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Subjective depressive symptoms and metabolic syndrome among the general population

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ABSTRACT

Objective: The evidence of the association between depression and metabolic syndrome is increasing, but the existence of sex differences in this association remains controversial. The aim of this study was to investigate the association between subjective depressive symptoms and metabolic syndrome and each of its components by sex in the Korean population.
Methods: The study sample comprised 15,073 men and 15,034 women who underwent routine health examinations. They completed the Beck Depression Inventory for depressive symptoms, and medical examinations provided data regarding metabolic syndrome. Adjustments for age, marriage, cigarette smoking, alcohol use, exercise, education, cancer, stroke, angina, and thyroid disease were performed. The association between depressive symptoms and metabolic syndrome and each of its components was analyzed by multiple logistic regression.
Results: In women, depressive symptoms were associated with metabolic syndrome (OR = 1.35, 95% CI = 1.11–1.64, $p = 0.002$) and the high-density lipoprotein cholesterol component (OR = 1.26, 95% CI = 1.09–1.46, $p = 0.002$) of metabolic syndrome. There was also an association between the severity of depressive symptoms and metabolic syndrome in women (OR = 1.046, 95% CI = 1.002–1.091, $p = 0.039$). In men, depressive symptoms were inversely associated with the hypertension component of metabolic syndrome (OR = 0.73, 95% CI = 0.58–0.91, $p = 0.005$).
Conclusions: Subjective depressive symptoms were associated with metabolic syndrome only in women. Further research should consider sex differences and dyslipidemia.

1. Introduction

Major depressive disorder is one of the most prevalent psychiatric diseases, with a 12-month point prevalence rate of 2.5% (1.7% in men, 3.2% in women) and a lifetime prevalence rate of 5.6% (3.6% in men, 7.6% in women) in the Korean population (Cho et al., 2010). Evidence supports increasing prevalence (Cho et al., 2010) and disease burden (Lepine and Briley, 2011) of depression over time. However the increasing prevalence may be explained due to methodological problems (Simon and VonKorff, 1992). As the importance of depression increases, evidence is accumulating with respect to other important outcomes associated with depression, such as cardiovascular disease (Vaccarino et al., 2008), diabetes (Windle and Windle, 2013), and mortality (Mykletun et al., 2007).

Metabolic syndrome, which includes a cluster of cardiovascular disease risk factors such as abdominal obesity, high triglyceride (TG) levels, low high-density lipoprotein cholesterol (HDL) levels, high blood pressure, and high glucose levels (Grundy et al., 2004), helps to explain the association between depression and cardiovascular disease. Obesity and insulin resistance are proposed core mechanisms for the development of metabolic syndrome, and lipid profiles are known to be associated with both obesity and insulin resistance (Grundy et al., 2004).

Several studies have investigated the association between depression and metabolic syndrome, and a recent meta-analysis (Pan et al., 2012) has shown that depression and metabolic syndrome are cross-

Abbreviations: TG, Triglyceride; HDL, High-density lipoprotein cholesterol; BDI, Beck Depression Inventory-1; OR, Odds ratio; CI, Confidence interval; df, Degrees of freedom; HPA, Hypothalamic–pituitary–adrenal.

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sectionally as well as bidirectionally associated, increasing the evidence for the association between the two. However there are studies conducted with large samples which have found no association (Herva et al., 2006; Hildrum et al., 2009) between the two conditions. Data showing sex differences in the association between depression and metabolic syndrome have been especially controversial. Some studies have reported that this association is confined to women (Gil et al., 2006; Kinder, 2004; Laudisio et al., 2009; Pulkki-Raback et al., 2009; Toker et al., 2008) or to men (Nishina et al., 2011; Viinamaki et al., 2009), and other studies have reported no sex interactions in the association (Hildrum et al., 2009; Kahl et al., 2012; Muhtz et al., 2009). It is possible that these controversies are attributable, in part, to the existence of different subtypes of depression, given the evidence that the somatic–affective symptom cluster (Marijnissen et al., 2013) and chronic atypical depression (Lamers et al., 2013) are associated with metabolic abnormalities.

The present study examined the association between subjective depressive symptoms and metabolic syndrome and its individual components in a large sample of the Korean general population who participated in a health screening program. Because there have been reports of sex differences in this association, we analyzed men and women separately. We hypothesized that depressive symptoms and metabolic abnormalities are associated and that there are sex differences in this association.

2. Methods

2.1. Patient population

Patients who underwent routine health examinations at the Seoul National University Hospital Healthcare System Gangnam Center from October 2004 to July 2012 were screened for this retrospective cross-sectional study. These health examinations are performed to screen for and enable early diagnosis of certain diseases and are available to all individuals for a fee. 15,073 men and 15,034 women aged 12 to 90 years who provided complete data from the Beck Depression Inventory-1 (BDI) and who had data available on metabolic syndrome were eligible for the study. The Institutional Review Board of Seoul National University Hospital approved the study protocol.

2.2. Assessment of subjective depressive symptoms

The severity of subjective depressive symptoms was assessed using the BDI, a 21-item self-report questionnaire that scores each question from 0 to 3 points (total score = 0–63 points) (Beck et al., 1961). A threshold of 19 points has been proposed for moderate depression (Beck et al., 1988), but previous studies have used different cutoff scores to indicate depression (Marijnissen et al., 2013; Miettola et al., 2008) when studying its association with metabolic syndrome.

A cutoff score of 21 points had been initially proposed for the Korean population (Hahn et al., 1986). However, the majority of subsequent studies proposed 16 points as the cutoff for clinical depression (Jo et al., 2007; Lee and Song, 1991; Shin et al., 1993). The sensitivity and specificity of the cutoff in those studies were 67.9–71.6% and 65.7%–77.3%, respectively (Jo et al., 2007; Lee and Song, 1991; Shin et al., 1993). In our study, patients with a total BDI score ≥16 were classified as having clinical depressive symptoms.

Assessments of associations involving symptom severity relied on the square-root transformation of the total BDI score (because the distribution was skewed) as a continuous predictor variable.

2.3. Assessment of metabolic syndrome

Based on the guidelines of the National Cholesterol Education Program Adult Treatment Panel III and the modified waist circumference criteria of the Korean Society for the Study of Obesity, metabolic syndrome was defined as the presence of three or more of the following components: (a) abdominal obesity as measured by a waist circumference of >90 cm for men and >85 cm for women, (b) TG level ≥150 mg/dL or use of antilipidemic medication, (c) HDL cholesterol level <40 mg/dL for men and <50 mg/dL for women, (d) systolic blood pressure ≥130 mm Hg or diastolic blood pressure ≥85 mm Hg or use of antihypertensive medication, and (e) fasting glucose level ≥100 mg/dL or use of antidiabetic medication (Grundy et al., 2004). Waist circumference was measured at the midpoint between the lower border of the rib cage and iliac crest. TG, HDL, and glucose levels were measured after 12 h of fasting. Blood pressure was measured in the right upper arm with an automated sphygmomanometer after at least 10 min of rest. Data on medication use were provided by self-reports.

2.4. Other assessments

Structured questionnaires were used to collect information on demographic variables. These included age, marriage, cigarette smoking, alcohol use, exercise, education, previously diagnosed diseases, current medication use including psychotropic medications and oral contraceptives/hormone treatment particularly for women, and menopause for women. Marriage (currently married or currently not married) was treated as a dichotomous variable. Cigarette smoking was divided into three groups (current smoker, ex-smoker, or non-smoker). Alcohol use (≤1/month, 2/month to 2/week, 3–4/week, or ≥5/week) and exercise (<1/week, 1–2/week, 3–4/week, or ≥5/week) were categorized by average number of days per week or month. Education was classified into four groups (less than high school graduate, less than college graduate, college graduate, or post-graduate). Cancer, stroke, angina, and thyroid disease were treated as dichotomous variables.

2.5. Statistical analyses

Differences in demographic and metabolic characteristics between patients with and those without depressive symptoms were assessed based on the cutoff value of a BDI score of 16 points. Continuous variables were analyzed with a two-tailed Student's *t*-test for normally distributed variables and with the Mann–Whitney *U*-test for variables not normally distributed. Categorical variables were analyzed with the *chi*-square test.

Logistic regression models were used to evaluate the association between depressive symptoms and metabolic syndrome and each of its components. First, single regression analysis was performed with depressive symptoms as a dichotomous independent variable and metabolic syndrome and each of its components as the individual outcome variables. In the multiple regression analyses, age, marriage, cigarette smoking, alcohol use, exercise, education, cancer, stroke, angina, and thyroid disease were added as covariates. Finally, menopause and oral contraceptive/hormone treatment were entered into the models in women to determine whether they influenced the associations. To determine if certain cutoff scores defining metabolic syndrome influenced the association we also conducted linear regression between depressive symptoms with the total number of metabolic syndrome components and the individual continuous metabolic syndrome components. Logistic transformations were used for skewed components.

We also used the square-root transformation of total BDI scores as a continuous variable and performed multiple logistic regression to determine whether there was a graded relationship between depressive symptom severity and metabolic syndrome.

Statistical significance was defined as $p < 0.05$. Statistical analyses were performed with SPSS 21.0 (SPSS, Inc., Chicago, IL).