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Field Report

The relationship between sleep disturbances and depression in daytime workers: a cross-sectional structured interview survey

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Abstract: The aim of this study was to clarify the relationship between sleep disturbances and depression in daytime workers using a structured interview. A total of 1,184 daytime workers were enrolled. We evaluated difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS), early morning awakening (EMA), and global insomnia scores (ISs) in all participants. As a result, the prevalences of DIS, DMS, and EMA were 16%, 46%, and 22 %, respectively. IS was significantly correlated with depression score. Additionally, although all IS subscales (i.e., DIS, DMS, and EMA) were significantly associated with depression score, the main factor contributing to depression score was DIS. Thus, the present study reveals that sleep disturbances and especially DIS are associated with depression in daytime workers.

Key words: Hamilton depression rating scale, Insomnia, Sleep quality, Sleep problems, Japanese daytime workers

Introduction

It is estimated that 20–30% of daytime workers experience sleep disturbances such as difficulty initiating sleep (DIS), difficulty maintain sleep (DMS), early morning awakening (EMA), and lack of sleep[1–3]. It has been hypothesized that these sleep disturbances are caused by long working hours and poor working conditions; Jacquinet-Salord *et al.*[4] reported that workers with the perception of a bad working environment including a poor atmosphere at work, minimal interest in their job, and working under time constraints were more likely to complain of sleep disturbances compared to workers without this perception. Nakashima *et al.*[5] reported that overtime work hours over a prolonged period led to sleep disturbances and a shortage of sleep time. Thus, it is possible that a large number of daytime workers experience sleep disturbances. Notably, sleep disturbances are associated with several disease states[6, 7], with one such example being depression.

Previous studies have provided evidence for a relationship between sleep disturbances and depression. McCall *et al.*[8] reported that the 93% of patients with major depression also experienced insomnia. Kaneita *et al.*[9] reported that sleep disturbances including DIS, DMS, and EMA were associated with depressive symptoms (the Center for Epidemiologic Studies Depression Scale: CES-D≥16). It has been hypothesized that comorbid sleep disturbances promote the development of depression. Breslau *et al.*[10]

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reported that the relative risk of new-onset major depressive disorder during a 3-yr follow-up period in individuals with a history of insomnia was 4.0 (95% confidence interval [CI], 2.2–7.0) compared to individuals without history of insomnia. Chang *et al.*[11] reported that, among 1,053 male undergraduate students followed for a median of 34 yr, the relative risk of clinical depression was significantly greater in students with self-reported sleep disturbances compared to students without sleep disturbances. Additionally, a cohort study of older adults with a history of major or non-major depression in full remission with 2 yr of follow-up showed that patients with subjective sleep disturbances were at an increased risk for the recurrence of depression compared to older adults without subjective sleep disturbances[12]. On this premise, it can be hypothesized that sleep disturbance is a risk factor for new-onset and recurrent depression.

The goal of this study was to investigate the relationship between sleep disturbances and depression in daytime workers. We considered that a structured interview would be ideal for assessing this relationship, as self-administered questionnaires are associated with response biases such as social desirability bias. For example, it is possible that truck drivers would be reluctant to admit to having sleep problems, and thus over-report sleep conditions. Moreover, no study to date has explored the relationship between sleep disturbances and depression in daytime workers using a structured interview. Therefore, we evaluated DIS, DMS, EMA, and overall insomnia scores (ISs) in daytime workers in order to determine the main components of sleep disturbance contributing to depression. We hypothesized that sleep disturbances would be significantly associated with depression in daytime workers.

Subjects and Methods

Participants

A total of 2,006 individuals who received a general health examination or medical checkup between July 2014 and October 2016 were screened for enrollment in this study. Of these, 1,184 daytime workers (age range, 20–64 yr) were included in the analysis. All participants provided informed consent. The study protocol was approved by the Research Ethics Committee of the National Institute of Occupational Safety and Health in Japan (H2809).

Procedure

A structured interview was administered by 1 of 5 trained interviewers, including a medical doctor, health nurse, clinical psychotherapist, industrial counselor, and managerial dietitian. The interviewer asked questions about sleep disturbances, depression, and demographic characteristics.

Survey

We collected demographic data including data on age, sex, work schedule, and comorbidities such as diabetes, hypertension, and metabolic syndrome (absence, being treated, or untreated). Sleep disturbances were measured using the 3 insomnia scales (DIS, DMS, and EMA) which included 6 modified questions (2 questions per scale) based on the Japanese version[13] of the Hamilton depression rating scale (HAM-D)[14]. The 6 questions about sleep disturbances during the past 2 wk were asked. The HAM-D is widely used to measure the severity and symptoms of depression with established reliability[15]. The following 2 questions were used to examine DIS: "Sometimes it takes more than 30 min to fall asleep (yes=1, no=0)" and "It is difficult to fall asleep every night (yes=2, no=0)." The following 2 questions were used to examine DMS: "Although I sometimes wake up during the night, I am able to fall asleep again (yes=1, no=0)" and "I wake up during the night and often get out of bed (yes=2, no=0)." The following 2 questions were used to examine EMA: "Although I wake up in the early hours of the morning, I am able to fall asleep again (yes=1, no=0)" and "I wake up in the early hours of the morning and am unable to fall asleep again (yes=2, no=0)." The total score of each pair of questions was used to compute each sleep disturbance score; additionally, if the participant answered positively to both questions, the score was recorded as 2 points. Thus, each sleep disturbances score ranged from 0–2. A higher score indicated higher symptom severe severity. Additionally, the total score of all 3 scales was used to rate the overall degree of insomnia (IS, ranging from 0–6).

Depression was measured using the new brief job stress questionnaire (NBJSQ)[16, 17]. The depression scale consisted of 6 items that were rated on a 4-point Likert scale (1: almost never, 2: sometimes, 3: often, and 4: almost always). The mean score of the 6 items ranged from 1–4. A higher mean score indicated greater depression severity. The reliability and validity of this questionnaire have been confirmed in a previous study[17].

Statistical analysis

A Spearman rank correlation analysis was conducted to examine the relationship between sleep disturbances (IS) and depression (NBJSQ depression score). A categori-

Table 1. Participant demographic data (n=1,184)

	n (%)	mean (SD)
Women	372 (31.4)	—
Mean age (yr)	—	45.3 (11.0)
Diabetes		
absence	1,121 (94.7)	—
under treatment	18 (1.5)	—
untreated	45 (3.8)	—
Hypertension		
absence	976 (82.4)	—
under treatment	57 (4.8)	—
untreated	151 (12.8)	—
Metabolic syndrome		
absence	963 (81.3)	—
under treatment	182 (15.4)	—
untreated	39 (3.3)	—

SD: standard deviation; yr: years

Table 2. Participant characteristics

Age group	n (%)					
	All	IS>0	DIS>0	DMS>0	EMA>0	Depression>1
Male						
20–29	63 (5)	31 (3)	14 (1)	13 (1)	17 (1)	28 (2)
30–39	139 (12)	71 (6)	19 (2)	54 (5)	26 (2)	52 (4)
40–49	279 (24)	154 (13)	39 (3)	114 (10)	67 (6)	102 (9)
50–59	232 (20)	158 (13)	29 (2)	135 (11)	49 (4)	90 (8)
60–64	99 (8)	66 (6)	10 (1)	58 (5)	19 (2)	31 (3)
Total	812 (69)	480 (41)	111 (9)	374 (32)	178 (15)	303 (26)
Female						
20–29	58 (5)	32 (3)	15 (1)	19 (2)	9 (1)	29 (2)
30–39	89 (8)	55 (5)	21 (2)	41 (3)	23 (2)	30 (3)
40–49	109 (9)	65 (5)	17 (1)	48 (4)	26 (2)	47 (4)
50–59	79 (7)	55 (5)	17 (1)	40 (3)	17 (1)	37 (3)
60–64	37 (3)	25 (2)	7 (1)	21 (2)	7 (1)	13 (1)
Total	372 (31)	232 (20)	77 (7)	169 (14)	82 (7)	156 (13)
Overall	1,184 (100)	712 (60)	188 (16)	543 (46)	260 (22)	459 (39)

DIS: difficulty initiating sleep; DMS: difficulty maintaining sleep; EMA: early morning awakening; IS: groval insomnia score

cal regression (CATREG) analysis was used to examine the effects of sleep disturbances on depression. Since CATREG quantifies categorical data by assigning numerical values to each category, the procedure treats quantified categorical variables in the same way as numerical variables[18]. Then, using nonlinear transformations, this approach allows variables to be analyzed on a number of levels to find the best-fitting mode. The dependent variable was depression score and independent variables included DIS, DMS, and EMA scores. Sex and age were entered as covariates. All statistical analyses were conducted using SPSS version 23.0 for Microsoft Windows (IBM Company, New York, USA). $p<0.05$ was adopted as the threshold for statistical significance.

Results

Table 1 summarizes the participant demographic data. Of 1,184 daytime workers included in the study, 69% were male and 31% were female. The mean age was 45.3 ± 11.0 yrs. Table 2 summarizes the characteristics of participants. Briefly, 60% of participants indicated some sleep disturbances (IS>0) and the 39% of participants had depressive symptoms (depression score>1). The prevalences of DIS,

Table 3. Results of the categorical regression analysis

Variables	β	p values
Difficulty initiating sleep	0.251	<0.001
Difficulty maintain sleep	0.157	<0.001
Early morning awakening	0.171	<0.001
Sex	0.020	0.340
Age	−0.040	0.167

β indicated standardized coefficient

DMS, and EMA (a scores>0) were 16%, 46%, and 22%, respectively.

IS was significantly correlated with depression score (Spearman's rank correlation coefficient [r_s]=0.320, $p<0.001$). Table 3 shows result of the CATREG (adjusted $R^2=0.158$, $p<0.001$). Additionally, all IS subscales were significantly associated with depression score, including DIS ($\beta=0.251$, $p<0.001$), DMS ($\beta=0.157$, $p<0.001$), and EMA ($\beta=0.171$, $p<0.001$). The main factor associated with depression score was DIS. There were no problem with collinearity given a range of minimal and maximal tolerance after transformation of 0.901–0.968.

Discussion

The present study showed that IS was significantly associated with depression score in daytime workers. While all IS subscales (i.e. DIS, DMS, and EMA) were associated with depression score, DIS was the main component contributing to depression score.

The prevalences of DIS, DMS, and EMA in our adult cohort of daytime workers were 16%, 46%, and 22%, respectively. In contrast, previous studies surveying Japanese adults[9, 19–22] reported prevalences of DIS, DMS, and EMA to be 7–18%, 15–27%, and 5–23%, respectively. Other studies specifically examining Japanese workers[1–3, 21, 23] reported that the prevalences of DIS, DMS, and EMA were 11–30%, 7–42%, and 2–8%, respectively. Accordingly, our study reported higher prevalences of DMS and EMA compared to previous studies. These differences were likely related to the study population and use of a self-rating survey method rather than a structured interview, respectively. The prevalence of insomnia (i.e., at least one positive response regarding sleep disturbances) in present study was 60%, which was also higher than that reported in populations of general adults (19–33%)[19, 20, 22] and Japanese workers (23–30%)[1, 2, 21, 23]. Although it may be difficult to compare these prevalence values given the use of different question items and approaches, we argue that the structured interview method may be more sensitive for identifying sleep disturbances than survey or questionnaire-based methods. Further studies are needed to clarify this issue.

Previous survey data[9] collected from 24,686 Japanese adults (≥20 yr old) indicated that sleep disturbances such as DIS, DMS, and EMA were associated with depressive symptoms (CES-D score ≥16 and ≥25), with DIS having the highest odds ratio. These results are consistent with our findings. Several work-related factors have been reported to deteriorate sleep quality; Nakashima *et al.*[5] reported that long work hours reduce sleep quality and decrease sleep quantity, and Kecklund and Åkerstedt[24] reported that apprehension for the next working day decreased the amount of slow wave sleep. Nakata *et al.*[2] reported that job stressors such as high cognitive demand and role conflict were associated with DIS, while high intragroup conflict was associated with DMS. The effects of these work problems on sleep may lead to vulnerability to or the onset of depression. Taken together, our findings suggest that day workers should be careful to self-assess sleep and depression.

Although we observed a relationship between sleep disturbances and depression in the present study, correlation coefficients and coefficients of multiple determinations for CATREG were small. A previous study[9] reported that although DIS, DMS, and EMA were associated with depression, the prevalences of these sleep disturbances in subjects with a CES-D score>16 points were 47.4%, 45.4%, and 36.7%, respectively; in subjects with a CES-D score>25 points, these prevalence values were decreased to 19.5%, 18.1%, and 13.0%, respectively. That is, more than half of subjects with depression did not have sleep disturbances. Thus, the relationship between sleep disturbances and depression may be relatively weak. The characteristics of participants in the present study as active daytime workers free of any mental disorders may underlie the observation of a weak association between sleep disturbances and depression score. Nevertheless, this study provides important insights into the actual prevalence of sleep problems and the relationship between sleep disturbances and depression in daytime workers.

This study had several limitations. First, our structured interview did not assess sleep duration, as there were no questions about sleep duration in the HAM-D. It was previously reported that daytime workers have short sleep durations, such that this should be evaluated with respect to depression in future research. Second, although this study revealed a relationship between sleep disturbances and depression, the causality of this relationship was not

confirmed. Future studies are required to better understand the exact nature of the relationship between sleep disturbances and depression, and especially between DIS and depression.

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