweight ($25 \leq \text{BMI} \leq 29.9 \text{ kg/m}^2$) and obese ($\text{BMI} \geq 30 \text{ kg/m}^2$) (NHLBI, 2013). Chronic disease was defined as medical conditions diagnosed by a physician and includes 16 diseases of KNHANES (KCDC, 2015). Sleep was self-reported as total time in bed and was categorized as less than 5 hr, 6–8 hr and 9 hr or more per day (KSSM, 2008). Smoking was categorized as non-smokers, past smokers and current smokers (KCDC, 2015). Non-smokers were those who had never smoked or had smoked less than five packs (100 cigarettes) in a lifetime. Past smokers were those who had smoked more than five packs (100 cigarettes) but quit smoking before the time of data collection. Current smokers were those smoking at the time of data collection. Drinking was categorized as past, light and heavy drinkers (KCDC, 2015). Past drinkers did not drink in the last

year or reported a low frequency of drinking (i.e., less than once a month for a year). Light drinkers reported a frequency of drinking 2–4 times/month a year, with the amount of drinking at one time being 5–6 cups or less for men and 3–4 cups or less for women. Heavy drinkers reported a drinking frequency of 2–3 times a week or more for one year, with the amount of drinking at one time being 7–9 cups or more for men and 5–6 cups or more for women. Regular exercise was categorized as present or absent using strength exercise variables such as push-ups, sit-ups, dumbbells, weights and horizontal weights (KCDC, 2015; KMHW, 2013). The exercise group exercised more than two days a week and the non-exercise group two or fewer days a week (KMHW, 2013).

3.4 | Analysis

Data were analysed using the IBM SPSS version 25 (IBM, USA). The KNHANES data are available for public use, and the data quality was assessed by two researchers before the analyses. We excluded the missing data because of the potential impact as a confounder (Staffa & Zurakowski, 2018). The level of significance was 0.05, two-tailed.

Before performing the PSM, we had identified explainable factors related to MetS in depressed patients through a literature review. We found a total of 12 factors (independent variables)—age, gender, living arrangement, marital status, current employment, education level, BMI, chronic disease, sleep, smoking, drinking and regular exercise—that were significantly associated with the MetS in individuals with depression (Lian et al., 2019; Lopresti et al., 2013; Pratt & Brody, 2014).

Descriptive statistics were calculated, and Chi-square was used to compare sociodemographic and health-related characteristics, and MetS depending on the presence or absence of depression. To assess the adequacy of matching, we assessed the differences in the confounding variables according to MetS between persons with and without depression. We confirmed the homogeneity of the groups by checking the differences between the two groups with and without depression. The two groups were identified as unequal ($F = 156.779, p < .001$), and we thus carried out PSM. Matching with replacement is effective in reducing bias by using controls similar to depressed adults multiple times. The propensity score was calculated by means of a logistic regression model considering all the covariates by attempting to match each person with and without depression (a 1:1 ratio). If the matched controls are no longer independent, the controls can be matched more than once (Stuart, 2010). In the nearest neighbour matching, a person with depression was matched with the closest person without depression.

After matching, we evaluated the balance of the measured covariates between the two groups, with and without depression. The variables between two groups in the matched participants were compared with the use of McNemar's test. In addition, McNemar's test with the propensity score-matched data was conducted to

compare differences in changes in the MetS and the five criteria of MetS between the two matched groups.

3.5 | Validity and reliability

Validity and reliability were checked through a quality control of the clinical laboratory for KNHANES (KCDC, 2015). In addition, the results were compared and examined with international standards. The professionalism and proficiency of inspectors, the adequacy of facilities and equipment and a systematic laboratory operation system that can affect reliability were evaluated as national projects. The education and training for investigators were conducted by KNHANES (KCDC, 2015). The interviews using the Computer Assisted Self Interview system and the surveys and data entry were simultaneously conducted to improve reliability and validity as national projects. In addition, we checked the internal reliability of all instruments. Double data entry was completed by two investigators and external validation by another investigator to assure the quality of the collected data.

3.6 | Ethical considerations

The KNHANES was approved by the Institutional Review Board (IRB) of the KCDC (IRB number: 2013-07CON-03-4C and 2013-12EXP-03-5C). Participation in the primary study was voluntary, and informed consent was obtained from all participants. For this secondary data analysis, IRB exempt status was obtained from the affiliated university IRB (IRB approval number: 2018-2245-001).

4 | RESULTS

4.1 | Characteristics of the participants

The baseline sociodemographic and health-related characteristics of the participants with depression were compared to those of participants without depression (Table 1). About 4.6% of the Korean adults in the baseline assessment had been diagnosed with depression by a physician. The likelihood of being diagnosed with depression was significantly greater for those who were older, female, living with their families, had a spouse, had no current employment and had a high school education. These participants were also more likely to have a higher percentage of chronic disease, but a lower percentage of being underweight or obese. In addition, participants who had been diagnosed with depression by a doctor were more likely to adopt healthy behaviours, such as sleeping an adequate number of hours (6–8 hr per day), past and light drinking and getting regular exercise. Conversely, among these participants, 30.4% were heavy drinkers, 32.0% were overweight, and 19.0% slept less than five hours per night.

TABLE 1 Sociodemographic and health-related characteristics of depression and no-depression groups before and after propensity score matching

Characteristics	Unmatched Participants (N = 5,383)			Matched Participants (N = 494)		
	Depression (n = 247)	No-depression (n = 5,136)	p Value	Depression (n = 247)	No-depression (n = 247)	p Value
	N (%)	N (%)		N (%)	N (%)	
Socio-demographic characteristics						
Age (years)						
19–34	41 (16.6)	1,458 (28.4)	<.001	41 (16.6)	43 (17.4)	.705
35–49	72 (29.1)	1,867 (36.4)		72 (29.1)	78 (31.6)	
50–64	134 (54.3)	1,811 (35.3)		134 (54.3)	126 (51.0)	
Gender						
Male	48 (19.4)	2,139 (41.6)	<.001 ^a	48 (19.4)	43 (17.4)	.424
Female	199 (80.6)	2,997 (58.4)		199 (80.6)	204 (82.6)	
Living arrangement						
Living with others	212 (85.8)	4,822 (93.9)	<.001 ^a	212 (85.8)	217 (87.9)	.486
Living alone	35 (14.2)	314 (6.1)		35 (14.2)	30 (12.1)	
Marital status						
Single	36 (14.6)	1,136 (22.1)	<.001	36 (14.6)	37 (15.0)	.787
Married	168 (68.0)	3,653 (71.1)		168 (68.0)	169 (68.4)	
Separated, widowed, or divorced	43 (17.4)	347 (6.8)		43 (17.4)	41 (16.6)	
Current employment						
Current	122 (49.4)	3,491 (68.0)	<.001 ^a	122 (49.4)	124 (50.2)	.874
None or past	125 (50.6)	1,645 (32.0)		125 (50.6)	123 (49.8)	
Education level						
Middle school or less	54 (21.8)	436 (8.5)	<.001	54 (21.8)	54 (21.9)	.388
High school	134 (54.3)	2,471 (48.1)		134 (54.3)	124 (50.2)	
Some college or higher	59 (23.9)	2,229 (43.4)		59 (23.9)	69 (27.9)	
Health-related characteristics						
Body mass index						
Underweight	11 (4.4)	233 (4.5)	.025	11 (4.4)	16 (6.5)	.604
Normal	139 (56.3)	3,324 (64.7)		139 (56.3)	140 (56.7)	
Over weight	79 (32.0)	1,344 (26.2)		79 (32.0)	78 (31.6)	
Obesity	18 (7.3)	235 (4.6)		18 (7.3)	13 (5.2)	
Chronic disease						
Yes	155 (62.8)	2,308 (44.9)	<.001 ^a	155 (62.8)	155 (62.8)	>.999
No	92 (37.2)	2,828 (55.1)		92 (37.2)	92 (37.2)	
Sleep (hours per day)						
< 5	47 (19.0)	637 (12.4)	.002	47 (19.0)	40 (16.2)	.219
6–8	178 (72.1)	4,163 (81.1)		178 (72.1)	186 (75.3)	
≥ 9	22 (8.9)	336 (6.5)		22 (8.9)	21 (8.5)	
Smoking						
Non-smoker	162 (65.6)	3,167 (61.7)	.227	162 (65.6)	163 (66.0)	.602
Past smoker	36 (14.6)	971 (18.9)		36 (14.6)	40 (16.2)	
Current smoker	49 (19.8)	998 (19.4)		49 (19.8)	44 (17.8)	

(Continues)

TABLE 1 (Continued)

Characteristics	Unmatched Participants (N = 5,383)			Matched Participants (N = 494)		
	Depression (n = 247)	No-depression (n = 5,136)	p Value	Depression (n = 247)	No-depression (n = 247)	p Value
	N (%)	N (%)		N (%)	N (%)	
Drinking						
Past drinker	124 (50.2)	2,030 (39.5)	.004	124 (50.2)	128 (51.8)	.248
Light drinker	48 (19.4)	1,224 (23.9)		48 (19.4)	40 (16.2)	
Heavy drinker	75 (30.4)	1,882 (36.6)		75 (30.4)	79 (32.0)	
Regular exercise						
Yes	240 (97.2)	4,944 (96.3)	.299 ^a	240 (97.2)	239 (96.8)	>.999
No	7 (2.8)	192 (3.7)		7 (2.8)	8 (3.2)	

^aFisher's exact test result.

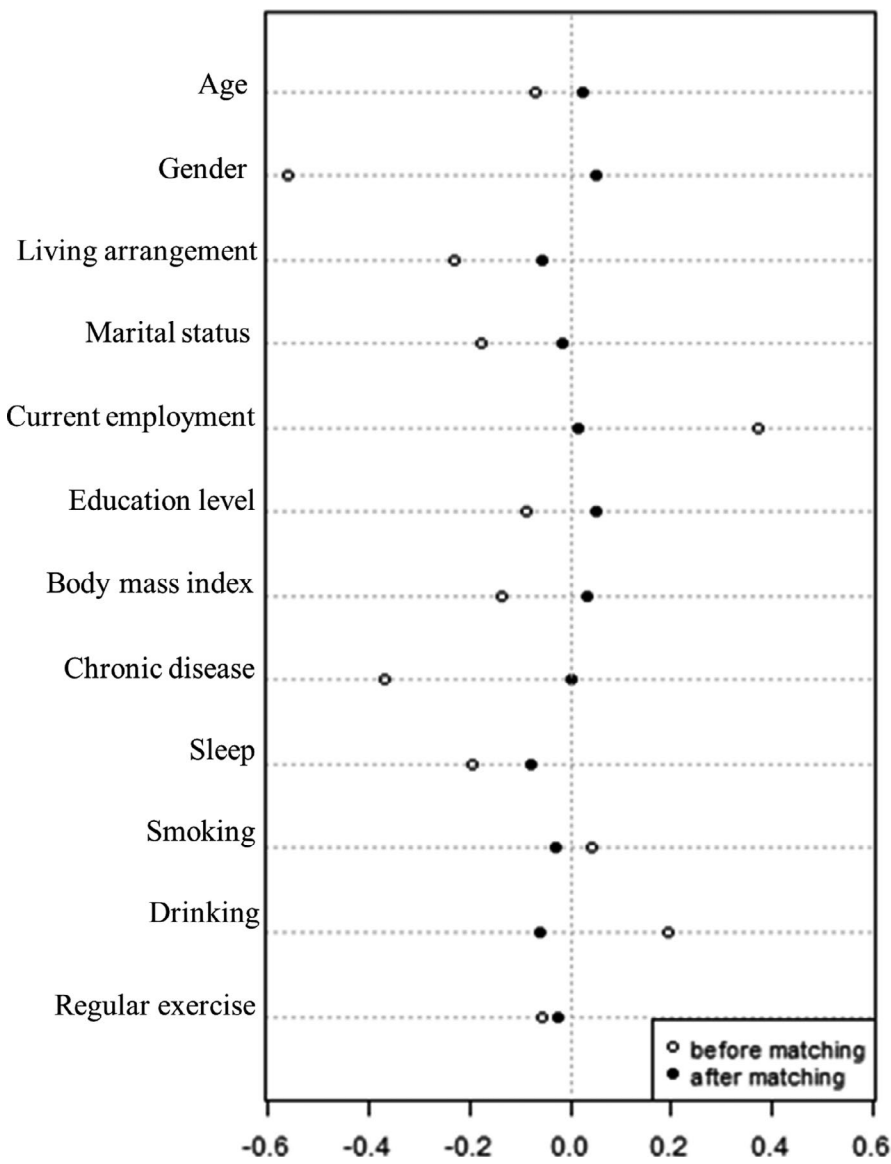


FIGURE 2 Love plot for standardized differences for all covariates before and after propensity score matching between the depression and no-depression groups

To control for the differences in baseline sociodemographic and health-related characteristics, we conducted a PSM. After the PSM was completed, there were 247 matched pairs of participants

(Table 1). Unlike the significant differences in the baseline socio-demographic and health-related characteristics between the unmatched participants with and without depression, there were no

significant differences in any of the 12 characteristics in the two groups of the matched participants. Therefore, this study used matching with replacement to identify whether depression is associated with MetS by minimizing the differences between groups.

An absolute standardized difference for all covariates was estimated to assess the degree of balance between before and after PSM and presented as a Love plot (Figure 2). The absolute standardized differences for the baseline sociodemographic and health-related characteristics were <10%, considering inconsequential bias (Rubin, 2001). The overall balance test was not significant (chi-square = 2.58, $df = 12$, $p = .998$), thus indicating equivalence between the groups (Hansen & Bowers, 2008). In addition, the multivariate imbalance was $L1 = 0.817$ and $L1 = 0.364$, before and after matching, respectively, confirming that the balance was well established after matching. Multivariate imbalance indicates that closer to 0, the better the distribution balance between the two groups, and closer to 1, the more the imbalance is strengthened (Iacus et al., 2012).

4.2 | Changes in MetS in the depression and no-depression groups

The MetS was significantly higher in the depression group compared with the no-depression group (Table 2). The participants with depression were more likely to have TG and HDL cholesterol problems and were more inclined to take medication than those without depression. In addition, the waist circumference of both male and female participants with depression significantly exceeded the average.

After the PSM, McNemar's test was conducted to compare the differences in changes in the MetS between the two matched groups (Table 2). The results showed that depression was not significantly associated with changes in the MetS. However, participants with depression had significantly higher TG than those without depression ($p = .008$). In further analysis of the items of TG levels in the depression group, three variables were found to be significant: age group of 50–64 years (odds ratio [OR] = 5.50; 95% confidence interval [CI] = 1.41–21.38; reference range = 19–34 years), female gender (OR = 5.54; 95% CI = 2.08–14.72; reference = female) and obesity (OR = 4.93; 95% CI = 1.42–17.10; reference = BMI normal).

5 | DISCUSSION

The study aimed to identify the association between MetS and depression among Korean adults using PSM analysis. In this study, depression was not associated with MetS diagnosis as a composite indicator; however, when investigating MetS sub-items, TG was different between the depression and no-depression groups.

The diagnosis of depression was not associated with MetS presence in our study. Previous cross-sectional (OR = 1.51) and cohort (OR = 1.6) studies have demonstrated that depression is significantly associated with a higher risk of MetS (Ghanei Gheshlagh et al., 2016). Some studies have shown that the association of

the subcomponents of MetS with depression also varied (Sekita et al., 2013; Shim & Kang, 2014). However, the diagnosis of MetS depends on several factors, such as waist circumference, TG, HDL cholesterol, BP and fasting plasma glucose (Grundy et al., 2005); it is better to use a composite indicator because inconsistencies among different sub-items are expected. In addition, data on depression and MetS were self-reported, and no clinical reports were obtained, which is a major potential confounding factor (Goldman et al., 2003). The prevalence of depressive and MetS symptoms may be higher than that of self-reported medical diagnosis of depression and MetS. Considering this limitation of secondary data analysis, it is difficult to conclude whether depression is a predisposing factor of MetS because of inconsistent findings like ours.

The depression group had high TG levels compared to those without depression. Recent studies demonstrated that TG is significantly associated with depressive symptoms (Oh & Kim, 2017; Wu et al., 2020). Oh and Kim (2017) reported that TG and depression are strongly associated in women (OR = 2.11; 95% CI = 1.28–3.50) and adults aged 45–64 years (OR = 2.20; 95% CI = 1.26–3.85). Because the confounders were already controlled for in our study's analysis, other factors, such as dietary habits, food intake and physical activities, may have affected the findings. Unhealthy dietary habits, such as junk food consumption, a strong desire to eat and physical inactivity, are also associated with depressive symptoms (Wrzosek et al., 2018). In particular, obesity has a robust relationship with depressive symptoms (Blasco et al., 2020) and TG levels (Skinner et al., 2015). Proper dietary habits, such as a lower-carbohydrate diet (Thom & Lean, 2017) and physical activity, may subsequently reduce TG (Mitchell et al., 2019). Therefore, nurses should conduct specific health screening and provide tailored interventions to reduce TG in individuals diagnosed with MetS and depression, taking the patient's age, gender and BMI into consideration. Furthermore, dietary management and physical activity may help control depressive symptoms and TG levels. Mental health care professionals and nurses need to pay attention to the management of MetS and its subcomponents in patients with depression, especially in developing educational materials and educating patients on the prevention and management of elevated TG.

Our study findings confirmed the well-known factors of MetS previously identified in adults with and without depression. In our study, significant factors of MetS in terms of sociodemographic and health-related factors were age, gender, living arrangement, educational level, BMI, chronic disease and sleep, which were similar to the findings of previous studies (Cameron et al., 2004; Lian et al., 2019; Moore et al., 2017; NCEP, 2002; Pratt & Brody, 2014; Pucci et al., 2017; Son & Kim, 2019). In general, the prevalence of MetS differs by age and gender, and in advanced age, this prevalence increases much more sharply in women than in men (Pucci et al., 2017). Living alone is a known risk factor of MetS, as young adults living and eating alone were more likely to develop MetS in a recent Korean study (Son & Kim, 2019). Interestingly, a lower education level has been linked with a higher risk of MetS (Moore et al., 2017). Generally, education is one of the essential elements

TABLE 2 Changes in metabolic syndrome by depression status

Outcome Variable	Unmatched Participants (N = 5,383)			Matched Participants (N = 494)		
	Depression (n = 247)	No-depression (n = 5,136)	p Value	Depression (n = 247)	No-depression (n = 247)	p Value
Metabolic syndrome						
Yes	69 (27.9)	1,156 (22.5)	.030 ^a	69 (27.9)	71 (28.7)	.902
No	178 (72.1)	3,980 (77.5)		178 (72.1)	176 (71.3)	
Blood pressure						
≥ 130/85 mmHg & medication	175 (70.9)	3,723 (72.5)	.310 ^a	72 (29.1)	86 (34.8)	.161
< 130/85 mmHg	72 (29.1)	1,413 (27.5)		175 (70.9)	161 (65.2)	
Fasting plasma glucose						
≥ 100mg/dl & medication	78 (31.6)	1,380 (26.9)	.062 ^a	78 (31.6)	70 (28.3)	.461
< 100mg/dl	169 (68.4)	3,756 (73.1)		169 (68.4)	177 (71.7)	
Triglycerides						
≥ 150mg/dl & medication	99 (40.1)	1,509 (29.4)	<.001 ^a	99 (40.1)	73 (29.6)	.008
< 150mg/dl	148 (59.9)	3,627 (70.6)		148 (59.9)	174 (70.4)	
HDL-cholesterol						
Men < 40mg/dl & medication	104 (42.1)	1,486 (28.9)	<.001 ^a	104 (42.1)	91 (36.8)	.237
Women < 50mg/dl & medication						
Men ≥ 40mg/dl, Women ≥ 50mg/dl	143 (57.9)	3,650 (71.1)		143 (57.9)	156 (63.2)	
Waist circumference						
Men ≥ 90cm, Women ≥ 85cm	81 (32.8)	1,327 (25.8)	.010 ^a	81 (32.8)	67 (27.1)	.115
Men < 90cm, Women < 85cm	166 (67.2)	3,809 (74.2)		166 (67.2)	180 (72.9)	

Abbreviation: HDL: High-density lipoprotein.

^aFisher's exact test result.

of health-promoting efforts that determine lifestyle behaviours and individual health (Hahn & Truman, 2015; Moore et al., 2017). In addition, education is a factor determining socioeconomic status, which is closely related to health outcomes, as it affects individuals' access to health care and resources (Galobardes et al., 2006; Hahn & Truman, 2015).

5.1 | Limitations

There are several limitations to this study. First, given the nature of the cross-sectional secondary data analysis, it was not possible to confirm causal associations between depression and MetS. Therefore, longitudinal studies to identify depression and MetS using the national dataset are necessary. Second, the KNHANES collects self-report data; thus, this may not reflect objective information. In the case of depression, this was determined only according to self-reporting of a doctor's diagnosis rather than medical records or medication review. Therefore, there may have been under-reporting of depression or limited response accuracy in the present study (Goldman et al., 2003). Future studies should identify depression

using medical diagnosis tools with adequate reliability and validity. Third, this study has a limitation of secondary data analysis studies, that is, when selecting variables related to MetS in depressed patients, only a limited number of variables were used for analysis. Therefore, subsequent studies should use primary data that reflect a variety of explanatory variables related to depression and MetS. Furthermore, it is necessary to select variables that compensate for the recall bias of self-reported information and the weakness of reliability due to under- or over-reporting.

6 | CONCLUSION

This secondary data analysis of nationally representative survey data from the KNHANES showed that depression is not associated with global MetS status as a composite indicator. However, TG levels were significantly associated with depression. Consequently, our study suggests that individuals with depression should continuously monitor their TG. In addition, it is suggested that the standardized nursing diagnosis system, including a checklist, reflects related factors that may affect MetS in depressed patients. Tailored

interventions aimed at managing depression ought to adopt a comprehensive and integrated approach, considering various influencing factors such as physical and social factors, as well as psychiatric problems. Thus, further studies are needed to develop and evaluate preventive interventions and services to reduce the risk of MetS in persons with depression.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

AUTHOR CONTRIBUTIONS

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors and agree with the manuscript. GK, NK and HK were responsible for both the concept and design of this study; GK and NK performed the data acquisition; GK and HK were responsible for data analysis and interpretation; and GK and NK wrote the manuscript under the supervision of HK. All the authors contributed to and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in KNHANES at the KCDC website (<https://knhanes.cdc.go.kr>).

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