Iran J Public Health, Vol. 52, No.3, Mar 2023, pp.515-524

Original Article

The Effects of Depression and Sleep Quality on Somatic Symptoms in Middle-Aged Women with Cardiovascular Risk Factors

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(Received 15 Apr 2021; accepted 18 Jul 2021)

Abstract

Background: This descriptive study investigated the effects of sleep quality and depression on somatization symptoms in middle-aged women with cardiovascular risk factors.

Methods: Data were collected from outpatients who visited three general hospitals and one private hospital in Korea between May 2017 and December 2018. Questionnaires and anthropometric data were used to analyze 144 middle-aged women (45–65 years) with at least one cardiovascular risk factor. SPSS and WIN 21.0 software were used for statistical analysis. To test the mediating effects, the relationships between independent variables and somatic symptoms were compared using the *t*-test, analysis of variance, and χ^2-test, and correlations were analyzed using Pearson's correlation coefficient. Finally, multiple linear regression and the Sobel test were used to identify predictors.

Results: Somatic symptoms showed a positive correlation with depression (r=46, $P<0.001$) and a strong negative correlation with sleep quality (r=-52, $P<0.001$). Depression and sleep quality explained 37% of somatic symptom variance in a multiple linear regression analysis after correcting for age ($R^2=0.37$, F=41.53, $P<0.001$). The Sobel test showed a sleep quality Z-value of 3.78, demonstrating that it was a mediating variable. By adding sleep quality to depressive symptoms, the absolute value of β, which shows the effect's strength, decreased from .49 to .32, confirming a partial mediating effect.

Conclusion: Depression and sleep quality were predictive of somatic symptoms in middle-aged women with cardiovascular risk factors, and sleep quality had a partial mediating effect on somatic symptoms. To reduce somatic symptoms, strategies that alleviate depression by improving sleep quality are required.

Keywords: Somatization; Women; Cardiovascular; Sleep quality; Depression

Introduction

Cardiovascular disease (CVD) caused approximately 17.9 million deaths in 2016, accounting for 31% of deaths worldwide (1). In the US in 2016, there were over 840,000 deaths from CVD; the prevalence of CVD among adults was 48%, and the incidence of CVD increases with age (2). In South Korea in 2018, the three major causes of death—cancer, cerebrovascular disease, and CVD—accounted for 45% of all deaths, and the mortality resulting from CVD was higher for females than for males (63.9 and 60.9 persons, respectively, per 100,000) (3). Females demonstrate a rapid increase in morbidity and mortality due to obesity and hypertension (major risk factors for

CVD) after menopause (4). Therefore, attention should be focused on the development and prevention of CVD in postmenopausal women.

Hypertension, total cholesterol, and low-density lipoprotein (LDL)-cholesterol are the most impactful factors in men, while smoking, diabetes, triglycerides, and high-density lipoprotein (HDL)-cholesterol levels are most impactful in women. Factors related to pregnancy complications and reproductive endocrine disorders affect the cardiovascular system in females (5, 6). Changes in female hormones begin with the transition to menopause, accompanied by an increase in depression and somatic symptoms (7). Somatic symptoms are more common than hot flashes in middle-aged females. Hot flashes are vasomotor symptoms, which can delay depression diagnosis and treatment, causing depression to worsen (8). Depression and sleep disturbance are CVD risk factors in middle-aged women (2, 9), and can typically hamper quality of life (10, 11). Psychosocial factors, which can aggravate CVD, heavily affect middle-aged women (12). Thus, there is an urgent need to actively manage, identify the causes, and improve somatic symptoms, depression, and sleep quality to reduce CVD morbidity in middle-aged women.

Moreover, somatic symptoms and depression can inhibit early recognition of CVD symptoms in middle-aged women (13–15) and cause delays in treatment (14). Women are socially expected to simultaneously handle housekeeping, childcare, and work; hence, their activities do not prevent CVD (16); furthermore, because individuals do not want to burden others with their own health problems, they neglect active prevention and treatment (14). Therefore, in middle-aged women, somatic symptoms occasionally lack differentiation from CVD symptoms, confounding the diagnosis of CVD (13). This makes it crucial to investigate the factors affecting somatic symptoms in middle-aged women.

This study aimed to investigate the mediating effect of sleep quality on the relationship between depression and somatic symptoms in middle-aged women with CVD risk factors. These results will provide basic data to support strategies for preventive programs to lower the prevalence of CVD in middle-aged women with CVD risk factors.

Materials and Methods

Research Design

A descriptive study investigating the effects of sleep quality and depression on somatic symptoms in middle-aged women with CVD risk factors.

Setting and Participants

Participants of this study were middle-aged women (45–65 years old) who lived in Seoul and other major cities between May 2017 and December 2018. I used convenience sampling to select participants with at least one of the CVD risk factors suggested by the American Heart Association (17, 18). The specific inclusion criteria were as follows:

- Obesity: body mass index (BMI, kg/m^2) ≥25, particularly central adiposity (waist to height ratio (WHtR)≥0.5) (19)
- Diagnosis or Treated hypertension
- Diabetes mellitus
- Treatment for dyslipidemia Family history: CVD occurring in men aged ≥55 years or in women aged ≥65 years

The exclusion criteria were as follows:

- History of CVD, including myocardial infarction or stroke
- Previous diagnosis of psychiatric or cognitive disorders

The sample size required for multiple regression analysis was calculated using G*power software version 3.1 (Düsseldorf, Germany), with a medium effect size (f2) =0.15, power (1-β) =0.80, significance level =0.05, and number of independent variables =8 (20). The minimum required sample size was 109 persons. I enrolled 144 participants to account for an expected dropout rate of 20%.

Measurements

The participants' general characteristics were

evaluated and physical characteristics were measured using a stadiometer (HW-8800, Korea) with ranges of error of ±1 mm and ±0.1 kg, respectively. These measurements were used to calculate each participant's BMI (kg/m^2). Waist circumference was measured by one researcher and one nurse using a tape measure (Office Depot Korea, South Korea) according to the method suggested by the World Health Organization (21); the measured value was used to calculate WHtR. The WHtR cutoff for increased CVD risk was ≥0.5 (19).

Physical activity

Physical activity was measured using the Global Physical Activity Questionnaire. Participants were asked to record the duration and frequency of physical activity (vigorous, moderate, and walking) that they recalled performing in the last 7 days. Based on the responses, the exercise time in minutes, number of days of exercise, and metabolic equivalent of task (MET) for each exercise intensity were multiplied to calculate each patient's MET-min/week, and the total physical activity was calculated from the sum of walking activity, moderate activity, and vigorous activity. The specific calculations are described below. Low physical activity was defined as ≤600 MET-min/week (22).

Depression

The Patient Health Questionnaire-9 (PHQ-9) was used for depression screening. Each question is rated on a 4-point Likert scale from 0 points ("not at all") to 3 points ("almost every day") based on the experience of the previous 2 weeks. Total scores range from 0 to 27 points. A total score of ≥10 points indicates clinical depression (23). For the Korean version of the PHQ-9, Cronbach's alpha was 0.81 in a validation study (24) and 0.79 in my study.

Sleep quality

The Korean Modified Leeds Sleep Evaluation Questionnaire (KMLSEQ) was used to measure quality of sleep. The KMLSEQ consists of 19 questions assessing a participant's ability to fall asleep, perceived quality of sleep, ease of awakening from sleep, and integrity of behavior following awakening. Total scores range from 0–100 points. A score of ≤67 points indicates poor sleep quality (25). Cronbach's alpha was 0.88 in a study testing the reliability and validity of the questionnaire in a Korean sample (26) and 0.87 in my study.

Somatic symptoms

Somatic symptoms were measured using the Korean version of the List of 90 Symptoms somatic factor (SCL-90R-SOM), which consists of 12 questions regarding somatic symptoms
from the Symptom Checklist-90-Revision (SCL-90R) (27). Each question is scored on a 5-point Likert scale from 0 points ("not at all") to 4 points ("very severe"). Total scores range from 0–48 points. Higher scores indicate more severe somatic symptoms (27). Cronbach's alpha was 0.93 in a study testing the reliability and validity of the instrument (28) and 0.86 in my study.

Data Collection and Ethical Considerations

Data were collected between May 2017 and December 2018 by board-certified physicians in the cardiology and endocrinology outpatient departments of three general hospitals and one private hospital in Korea. Before data collection, one researcher and one cardiovascular nurse explained the study objectives to the participants and obtained their written consent to participate. Data were collected using structured questionnaires. Physical measurements were taken privately in the consultation room. Participants who completed the questionnaires were given a small compensation item as a token of gratitude.
Data were de-identified and stored in a locked cabinet accessible only by the researchers.
This study was approved by the H-University Bioethics Committee (Institutional Review Board, HYI-14-118-3).

Statistical Analysis

Data were analyzed using IBM's SPSS software version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to analyze general

characteristics and CVD risk factors. The *t*-test, analysis of variance, and χ^2-test were used to compare general characteristics and independent variables. The Pearson correlation coefficient was used to analyze the relationships of the independent variables with the dependent variable of somatization symptoms. To test the effects of depression and sleep quality on somatic symptoms, a multiple linear regression analysis was performed using the "enter" method, and the Sobel test was performed to test the mediating effects.

I followed the four criteria suggested by Baron and Kenny (1986) to establish a mediating effect (29). The conditions were as follows: 1) the independent variable should have a significant effect on the mediating variable; 2) the independent variable should have a significant effect on the dependent variable; 3) the mediating variable should have a significant effect on the dependent variable; and 4) in a regression analysis including the mediating variable, if the effect of the independent variable on the dependent variable is smaller than in condition 2, this is a partial mediating effect; if the effect of the independent variable disappears, it is a full mediating effect. In the Sobel test, the error and beta coefficient were inserted into the Sobel Test Calculator for the Significance of Mediation. A value greater than ±1.96 indicated a significant mediating effect.

Results

General Characteristics

The participants' mean age was 56.4±6.21 years; 74.6% of the participants were post-menopausal women. The mean age of menopausal women was 50.9±3.87 years. The employment rate of the participants was 76.7%, and 22.5% of the participants reported that their current perceived health status was "good" (Table 1).

Table 1: General characteristics of participants (N=144)

Variables	*Categories*	*n*	*%*	*M±SD*
Age (yr)	45–51	38	26.8	56.4±6.21
	52–65	104	73.2	
Presence of menopause	Yes	106	74.6	50.9±3.87
	No	38	25.4	
Education level	≧High school	74	54.4	
	≦Middle school	70	45.6	
Living with	Spouse or Children	119	83.8	
	Alone	23	16.2	
Household income	<200	60	41.7	
Monthly (10,000 won)	201–300	23	15.9	
	≧300	61	42.4	
Occupation	Managerial/Professional	29	20.1	
	Service/Sales	28	19.5	
	Routine/Manual	52	36.1	
	Unemployed/Housewives	35	24.3	
Perceived health status	Good	32	22.5	
	Moderate	68	47.9	
	Poor	42	29.6	

M= mean; SD= standard deviation

Cardiovascular Disease-related Characteristics

The WHtR was ≥0.5 for 68.3% of participants, and 39.4% of patients reported physical activity of ≤600 MET-min/week. The percentages of participants diagnosed with hypertension, diabetes, and hyperlipidemia were 69.0%, 18.3%, and 51.4%, respectively. Participants with a family

history of CVD comprised 67.6%. Sleep quality was poor (sleep quality score ≤67 points) for 50% of participants, 11.3% of participants experienced depression (depression score ≥10 points), and the mean somatic symptoms score was 7.8±6.57 (Table 2).

Table 2: Cardiovascular disease-related characteristics of participants (N=144)

Variables	*Categories*	*n*	*(%)*	*M±SD*
Height (cm)				157.2±5.10
Weight (cm)				60.9±8.59
Hip (cm)				101.69±6.16
Waist (cm)	≥85	65	45.8	83.9±9.67
	<85	77	54.2	
WHtR	≥0.5	97	68.3	0.53±0.06
	<0.5	44	31.7	
BMI (kg/m²)	≥25	82	57.7	24.64±3.20
	<25	60	42.3	
PA (MET-min/week)	≥600	86	60.6	2561.68±4998.85
	< 600	56	39.4	
Sedentary time (h/day)				6.20±3.20
CVD risk factors†	Hypertension	98	69.0	
	Diabetes	26	18.3	
	Hyperlipidemia	73	51.4	
	Stroke	1	0.7	
	Angina	6	4.2	
	Other‡	15	10.5	
CVD risk factors related to family history†	Yes	96	67.6	
	Hypertension	68	47.9	
	Diabetes	46	32.4	
	Stroke, MI	34	23.9	
	Cancer	35	24.6	
Smoking	Current smoker	7	4.9	
	Ex-smoker or never	135	95.1	
Duration of sleeping time	<7 or >8	85	60.7	
	7–8	55	39.3	
Quality of sleep	>67	71	50	66.9±15.0
	≦67	71	50	
Depression	≥10	16	11.3	4.8±4.3
	<10	126	88.7	
Somatic symptoms (score)				7.8±6.57

M= mean; SD= standard deviation; †Multiple responses; WHtR= Waist-to-height ratio; BMI=Body mass index; MI= myocardial infarction, PA= physical activity; MET= metabolic equivalent of task (min/week); CVD= cardiovascular disease; Other‡= fatty liver, arthritis, chronic kidney disease, arrhythmia

Comparison of the Univariate Relationships with Somatic Symptoms

Participants were divided into "good" and "poor" sleep quality groups using a sleep quality score cutoff of 67 points. The relationship between sleep quality and somatic symptoms score was analyzed for both groups. The "poor sleep quality" group demonstrated significantly increased somatization symptom scores (t=3.66, P<0.001).

Next, participants were divided into "depression" and "no depression" groups using a depression score cutoff of 10 points. The relationship between depression status and somatization symptoms was analyzed for both groups. There were

significant differences between the two groups (t=-3.50, P<0.001).

Perceived health status (good, moderate, and bad) also showed a statistically significant relationship with somatization symptoms (F=9.52, P<0.001; Fig. 1).

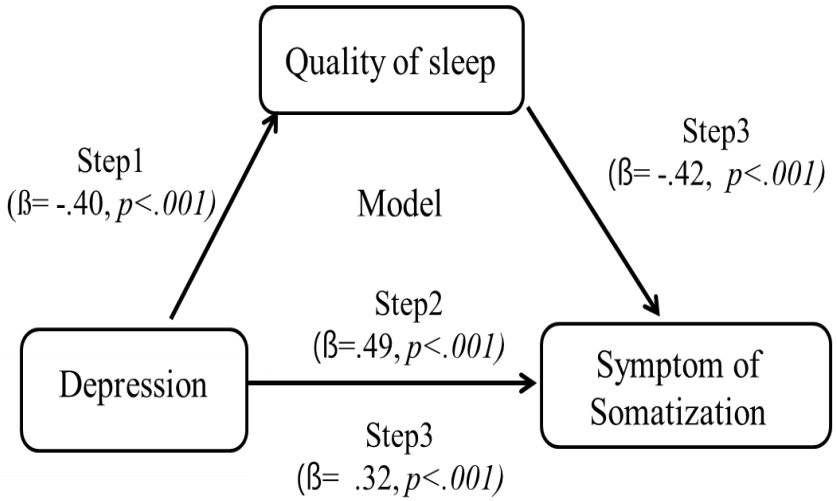

Fig. 1: Mediating effects of depression between quality of sleep and quality of life

Mediating Effects of Sleep Quality on the Effects of Depression on Somatization

I analyzed the mediating effects of sleep quality on the relationship between depression and somatic symptoms in the participants. The results are shown in Table 3.

Table 3: Mediating effect of somatic symptoms in middle-aged women with CVD risk factors (N=144)

Causal steps	*B*	*ß*	*Adj R²*	*F*	*P*
Step 1. Depression →Quality of sleep	-1.48.	-.40	0.15	13.80	<.001
Step2. Depression → Somatic symptoms	.74	.49	0.23	21.43	<.001
Step 3.			0.37	41.53	<.001
1) Depression→ Somatic symptoms	.49	.32	0.23	41.69.	<.001
2) Quality of sleep→ Somatic symptoms	-.17	-.42	0.36	31.91	<.001

B= Unstandardized regression coefficient; β= standardized regression coefficient; Adj= adjusted; CVD= cardiovascular disease; WHtR= waist-to-height ratio

I performed a multiple regression analysis to investigate independent predictive factors for somatization symptoms. Before performing the analysis, I checked whether the assumptions for regression analysis were satisfied. Since the tolerance was ≥0.1 (0.822–0.983) and the variance inflation factor was ≤10 (1.067–1.216), I concluded that there were no problems with multicollinearity. The model of the effects of depression on somatic symptoms with age as a covariate showed a significant result. The explanatory power of the model was 38% (R^2=0.37, F=41.53, P<0.001).

In the analysis of their mediating effect, depressive symptoms (independent variable) showed a significant effect on sleep quality (mediating variable: β=-.40, P<0.001), satisfying condition 1. Depressive symptoms exhibited a statistically significant effect on somatic symptoms (dependent variable: β=.49, P<0.001), satisfying condition 2.

The addition of sleep quality to the hierarchical regression model caused the absolute value of β for the effects of depressive symptoms to decrease from .49 to .32, while the explanatory power increased from 23% to 36% (F=31.91, *P*<0.001), satisfying condition 3. Because depression still demonstrated a significant effect on somatic symptoms even with the addition of sleep quality to the model in step 3, that sleep quality had a partial mediating effect. In the Sobel test, the Z-value was 3.78, demonstrating that sleep quality was a significant mediating variable in the relationship between depression and somatic symptoms in the study population (*P*<0.001) (Fig.1).

Discussion

In middle-aged women, somatic symptoms decrease sensitivity to symptoms at the onset of CVD (17), increasing CVD morbidity due to delayed detection (30). My study investigated factors affecting somatic symptoms in middle-aged women with CVD risk factors.

My findings indicated that sleep quality affects depression in middle-aged women with CVD risk factors and that poor sleep quality and worsened depression are associated with increased somatic symptoms. Additionally, sleep quality showed a partial mediating effect on the relationship between depression and somatic symptoms. This is consistent with the results of a previous German study of 15,010 adults, in which somatic symptoms were associated with CVD risk factors (7). In another study of 186 adults with depression and sleep disturbance, individuals with depression and insomnia showed more somatic symptoms, which were not significant in persons with only depression and no insomnia (26). These results are consistent with my finding that sleep quality mediates somatic symptoms. Furthermore, my finding that depressive symptoms are predictive of sleep quality is supported by a report that hormonal changes in middle-aged women increase depressive symptoms, which are CVD risk factors, and that this in turn leads to sleep disturbance (31). Hence, it is necessary to develop and implement effective interventions to improve sleep quality.

Somatic symptoms manifest as emotional symptoms and physical conditions, and emotional symptoms govern physical conditions (8). This is consistent with a US cardiovascular health study, in which physical inactivity accounted for 25% of the CVD mortality risk arising from depressive symptoms (33, 34). In my study, although I only included participants with CVD risk factors, 39.4% of participants did not perform a healthy amount of physical activity. Furthermore, 68.3% of participants had a WHtR ≥0.5, which is a CVD risk factor, demonstrating the need of improving physical activity levels to reduce CVD risk factors. In a UK study of 480,940 adults, 74% of participants with cardiometabolic multimorbidity and depression were inactive; among participants with a combination of diabetes, CVD, and depression, active participants lived 6.8 years longer than inactive participants (35). Therefore, the participants' inactivity suggests the need for strategies to promote physical activity. First, it is important to eliminate factors hindering physical activity. Depressive and somatic symptoms are negatively correlated with physical activity in adults (36, 37). Physical activity effectively reduces depression, somatic symptoms, and CVD risk factors in women (29, 35, 38, 39). However, I did not observe such a correlation in my study. As an explanation for this discrepancy, I cannot exclude the possibility of measurement bias; I measured physical activity based on the participants' recall of the previous week, which may have been inaccurate. Additionally, in South Korean culture, middle-aged women bear a greater burden of house-keeping and longer labor duration than men (40). Therefore, women may have confused leisure and housekeeping activities when calculating physical activity levels; therefore, reporting higher-than-accurate physical activity levels. In support of this possibility, 77.5% of the participants in my study reported moderate or worse perceived health status, but somatic symptoms scores were lower. As the participants had CVD risk factors and were taking medication

for these conditions, I believe that they considered somatic symptoms natural consequences of their disease and were not able to properly differentiate and describe their symptoms. Future studies should investigate differences in somatic symptoms and knowledge in middle-aged women with CVD risk factors and healthy middle-aged women. In summary, depression and sleep quality were clearly shown to be predictive factors of somatic symptoms in middle-aged women with CVD risk factors. In order to ameliorate somatic symptoms and reduce CVD morbidity, it is necessary to consider intervention strategies utilizing cognitive behavioral therapy for depressive symptoms, non-hormonal drug therapy, and exercise.

Conclusion

I investigated factors affecting somatic symptoms in middle-aged women with at least one CVD risk factor and found that somatic symptoms increased with increasing depressive symptoms and lower quality of sleep. Moreover, sleep quality showed a partial mediating effect on somatic symptoms, indicating that improved sleep quality may reduce somatic symptoms in middle-aged women with CVD risk factors.

I propose that the importance of recognizing somatic symptoms in middle-aged women with CVD risk factors should be publicized, and interventional studies should be conducted to reduce depression and improve sleep quality in them.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

I am grateful to the participants of this study. I would also like to thank my fellow Professor Jae Ran Sim, who advised me on the statistics of this study. This research was supported by Kyungdong University Research Fund, 2020, and the National Research Foundation of Korea (grant number NRF- 2020R1G1A1013553).

Conflict of Interest

The author declares that there are no conflicts of interest.

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