Insomnia as a Risk for Depression: A Longitudinal Epidemiologic Study on a Japanese Rural Cohort

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ABSTRACT

Objectives: To determine (1) whether insomnia is a factor related to the presence or persistence of depression for 2 years in the Japanese population and (2) which component of insomnia is associated with the presence of depression for 2 years in a rural cohort.

Method: This is a community-based longitudinal study. Two thousand eight hundred twenty-five people aged 20 years or older were evaluated at baseline, and of those participants, 1,577 (56%) were reevaluated after 2 years. During both surveys, the participants were asked to describe demographic variables and to fill out self-rating scales of insomnia (Pittsburgh Sleep Quality Index [PSQI]) and depressive symptoms (Center for Epidemiologic Studies Depression Scale).

Results: The results of a multiple logistic regression analysis showed that depression (OR = 6.0; 95% CI, 4.4–8.0) and insomnia (OR = 2.1; 95% CI, 1.5–2.8) at baseline were significantly associated with the presence of depression at the follow-up. Most of the PSQI subscales, except for sleep duration and habitual sleep efficiency, were significantly associated ($P < .01$) with the presence of depression at the follow-up. In addition, the new appearance and repeated existence of depression at the follow-up were related to persistent insomnia (adjusted ORs = 7.0 and 3.3 [$P < .001$], respectively). A result of the receiver operating characteristic curve showed that persons with insomnia whose PSQI scores exceeded 8 points at the baseline were most likely to still have insomnia at the follow-up (cutoff point = 7.5).

Conclusions: On the basis of our results in a Japanese population, insomnia with high severity level could be a risk factor for the presence/persistence of depression in the long-term prognosis.

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Insomnia is well-known as a common disorder with an extremely high prevalence,[1–3] and it has been reported that one-fifth of the general population in Japan has symptoms related to insomnia.[4] In addition, insomnia is suspected to be a risk factor for the development of other psychiatric disorders (eg, anxiety disorders, depressive disorders, and substance abuse),[5,6] and particularly, its association with depression has been widely accepted.[7,8]

The results of previous longitudinal epidemiologic studies[5,7,9] have revealed that people who had suffered from persistent insomnia from the baseline to a follow-up survey conducted several years later had a markedly increased risk for developing depression at the follow-up compared to people who had not suffered from insomnia. This finding was consistent in studies of young adults[6,10] and of older adults.[11,12] Therefore, insomnia is considered an important risk factor for the development of depression. However, thus far, no longitudinal study has been performed in Japan regarding this issue. In addition, previous studies have not yet elucidated which of the insomnia symptoms (eg, sleep quality, sleep onset latency, sleep duration, sleep efficiency, and daytime dysfunction) becomes a risk factor for developing depression. Moreover, the relationship between the occurrence and persistence/disappearance of insomnia symptoms in a long-term interval and the development of depression has not been sufficiently confirmed, especially in the Asian population. In addition, if the chronicity of insomnia is actually involved in the development of depressive symptoms, it still remains unclear as to what level of insomnia severity leads to chronic morbidity of insomnia.

In order to clarify these issues, we conducted a longitudinal study on the basis of an anonymous self-rating questionnaire survey over a 2-year interval on a rural population cohort in Japan.

METHOD

Participants and Procedure

The Ethics Committee of Tottori University, Tottori, Japan, approved this study. Two-point epidemiologic surveys with a 2-year interval were performed on the same adult cohort in the town of Daisen in Tottori Prefecture, Japan. In 2004, the total population of the town was 6,643, and there were 5,528 residents aged 20 years or older (2,521 men, 3,007 women, mean age = 55.2 years). The questionnaire survey was conducted from November 2005 to January 2006 as the first survey (baseline) and from November to December 2007 as the second survey (follow-up). With the cooperation of local public health nurses, questionnaires with individual code numbers were delivered to all residents aged 20 years and older at baseline and at follow-up. All the participants gave their written informed consent to participate in this study at the time of questionnaire delivery. Response to the questionnaire was obtained from 2,825 people anonymously at the baseline survey (responder rate, 51%; 1,220 men, 1,605 women; mean [SD] age = 57.4 [17.7] years). Two years later, a follow-up survey was conducted of the people who had submitted responses for the baseline survey, and 1,577 of them responded to the questionnaire (responder rate, 56%; 683 men, 894 women; mean [SD] age = 58.6 [16.1] years; Figure 1). The respondents of the 2 surveys were matched using code numbers.

Clinical Points

- Patients with chronic insomnia are highly likely to develop and sustain depression.
- Current evidence best supports the position that early intervention for insomnia patients with 7.5 or higher score on the Pittsburgh Sleep Quality Index can be helpful for the prevention, onset, and relapse of depression.

Measures

The contents of the questionnaire were as follows:

(1) Demographic variables—The participants were asked about their age, gender, disease currently treated ("What kind of disease you are currently being treated for?"), family constitution ("Do you currently live with your family?"), smoking habits ("Do you currently smoke?"), and alcohol habits ("Do you currently have a drinking habit?").

(2) The Japanese version of the Pittsburgh Sleep Quality Index (PSQI)[13]—We used the scale for estimating sleep disturbance. The PSQI included subitems evaluating sleep quality (C1), sleep latency (C2), sleep duration (C3), habitual sleep efficiency (C4), sleep disturbance (C5), use of sleeping medication (C6), and daytime dysfunction (C7). The cutoff score of PSQI for insomnia was already determined to be 5.5 points.[13] Therefore, in this study, responders with PSQI scores of 6 or higher were considered to have insomnia.

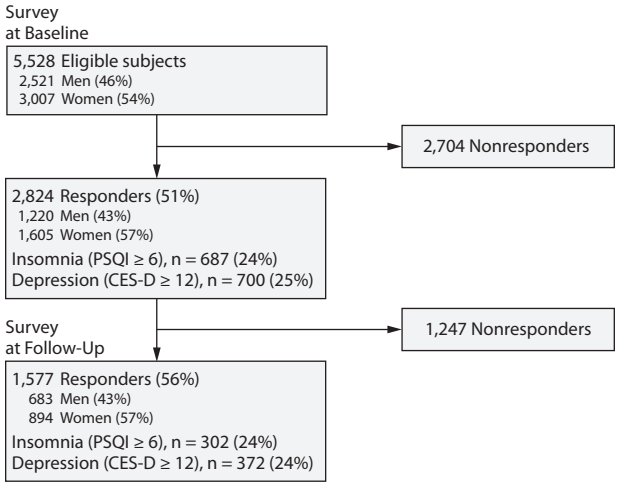
(3) Twelve-item version of the Center for Epidemiologic Studies Depression Scale (CES-D)[14]—We used the scale for estimating depressive symptoms similar to the report by Kaneita et al.[15] The scale had 4 response options, namely, "never or rarely," "sometimes," "often," and "always," which were coded 0 to 3, respectively. We used the total scores of CES-D as parameters of depression, and the scores were divided into 3 categories: 0 to 11 as normal, 12 to 20 as moderate, and 21 to 36 as severe.[14] On the basis of these criteria, we classified the participants into a nondepression group (CES-D score < 12) and a depression group (CES-D score ≥ 12).

Statistical Analysis

All statistical and receiver operating characteristic (ROC) analyses were performed using SPSS (version 11.5, SPSS Japan, Inc, Tokyo) unless otherwise stated.

Using the above-mentioned standard cutoff score of PSQI and CES-D, we classified the participants on the basis of the presence/absence of insomnia and depression in both surveys. Using this classification, we performed a univariate and multivariate logistic regression analysis with the presence/absence of depression during the follow-up as a dependent variable and the above-mentioned demographic variables (gender, age, disease currently treated, drinking habit, smoking habit, and living alone) and the presence/absence of insomnia and depression as independent variables. In addition, to determine the insomnia symptom component associated with the presence of depression at the follow-up, we conducted univariate and multivariate logistic regression analyses with the presence/absence of depression at the follow-up as a dependent variable and the scores of PSQI subscales as independent variables.

Figure 1. Participants Flowchart



Abbreviations: CES-D = Center for Epidemiologic Studies Depression Scale, PSQI = Pittsburgh Sleep Quality Index.

On the basis of the results of the 2 surveys, the participants were divided into 4 insomnia subcategories (ie, i-category 1, the category without insomnia symptoms during both surveys; i-category 2, the category in which participants did not have insomnia symptoms at the baseline but had them at the follow-up; i-category 3, the category in which the participants had insomnia symptoms at the baseline but did not have the symptoms at the follow-up; and i-category 4, the category with insomnia symptoms during both surveys). The participants were also divided into 4 depression subcategories (ie, d-category 1, the category without depressive symptoms at both surveys; d-category 2, the category in which participants did not have depressive symptoms at the baseline but had them at the follow-up; d-category 3, the category in which participants had depressive symptoms at the baseline but did not have them at the follow-up; and d-category 4, the category with depressive symptoms during both surveys). In order to elucidate the association between the changes in the status of insomnia and depression symptoms on the basis of these classifications, we conducted a logistic regression analysis controlling for demographic variables by using the "new appearance of depression at the follow-up" (d-category 1 vs d-category 2) and the "repeated existence of depressive symptoms" (d-category 3 vs d-category 4) as dependent variables and the course patterns of insomnia (i-categories 1, 2, 3, 4) as an independent variable.

Receiver operating characteristic curves[16] were plotted and the mean (95% confidence interval) estimated area under the curve (AUC) for the PSQI score at the baseline was calculated targeting the repeated existence of insomnia at the follow-up. When the slope of the tangent line of the

Table 1. Descriptive Statistics of Demographic Data, the Scores on CES-D and PSQI, and Frequency of Medication Use Among the Participants

	Insomnia Negative at Baseline (n = 879)		Insomnia Positive at Baseline (n = 299)	
Characteristic	Insomnia Negative at Follow-Up (i-category 1, n = 762)[a]	Insomnia Positive at Follow-Up (i-category 2, n = 117)[b]	Insomnia Negative at Follow-Up (i-category 3, n = 128)[c]	Insomnia Positive at Follow-Up (i-category 4, n = 171)[d]
Gender, n				
Male	357	47	52	72
Female	405	70	76	99
Age, mean (SD), y	58.6 (15.8)	60.3 (16.2)	58.1 (15.8)	62.5 (15.9)
Disease currently treated, n (%)				
Baseline	273 (23.2)	41 (3.5)	49 (4.2)	80 (6.8)
Follow-up	295 (25.0)	56 (4.8)	43 (43.7)	94 (8.0)
Drinking habit, n (%)				
Baseline	300 (25.6)	48 (4.1)	50 (4.3)	55 (4.7)
Follow-up	218 (18.6)	41 (3.5)	39 (3.3)	37 (3.1)
Smoking habit, n (%)				
Baseline	143 (12.2)	24 (2.0)	26 (2.2)	31 (2.6)
Follow-up	131 (11.1)	22 (1.9)	25 (2.1)	32 (2.7)
Living alone, n (%)				
Baseline	23 (2.0)	2 (0.2)	4 (0.3)	9 (0.8)
Follow-up	25 (2.2)	4 (0.3)	5 (0.4)	9 (0.8)
CES-D score, mean (SD)				
Baseline	7.1 (4.0)	9.1 (4.4)	10.5 (5.1)	11.9 (5.1)
Follow-up	7.3 (4.0)	11.5 (4.3)	8.9 (3.9)	12.4 (5.1)
PSQI score, mean (SD)				
Baseline	2.7 (1.4)	3.6 (1.3)	7.1 (1.4)	8.4 (2.3)
Follow-up	2.8 (1.4)	7.3 (1.5)	3.6 (1.2)	8.2 (2.3)
Sleeping medication use score, mean (SD)[e]				
Baseline	0.0 (0.1)	0.0 (0.3)	0.4 (1.0)	1.0 (1.3)
Follow-up	0.0 (0.2)	0.7 (1.2)	0.1 (0.4)	1.0 (1.3)

[a]Includes subjects without insomnia symptoms at both surveys.
[b]Includes subjects who did not have insomnia symptoms at the baseline but had symptoms at the follow-up.
[c]Includes subjects who had insomnia symptoms at baseline but did not have symptoms at the follow-up.
[d]Includes subjects with insomnia symptom at both surveys.
[e]Frequency of medication use was rated on C6 on PSQI (0, not during the past month; 1, less than once a week; 2, once or twice a week; 3, 3 or more times a week).
Abbreviations: CES-D = Center for Epidemiologic Studies Depression Scale, PSQI = Pittsburgh Sleep Quality Index.

ROC curve was statistically equal to 1 (ie, AUC = 0.5), computed by the SPSS software, the ROC curve was regarded as inaccurate for prediction. The best cutoff value for the repeated existence of insomnia was determined on the basis of sensitivity, specificity, and positive likelihood ratio and negative likelihood ratio. In accordance with the authorized method, the cutoff score was assessed as adequate when positive likelihood ratio was 2.0 or higher and negative likelihood ratio was 0.5 or less.[17]

RESULTS

When the demographic data pertaining to the responders who answered only at the baseline (n = 1,247) and those who responded at both the baseline and the follow-up (n = 1,577) were compared, the result showed a significant difference in age ($t_{2394} = -3.56$, $P < .01$; mean [SD] age = 55.9 [19.6] vs 58.6 [16.1] years), but the difference between the 2 groups was only 2.7 years. No gender difference was found. Of the 687 responders who were assessed as having insomnia at baseline, 385 (56.0%) responded at the follow-up. A comparison between the responders who answered only at the baseline and those who responded at both the baseline and the follow-up showed a statistical difference in age ($t_{471} = -2.20$, $P = .02$; mean [SD] age = 56.9 [19.5] vs 60.1 [16.0] years), but the difference between the 2 groups was only 3.2 years. No gender difference was found (men/women, n/n = 113/143 vs n/n = 154/231; $\chi^2_1 = 1.09$; $P = .3$). The comparison of the percentages of participants with insomnia or depression at each survey showed that the percentages were almost similar in both surveys ([insomnia] baseline, 24.0%; follow-up, 24.3%; [depression] baseline, 24.9%; follow-up, 24.4%). The participants who belonged to i-category 1 accounted for 64.2%; i-category 2, 9.9%; i-category 3, 10.9%; and i-category 4, 14.5%. Table 1 shows the demographic data of each survey, the CES-D scores, PSQI total scores, and frequency of the use of sleep medication manifested as C6 score of the PSQI scale. The number of participants taking sleep medication 3 days a week or more (C6 score = 3) was 82 (5.6%) at baseline and 105 (7.0%) at follow-up. A total of 161 participants (10.6%) answered that they had received treatment for insomnia in the period between the 2 surveys.

Association Between the Baseline Data and the Presence/Absence of Depression at the Follow-Up

To examine the risk factors on the presence of depression at the follow-up, we conducted univariate and multivariate logistic regression analyses. The results of both analyses revealed that CES-D score ≥ 12 and PSQI score ≥ 6 at the

Table 2. Logistic Regression Analysis on the Associated Factors for the Existence of Depression (CES-D score ≥ 12) at the Follow-Up Among the Descriptive Variables[a]

Baseline	Total Sample, N	Positive for Depression at the Follow-Up, n (%)	Univariate Relative Risk (95% CI)[b]	*P*	Multivariate Relative Risk (95% CI)	*P*
Gender						
Male	664	148 (22.3)				
Female	871	224 (25.7)		NS		NS
Age[c]						
< 60	666	169 (25.4)				
≥ 60	868	203 (23.4)		NS		NS
Disease currently treated						
No	933	218 (23.4)				
Yes	602	154 (25.6)		NS		NS
Drinking habit						
No	955	225 (23.6)				
Yes	563	243 (43.2)		NS		NS
Smoking habit						
No	1,247	288 (23.1)				
Yes	272	79 (29.0)	1.4 (1.0–1.8)	.04		NS
Living alone						
No	1,493	348 (24.0)				
Yes	66	22 (34.4)		NS		NS
CES-D score						
< 12	1,131	168 (14.9)				
≥ 12	320	180 (56.3)	7.4 (5.6–9.7)	< .001	6.0 (4.4–8.0)	< .001
PSQI score						
< 6	1,052	188 (17.9)				
≥ 6	376	160 (42.6)	3.4 (2.6–4.4)	< .001	2.1 (1.5–2.8)	< .001

[a]The analyses within this table were conducted on the subset with complete data for each variable.
[b]Relative risks approximated with odds ratios.
[c]The age category was divided at the median age (= 60 years old).
Abbreviations: CES-D = Center for Epidemiologic Studies Depression Scale, NS = nonsignificant, PSQI = Pittsburgh Sleep Quality Index.

Table 3. Logistic Regression Analysis on the Associated Factor for the Existence of Depression (CES-D score ≥ 12) at the Follow-Up Among PSQI Variables

PSQI Subitem	Univariate Relative Risk (95% CI)[a]	*P*	Multivariate Relative Risk (95% CI)	*P*
C1: sleep quality	2.6 (2.1–3.2)	< .01	1.6 (1.3–2.1)	< .01
C2: sleep latency	1.7 (1.5–2.0)	< .01	1.2 (1.0–1.5)	< .01
C3: sleep duration	1.1 (1.0–1.3)	NS	1.1 (0.9–1.3)	NS
C4: habitual sleep efficiency	1.5 (1.3–1.8)	< .01	1.1 (0.9–1.3)	NS
C5: sleep disturbance	2.5 (2.0–3.1)	< .01	1.3 (1.0–1.7)	< .01
C6: use of sleeping medication	1.5 (1.3–1.8)	< .01	1.2 (1.0–1.4)	< .01
C7: daytime dysfunction	2.3 (1.9–2.8)	< .01	1.8 (1.4–2.2)	< .01

[a]Relative risks approximated with odds ratios.
Abbreviations: CES-D = Center for Epidemiologic Studies Depression Scale, NS = nonsignificant, PSQI = Pittsburgh Sleep Quality Index.

baseline were factors significantly associated with the presence of depression at the follow-up ([CES-D] univariate OR = 7.4; 95% CI, 5.6–9.7; multivariate OR = 6.0; 95% CI, 4.4–8.0; [PSQI] univariate OR = 3.4; 95% CI, 2.6–4.4; multivariate OR = 2.1; 95% CI, 1.5–2.8; respectively [Table 2]). The same result was obtained from the multivariate logistic regression analysis when the item for insomnia was excluded from the total CES-D score and item C7, which may assess depressive thought, was excluded from the total PSQI ([CES-D] OR = 4.5; 95% CI, 3.3–6.2; [PSQI] OR = 1.6; 95% CI, 1.1–2.2).

Since it was revealed that the existence of insomnia at baseline was associated with the presence of depressive symptoms at follow-up, we conducted univariate and multivariate logistic regression analyses to examine which of the insomnia symptom components were associated with depression at the follow-up. The results showed that poor quality of sleep (C1, OR = 1.6), sleep latency (C2, OR = 1.2), sleep disturbance (C5, OR = 1.3), use of sleeping medication (C6, OR = 1.2), and daytime dysfunction (C7, OR = 1.8) at the baseline were factors significantly related to the presence of depression at the follow-up (Table 3). However, sleep duration (C3) and habitual sleep efficiency (C4) did not appear to be significantly associated factors.

Examining the Association Between Symptoms of Insomnia and Depression Through the 2 Surveys

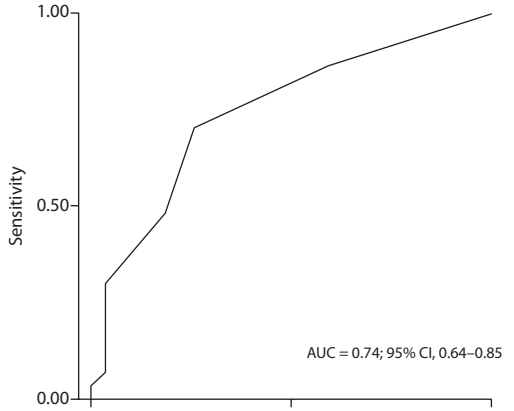
The results of the logistic regression analysis showed that i-category 2 (OR = 10.0) and i-category 4 (OR = 7.0) were significantly associated factors for the new appearance of depression at the follow-up in comparison to i-category 1. In addition, it was revealed that i-category 4 (OR = 3.3) was

Table 4. Associated Risk for the New Appearance of Depression at Follow-Up or the Repeated Existence of the Symptom at 2 Surveys in Relation to the Variations of Insomnia Course Pattern Categories[a]

Variable	i-Category 1 (n = 762)	i-Category 2 (n = 117)	i-Category 3 (n = 128)	i-Category 4 (n = 171)
New appearance of depressive symptom at follow-up, n (%)	48 (6.3)	39 (33.3)	10 (7.8)	29 (17.0)
Unadjusted odds ratio (95% CI)	…	10.1 (6.0–16.8)*	1.8 (0.9–3.7)	6.3 (3.6–10.9)*
Adjusted odds ratio (95% CI)[b]	…	10.0 (5.9–16.7)*	1.8 (0.9–3.7)	7.0 (3.9–12.2)*
Repeated existence of depressive symptom, n (%)	40 (5.3)	16 (13.7)	16 (12.5)	54 (31.6)
Unadjusted odds ratio (95% CI)	…	2.3 (1.0–5.9)	0.7 (0.4–1.6)	2.8 (1.5–5.4)*
Adjusted odds ratio (95% CI)[b]	…	2.5 (0.9–6.8)	0.7 (0.3–1.6)	3.3 (1.6–6.6)*

[a]i-Category 1: the category of subjects without insomnia symptoms at both surveys; i-category 2: the category in which subjects did not have insomnia symptoms at the baseline but had symptoms at the follow-up; i-category 3: the category in which subjects had insomnia symptoms at baseline but did not have symptoms at the follow-up; i-category 4: the category of subjects with insomnia symptoms at both surveys.
[b]Odds ratio adjusted for the factors including gender, age, disease currently treated, habitual alcohol ingestion, smoking habit, and living alone, with i-category 1 as the reference.
*$P < .001$.

Figure 2. Cutoff Point of the Pittsburgh Sleep Quality Index for the Repeated Existence of Insomnia Estimated With Receiver Operating Characteristic Curve



Cutoff Point	Sensitivity	Specificity	Positive Likelihood Ratio	Negative Likelihood Ratio
5.0	1.00	0.00	1.00	…
6.5	0.86	0.41	1.45	0.34
7.5	0.70	0.74	2.70	0.40
8.5	0.48	0.81	2.61	0.63

Abbreviation: AUC = area under the curve.

a factor significantly associated with the repeated existence of depression (Table 4).

The PSQI Cutoff Score for Predicting the Existence of Depression at the Follow-Up

The results described above revealed that the repeated existence of insomnia (i-category 4) has an influence on both the new appearance of depression and the repeated existence of depression at the follow-up. Therefore, we used the ROC curve to examine the cutoff value of the PSQI scores at the baseline for participants who repeatedly had insomnia at the follow-up. As a result, AUC of the ROC curve was 0.74 (95% CI, 0.64–0.85), and it was statistically larger than 0.50. The cutoff value of the PSQI at baseline was estimated at 7.5 points. This cutoff value's sensitivity was 70%, specificity was 74%, positive likelihood ratio was 2.70, and negative likelihood ratio was 0.40 (Figure 2).

DISCUSSION

We conducted a longitudinal study over a 2-year interval on a rural population cohort in Japan to examine whether persistent insomnia was a risk factor for the existence of depression at the follow-up using a multivariate logistic regression analysis. The results revealed that the risk of depression at the follow-up was high, with an OR of 2.1 for people with insomnia at the baseline. This finding is compatible with the reports in Western countries.[5,7] In addition, OR values between 2 and 4 reported in previous cohort studies for the later existence of depression relating to the presence of insomnia at the baseline[7,12,18] were equivalent to the results of this study (OR = 2.1).

This is the first study examining the relationship between each insomnia symptom component at the baseline and the presence of depression at the follow-up from a prognostic viewpoint. As a result, poor quality of sleep (C1), sleep latency (C2), sleep disturbance (C5), use of sleeping medication (C6), and daytime dysfunction (C7) were significantly associated with the presence of depression at follow-up. Few studies have examined the symptom components of insomnia associated with depression. In the report by Chang et al,[19] people's poor quality of sleep and less than 7 hours of sleep during their university days were associated with the occurrence of depression in the later years. Because their study showed the association between insomnia and depression occurring 30 or more years later, a simple comparison with our study results is not possible, although the findings of our study and those of Chang's study[19] are congruent with respect to the fact that poor quality of sleep was involved in the risk factors of later occurrence of depression. Early morning awakening has been believed to be a pathognomonic symptom of depression.[20] Recently, however, cross-sectional surveys[15,21] have shown that difficulty in initiating sleep is a factor associated with the presence of depressive symptoms. In particular, a study by Kaneita et al[15] conducted on a community sample of persons aged 20 years or older in a cross-sectional survey revealed that, among the symptoms of insomnia, difficulty in initiating sleep had the highest odds of association with depression (difficulty initiating sleep,

OR = 1.56; difficulty maintaining sleep, OR = 1.49; early morning awakening, OR = 1.34). Interestingly, our result showed that difficulty in initiating sleep at the baseline was indicated as a possible long-term risk factor for the presence (development or persistence) of depression. In other words, from the prophylactic viewpoint, clinicians treating patients who complain of difficulty in initiating sleep should consider the possibility of future development of depression.

The results of the relationship between the successive changes in the status of both insomnia and depression have shown that the new appearance and the repeated existence of insomnia are significantly associated with the new appearance of depression during the follow-up, and that the repeated existence of insomnia is significantly associated with the repeated existence of depression in both surveys. Previous studies have shown that the existence of insomnia that persisted for 2 weeks or more sometime during the survey period was significantly predictive of developing a major depressive episode.[10] In addition, it has been reported that, in people who were affected with persistent insomnia for 1 year, the risk of developing depression 1 year later was high, with an OR in a subsequent survey of about 40.[9] The results of this study showed that for people whose insomnia lasted for 2 years, the ORs of a new appearance of depression at the follow-up and of the repeated existence of depression were 7 and 3, respectively. These findings indicate that persistent insomnia is strongly related to the development and prolongation of depression, although there was a difference in the odds ratio between the studies, possibly because of a difference in terms of target populations and survey methods. Therefore, from the perspective of the prevention of depression, it would be clearly important to prevent chronicity and development of insomnia.

It is noteworthy that the results of the ROC curve revealed that, in the 2-year prognosis, insomnia was highly likely to appear repeatedly in people whose PSQI score exceeded 8 points at the baseline. The PSQI cutoff score for the chronicity of insomnia in the participants examined in this study (7.5 points) was unexpectedly lower than the general average PSQI score of patients with chronic insomnia examined in a clinical setting (range of mean scores: 10–12 points).[22,23] However, undoubtedly, the patients in clinical settings who seek treatment for insomnia experience a higher severity of the symptom than the general population. In addition, while the majority of patients with chronic insomnia in a clinical setting use sleep medication,[24] the frequency of the use of sleep medication by the participants examined in this study was extremely low (baseline C6 mean score, 0.23; the number of participants who used medication for 3 days a week or more, 89 [5.6%]; follow-up C6 mean score, 0.27; the number of participants who used medication for 3 days a week or more, 105 [7.0%]), and this might have played a role in the low score of PSQI in the participants with insomnia in our study. Thus, in order to prevent the subsequent development of depression, intensive treatment would presumably be necessary for the cases with PSQI scores of 8 or above if they do not take any sleep medication.

Limitations

First, we used the cutoff value of an established questionnaire-based rating scale to define insomnia and depression in this study. To obtain an accurate diagnosis, it might be necessary to diagnose through structured interviews. The findings of our study, which showed that insomnia at the baseline is a factor related to the long-term development of depression, are relatively consistent with previous studies in which participants were diagnosed using a structured interview.[7,10] Therefore, the results of this study regarding this issue are unlikely to deviate much from the actual conditions.

Second, the 12-item version of CES-D we used includes an item inquiring the severity of insomnia, and item C7 of PSQI may assess depressive thought (the problem of keeping up enough enthusiasm to get things done). However, we confirmed that the same results were obtained after excluding these items from the CES-D and the PSQI.

Third, we classified the successive changes in the status of insomnia and depression into 4 categories on the basis of survey scores obtained at 2 points in time, but because the 2 surveys were separated by a long interval of 2 years, the changes in insomnia and depressive symptoms may not have been assessed accurately. Therefore, it is unclear whether insomnia actually precedes or follows the occurrence of depression in the participants. In other words, our categorization does not apply to the cases wherein symptom levels have changed several times during the survey period, and this point cannot be elucidated through this study. To clarify this issue, future studies should use more frequent assessments with monthly or longer reference periods to obtain more reliable data about insomnia, as indicated by Morin et al.[25]

Finally, the response rate was approximately 50% at both survey points in this study. However, a sampling bias was considered to be relatively small, because a significant but small difference was observed only in age when demographic variables of the responders who answered only at the baseline and of those who responded to both the surveys were compared.

CONCLUSION

Our results revealed that insomnia is a risk factor for the development and persistence of depression in Japan, and insomnia symptoms, especially poor quality of sleep, difficulty in initiating sleep, and daytime dysfunction, are factors significantly related to depression. In addition, the results suggested that persistent insomnia is likely to increase the risk of new appearance or repeated existence of depression in the long-term prognosis. In particular, insomnia is highly likely to become chronic in people with untreated insomnia with PSQI scores of 8 or higher, and this outcome may lead to the risk of development and persistence of depression. These results emphasize that insomnia needs to be treated cautiously to prevent the occurrence of depression.

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