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ORIGINAL RESEARCH

Association between insomnia and coping style in Japanese patients with type 2 diabetes mellitus

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Purpose: Insomnia, which is associated with type 2 diabetes mellitus (DM), results in a low quality of life, and several relationships exist between insomnia and coping style. Thus, we clarified the association between some coping styles and insomnia among Japanese type 2 DM patients.

Subjects and methods: The subjects included 503 type 2 DM patients (mean age 63.9 ± 12.5 years). Sleep disturbance and personality traits were evaluated using the Japanese version of the Pittsburgh Sleep Quality Index and the Brief Scale for Coping Profile, respectively. Lifestyle factors, glycated hemoglobin A1c (HbA1c) levels, and the depression statuses of the patients were also included in the analyses.

Results: Among the 503 subjects with type 2 DM, 141 (28.0%) subjects exhibited probable insomnia. After adjusting for confounders, being female, living alone, and using “avoidance and suppression” were significantly correlated with current insomnia. No other relationships were found between insomnia and HbA1c or lifestyle factors, such as smoking, drinking alcohol, and exercise frequency.

Conclusion: The prevalence of insomnia in individuals with type 2 DM was high, and the protective factors included some emotion-focused coping styles. Future prospective studies are required to confirm the therapeutic effects of behavioral interventions on insomnia in patients with type 2 DM.

Keywords: cross-sectional studies, coping style, Japanese, insomnia, type 2 DM

Introduction

The global costs of diabetes and its consequences are large and will substantially increase by 2030.¹ Asia is a major area for the rapidly emerging type 2 diabetes mellitus (DM) global epidemic, with China and India being the top two epicenters. Although genetic predisposition partially determines individual susceptibility to type 2 DM, an unhealthy diet and a sedentary lifestyle are important drivers of the current global epidemic; early developmental factors (such as intrauterine exposure) also play a role in the susceptibility to type 2 DM later in life. Most patients with type 2 DM have at least one complication, and cardiovascular complications are the leading cause of morbidity and mortality in these patients.² Thus, the high prevalence of type 2 DM as a lifestyle-related disease has become a further burden and type 2 DM can increase the risk of serious physical and mental health issues.

Sleep disturbance, particularly insomnia (defined as trouble initiating or maintaining sleep), is one of the most frequent mental disorders^{3,4} leading to clinically relevant impairments in health-related quality of life.⁵ In recent years, several studies have indicated that short or disturbed sleep is associated with glucose intolerance, insulin resistance, reduced acute insulin response to glucose,^{6,7} and increased risks for developing

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type 2 diabetes.^{8–11} Over 40% of type 2 DM patients suffer from insomnia, and the prevalence of insomnia is higher in type 2 DM patients than in the general population.^{12–15}

Coping is regarded as a mediator of the relationship between stress and illness.^{16,17} Effective coping styles that involve actively engaging problems, positively interpreting situations, and using humor lead to faster resolution of difficulties and help maintain the psychological health of an individual during times of stress, thereby allowing a greater sense of safety and security. By contrast, ineffective coping styles lead to poorer psychological health and allow one to avoid problematic situations and vent feelings; these coping styles do not lead to a resolution of difficulties and may lead to an exacerbation of problems, thereby disturbing sleep.^{18,19}

We hypothesized that insomnia is associated with coping style, which may be linked to glucose control, although there is little information on the relationship between insomnia and coping strategies. Therefore, we examined the association between insomnia and coping style in type 2 DM patients.

Subjects and methods

Subjects

The current study was approved by the ethics committee of the Hirosaki University Graduate School of Medicine, and all subjects provided written informed consent before participating in this study.

This study included 728 individuals with type 2 DM who received treatment for at least 1 year at the Department of Endocrinology and Metabolism at Hirosaki University Hospital. We recruited 945 patients, and 728 patients agreed to participate in the survey. The remaining 217 patients were excluded because of a decline (41 patients), moderate-to-severe dementia (85 patients), blindness (23 patients), or moderate-to-severe psychiatric diseases (eg, bipolar disorder and schizophrenia; 68 patients).

A total of 611 patients of the 728 patients returned the questionnaires, and 503 (69.1%) patients had complete questionnaires. Blood samples from these patients were collected routinely for glycated hemoglobin A1c (HbA1c) analysis at least four times per year. Among the subjects, 408 patients were receiving an oral hypoglycemic agent and 235 patients were receiving insulin therapy. The demographic data (age, sex, smoking history, alcohol consumption, solitary living, and exercise habits) and medical histories of the patients were obtained from the questionnaires and medical records.

Subjective sleep difficulty was assessed using the validated Japanese version of the Pittsburgh Sleep Quality

Index (PSQI-J).^{20,21} The PSQI-J is a self-rated questionnaire that measures sleep difficulty, including sleep disturbance, retrospectively for a 1-month period, with total scores ranging from 0 to 21. Increased PSQI-J scores indicate greater sleep difficulty. Insomnia was defined as 5.5 or above on the PSQI-J.

We used the Brief Scale for Coping Profile (BSCP) to assess coping behaviors. The BSCP consists of 18 items rated on a 4-point scale.^{22,23} The participants were asked to indicate the frequency, which ranged from 1 (almost never) to 4 (very often), at which they used the strategy described by a particular item in stressful situations. The scale assesses an individual's ability to cope with daily stressful circumstances using the following six subscales: "active solution (AC)", "seeking help for a solution (S)", "changing mood (CM)", "emotional expression involving others (EE)", "avoidance and suppression (AV)", and "changing one's point of view (CV)".

The Japanese version of the Center for Epidemiological Studies Depression (CES-D) scale was used for all patients to measure depressive symptoms.^{24,25} The CES-D is a 20-item, self-report measure that focuses on depressive symptoms during the week prior to the administration of the questionnaire. The maximum score on this scale is 60, and a CES-D score of ≥ 16 is indicative of the presence of depression.

Data analyses

Herein, comparisons of several factors between insomnia and noninsomnia were performed using Student's *t*-tests and chi-square tests. The data are presented as the mean \pm SD. A *P*-value of <0.05 indicated statistical significance. The factors associated with insomnia, including age, sex, body mass index (BMI), HbA1c, smoking status, alcohol consumption, solitary living, exercise frequency, and score for each of the six coping subscales, were examined using forward stepwise logistical regression analyses. In addition, regression analyses were adjusted for the confounding factors. Linear regression analyses with forward stepwise selection were performed to examine the correlation between the severity of insomnia and several factors. The dummy variables were as follows: male=1, female=2, presence of spouse=1, absence of spouse=2, living with family=0, living alone=1, presence of smoking=1, absence of smoking=2, presence of alcohol consumption=1, absence of alcohol consumption=2, no exercise=1, exercise once a week=2, exercise 2–3 days per week=3, exercise 4–5 days per week=4, and exercise almost every day=5. A *P*-value of <0.05 indicated statistical significance. The IBM SPSS Statistics software program

for Windows Version 24.0 (IBM Corporation, Armonk, NY, USA) was used for all analyses.

Results

A total of 141 (28.0%) of the 503 patients had current sleep disturbances/insomnia based on the PSQI-J cutoff value. The sex, age, BMI, solitary living, depression, and use of “avoidance and suppression” factors differed significantly between patients with and without current insomnia, but the HbA1c, lifestyle, and marital status factors did not (Table 1). The HbA1c levels did not differ between the patients with and without insomnia.

Because strong colinearities existed between the CES-D score and coping style, the CES-D score was removed from the multiple variable regression. Table 2 shows the results of

the logistical regression analysis that were used to determine the factors associated with sleep disturbances/insomnia, such as being female, BMI, and use of avoidance and suppression. Multiple regression analysis showed the same results, indicating that using avoidance and suppression, using “changing one’s point of view”, living alone, being female, and being young were correlated with the severity of insomnia as measured by the total PSQI-J score (Table 3). Multiple regression analyses did not reveal a correlation between the HbA1c level and insomnia severity.

Discussion

The present study investigates the prevalence of probable insomnia as measured by the PSQI-J and assessed the relationship between insomnia and coping styles among individuals

Table 1 Characteristics of subjects with and without insomnia

Characteristics	With insomnia (n=141)	Without insomnia (n=362)	Significance
Sex			
Male, n (%)	68 (48)	224 (62)	P<0.01
Female, n (%)	73 (52)	138 (38)	
Age (years)	61.3±13.6	64.9±11.9	P<0.01
BMI	26.1±4.7	24.7±4.0	P<0.01
HbA1c (%)	7.1±1.0	7.1±0.8	ns
Smoking habit			
Yes, n (%)	24 (17)	55 (15)	ns
No, n (%)	117 (83)	307 (85)	
Habitual alcohol consumption			
Yes, n (%)	39 (28)	121 (33)	ns
No, n (%)	102 (72)	241 (67)	
Exercise frequency			
No, n (%)	87 (62)	186 (51)	
Once a week, n (%)	10 (7)	22 (6)	
2–3 times a week, n (%)	22 (16)	52 (14)	ns
4–5 times a week, n (%)	12 (9)	35 (10)	
Almost every day, n (%)	19 (13)	67 (18)	
Single			
Yes, n (%)	51 (36)	99 (27)	ns
No, n (%)	90 (64)	263 (73)	
Living alone			
Yes, n (%)	25 (18)	38 (10)	P<0.05
No, n (%)	116 (82)	324 (90)	
Depression (CES-D)	17.1±8.7	11.6±6.8	P<0.001
Coping profile			
Active solution	6.3±2.5	6.2±2.7	ns
Seeking help for a solution	8.1±2.7	8.0±2.9	ns
Changing mood	7.8±2.6	8.2±2.6	ns
Emotional expression involving others	10.9±1.7	11.2±1.5	ns
Avoidance and suppression	9.1±2.2	9.5±2.1	P<0.05
Changing one’s point of view	7.8±2.4	7.5±2.8	ns

Notes: Data are shown as mean ± SD. Current insomnia is defined as ≥5.5 on the PSQI-J.

Abbreviations: BMI, body mass index; CES-D, Center for Epidemiological Studies Depression; HbA1c, hemoglobin A1c; ns, no significance; PSQI-J, Japanese version of the Pittsburgh Sleep Quality Index.

Table 2 Logistic regression results for factors associated with insomnia among type 2 DM patients

Variables	Wald	Significance	Exp(β)	95% CI
Sex	6.19	0.013	1.68	1.12–2.52
Age				
BMI	8.01	0.005	1.07	1.02–1.12
HbA1c				
Smoking				
Alcohol				
Exercise frequency				
Single				
Living alone	5.11	0.024	1.93	1.09–3.40
Coping profile				
Active solution				
Seeking help for a solution				
Changing mood				
Emotional expression involving others				
Avoidance and suppression	6.13	0.013	0.88	0.80–0.97
Changing one's point of view	3.91	0.048	1.09	1.11–1.19

Note: Current insomnia is defined as ≥ 5.5 on the PSQI-J.

Abbreviations: BMI, body mass index; DM, diabetes mellitus; HbA1c, hemoglobin A1c; PSQI-J, Japanese version of the Pittsburgh Sleep Quality Index.

with type 2 DM using a cross-sectional study design. This study is the first to identify a significant association between the absence of insomnia and the use of avoidance and suppression, an inverse association between the severity of insomnia and the use of avoidance and suppression, and a possible association between the severity of insomnia and the use of changing one's point of view in individuals with type 2 DM. The six BSCP subscales reflect the following three different coping dimensions: problem-focused (AC and S), adaptive emotion-focused (CM and EE), and maladaptive emotion-focused (AV and CV) coping strategies.^{22,23} Despite being in the same category, avoidance and suppression and changing one's point of view were oppositely associated with insomnia. Avoidance and suppression was protective, and changing one's point of view was a risk factor for insomnia.

Insomnia occurs in $>90\%$ of patients with clinical depression. As a symptom, insomnia has a 60%–70% positive predictive value in diagnosing major depressive disorder (MDD). More than 50% of patients presenting to sleep disorder clinics have insomnia, and those who present with insomnia have a higher prevalence of MDD. The coping profile is a mediator that influences mood,²⁶ and we therefore removed the CES-D score from our regression analysis because too high of a correlation was found between the CES-D score and the PSQI-J score.

Table 3 Simple and multiple regression results for factors associated with the severity of insomnia among type 2 DM patients

Variables	r	Significance	β	Significance
Sex	0.129	0.002	0.111	0.012
Age	-0.098	0.014	-0.097	0.029
BMI	0.100	0.013		
HbA1c	0.024	0.296		
Smoking	-0.045	0.159		
Alcohol	0.014	0.379		
Exercise frequency	-0.028	0.265		
Single	0.134	0.001		
Living alone	0.142	0.001	0.151	<0.000
Coping profile				
Active solution	-0.017	0.057		
Seeking help for a solution	0.022	0.315		
Changing mood	-0.043	0.170		
Emotional expression involving others	-0.074	0.048		
Avoidance and suppression	-0.104	0.010	-0.111	0.013
Changing one's point of view	0.071	0.057	0.112	0.013
Multiple correlation coefficients			0.255	<0.000

Note: Current insomnia is defined as ≥ 5.5 on the PSQI-J. Bold indicates significance.

Abbreviations: BMI, body mass index; DM, diabetes mellitus; HbA1c, hemoglobin A1c; PSQI-J, Japanese version of the Pittsburgh Sleep Quality Index.

Our results were inconsistent with the hypothesis that participants who typically use disengagement coping have worse sleep based on several key indicators of sleep health. Avoidance coping, however, has been identified as an effective short-term strategy. A functional coping style is considered protective, while a nonfunctional coping style is considered a risk factor for depression. Similar to avoidance and suppression, denial is used in “an attempt to reject the reality of the stressful event.”²⁷ In the long term, however, avoidance coping impedes psychological adjustment and increases distress symptoms, such as depression.^{28–30} Emotion-focused coping has been described as the strongest mediator of the stress–illness relationship. Stress-related illness, deterioration in general health status, and poor physical health have been found to occur more frequently in those who consistently employ emotion-focused coping.¹⁹ Morin et al³¹ demonstrated that emotion-focused coping is associated with increased perceived stress. Such strategies are assumed to be more common in the insomnia population. In addition, Sadeh et al³² showed that for the group of students with good sleep, high emotion-focused coping scores are more likely to correspond to a decrease in total sleep time during the week prior to an important interview. Fernandez-Mendoza et al³³ indicated that compared to people who are not vulnerable, vulnerable people are more likely to

employ maladaptive coping strategies and to report increased emotional cognitive arousal. For young offenders, increased emotion-focused coping predicted increased anxiety and insomnia ($P<0.0001$), whereas increased rational coping predicted decreased symptoms ($P<0.005$). For juveniles, increased emotion-focused coping predicted increased anxiety and insomnia ($P<0.0001$).³⁴

Interestingly, the scores for avoidance and suppression and “emotional expression involving others”, which are regarded as negative coping styles, were higher in one study’s subjects than in a healthy population in Japan.³⁵ Values for Japanese references and subjects in this study were 6.6 and 9.4 for avoidance and suppression and 4.4 and 7.6 for emotional expression involving others, respectively, although a direct comparison was not conducted.²³ Therefore, using coping strategies such as maladaptive emotion-focused coping may be one method for treating multiple chronic disorders.

A previous review found no effect of stress on sleep parameters in adults.³⁶ In the subset of nine studies that used measures of daily stress and stressful life events, the results were mixed, but the best evidence indicates that stress affects sleep continuity. In addition, the sleep duration measured by actigraphy was unrelated to the measured daily hassles.³⁷

Several studies reported no correlations between insomnia and HbA1c in patients with type 2 DM,^{38,39} while increased HbA1c was significantly related to insomnia in a Japanese male subclinical population.⁴⁰ Thus, the association between HbA1c values and sleep disturbance is still inconclusive. A previous study showed that the treatment of sleep problems in diabetic patients did not lead to a reduction in HbA1c.³⁸ Therefore, HbA1c may not be a predictive factor for insomnia in patients with type 2 DM. A recent review showed that sleep quality was significantly related to glycemic control in 14 of 22 studies, while nine studies found no relationship between any measure of sleep and glycemic control.⁴¹ Compared to normal sleep, short and long sleep durations were associated with increased HbA1c, suggesting a U-shaped dose–response relationship. Similarly, poor sleep quality was associated with increased HbA1c.⁴¹

Several systematic reviews have found that short sleep duration is associated with a greater risk of obesity,^{42,43} while a recent meta-regression analysis showed that the association between sleep and obesity is still inconclusive.⁴⁴ People with obesity may have hypoventilation syndrome or obstructive sleep apnea (OSA), which are both related to sleep disorders,⁴⁵ possibly affecting the results of our study.

Several studies have suggested that living alone is correlated with long-term insomnia.³⁹ Thus, these results suggest that living alone may be a cause of insomnia even

in this type 2 DM population. In addition, the results of this study suggest that being female is a risk factor for insomnia. Several previous studies have shown a higher prevalence of insomnia in women than in men,^{46–48} while a meta-analysis showed no significant associations between the prevalence of insomnia and sex.⁴⁹ Therefore, the evidence for an effect of sex on the prevalence of insomnia is still inconclusive.

This study has several limitations. First, due to the lack of a control group, a reference score for the neuroticism personality trait could not be provided. Studies that include a control group are needed. Second, since this study was a cross-sectional study, identifying a causal relationship between the presence and severity of insomnia and risk factors was difficult. Third, all patients who had subjective insomnia in this study were not clinically diagnosed. We defined insomnia based on the PSQI scores, which measure only sleep quality and do not cover all the diagnostic criteria needed to diagnose insomnia according to the International Classification of Sleep Disorders. Objective sleep measures are necessary to make a definite diagnosis and clarify the presence/absence of other sleep disorders that are potentially causative of the participants’ subjective disturbances in sleep maintenance, such as OSA and restless legs syndrome. Finally, since the subjects were recruited from a single institute, hidden sampling bias may be present in this study. Therefore, a large sample from multiple centers is required to confirm our findings.

Conclusion

The risk factors were being female and living alone, and the protective factor was using the avoidance and suppression coping style. Future prospective studies are required to confirm the therapeutic effects of behavioral interventions for insomnia in patients with type 2 DM.

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