The Relationship Between Depression and Sleep Disturbances: A Japanese Nationwide General Population Survey

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Objective: Among the existing epidemiologic studies that have examined the relationship between depression and sleep disturbances, there are few nationwide studies that have been conducted on subjects representing the general population. The present study was therefore conducted to clarify the relationship between depression and sleep disturbances, in particular the relationship between depression and both sleep duration and subjective sleep sufficiency, using a large sample representative of the general population.

Method: The survey was conducted in June 2000, using self-administered questionnaires, targeting a population that was selected randomly from among 300 communities throughout Japan. Among the respondents, data from 24,686 individuals aged 20 years or older were analyzed. The Center for Epidemiologic Studies Depression Scale was used to assess the presence of depression. Sleep status, including sleep duration, subjective sleep sufficiency, and the presence or absence of insomnia symptoms, was evaluated.

Results: Those whose sleep duration was less than 6 hours and those whose sleep duration was 8 hours or more tended to be more depressed than those whose sleep duration was between 6 and 8 hours. Thus, sleep duration exhibited a U-shaped association with symptoms of depression. As subjective sleep sufficiency decreased, symptoms of depression increased, indicating a linear inverse-proportional relationship.

Conclusion: The fact that sleep duration and subjective sleep sufficiency exhibited different relationships with symptoms of depression indicates that these 2 sleep parameters each have their own significance with regard to depression. These findings may be useful in the medical management of mental diseases.

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Both depression and sleep disturbances are mental disorders that can be observed often in today's developed countries. Symptoms of various sleep disturbances are often recognized among people suffering from depression and are included in the *International Statistical Classification of Disease and Related Health Problems*, Tenth Revision,[1] and the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition,[2] as diagnostic criteria for depression. Historically, it has been assumed that depression causes sleep disturbances. However, sleep disturbances may also affect depression, and several studies have provided data suggesting that sleep disturbances are risk factors for the development of depression.[3–7] Treatment for depression usually improves sleep significantly. Conversely, when the sleep disturbance predominates, treatment for it may improve the management of depression.[8] Thus, it can be said that depression and sleep disturbances can mutually become each other's cause and result. Therefore, it is important to clarify the close relationship between these 2 conditions for their prevention and effective management.

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From a physiologic perspective, studies on the relationship between depression and sleep disturbances using polysomnography have shown that symptoms such as prolonged sleep latency, increased wakefulness during sleep, and early-morning awakening can be associated with depression.[9] There is also evidence for a relationship between depression and sleep disturbances from an epidemiologic perspective. Ford and Kamerow[3] found that subjects who complained of persistent insomnia were 3 times more likely to develop depression than those without persistent insomnia. Livingston et al.[4] reported that the strongest predictor of future depression among those who were not depressed at baseline was sleep disturbance at baseline, and Breslau et al.[5] reported that the relative risk for the onset of major depression was 4 times greater for subjects with a lifetime history of 2 or more weeks of insomnia than for those without such a complaint.

These studies are significant in that they indicate, through longitudinal observation of the subjects, that sleep disturbances could be a risk factor for the onset of depression. However, these epidemiologic studies have some limitations. First, few studies have analyzed sleep disturbances from diverse perspectives, for example by including items such as sleep duration and subjective sleep sufficiency. Second, few studies have selected subjects that are representative of the general adult population; in most studies, subjects were selected from a particular age group or community. Third, most studies were conducted with small sample sizes; there has been no large-scale survey targeting 10,000 or more individuals.

In our study, an epidemiologic survey targeting over 24,000 subjects representative of the general adult population of Japan was conducted to search for symptoms of depression and to examine the association between those symptoms of depression and sleep disturbances. The purposes of our study were to clarify the prevalence of symptoms of depression and sleep disturbances and to analyze closely the association between symptoms of depression and sleep disturbances (in particular, the associations between symptoms of depression and sleep duration, subjective sleep sufficiency, and insomnia symptoms were to be clarified).

METHOD

Selection of Subjects

The present study was part of a national survey (Active Survey of Health and Welfare) organized by the Statistics and Information Department of the Ministry of Health, Labour and Welfare of Japan. This national survey was planned to collect basic information on health and welfare and included questions concerning symptoms of depression and sleep. The survey was conducted through health centers across Japan.

This survey was conducted in subjects from 300 census precincts in Japan selected randomly from among some 824,000 precincts, which had been apportioned for equal population size. Each census precinct was numbered from north to south, and 300 precincts were selected by choosing precinct numbers at certain intervals. As a result, the sample represented the entire country. A health center with jurisdiction for each precinct was designated. Investigators sent by those health centers visited all the households to distribute the questionnaires and collected them a few days later. The survey targets were all those aged 12 years or older in the 300 sampled precincts. The survey was conducted simultaneously throughout Japan in June 2000. Oral informed consent was obtained from subjects. Participants' privacy was protected in accordance with Declaration of Helsinki guidelines.

Measures

A self-administered questionnaire was devised by 2 of the authors (T.O. and M.U.) with the appropriate official of the Ministry of Health, Labour and Welfare. This questionnaire consisted of 44 items, including items on (1) sociodemographic information such as age, gender, and size of the community; (2) general health status; (3) physical and psychological complaints; (4) information on mental stress; and (5) sleep habits and sleep problems as well as (6) the Japanese version of the Center for Epidemiologic Studies Depression Scale (CES-D).[10]

The CES-D, which is a 20-item inventory designed specifically to assess symptoms of depression in the general population, was used to screen for current depressive states during the period of 1 week leading up to the survey. This questionnaire is adequately reliable and valid for use in a general population. The CES-D yields an item score (range, 0–3) and the sum of the 20-item scores (range, 0–60). Higher scores indicate increasing severity of symptoms of depression. Although this scale is designed to screen, but not diagnose major depression, a score of 16 or higher is highly suggestive of symptoms of depression. In addition, a score of 25 or higher is assumed to be a severer cutoff point in several studies.[11,12] Shima et al.[13] developed the Japanese version of the CES-D, examined its reliability and validity, and recommended the cutoff point to be set at 16, as with the U.S. version of the CES-D.

The following 6 questions about sleep experienced during the previous month (listed here followed by the variables that they targeted) were embedded in the questionnaire:

1. "Do you have difficulty falling asleep?" (yes/no): difficulty initiating sleep (DIS).
2. "Do you wake up during the night after you have gone to sleep?" (yes/no): difficulty maintaining sleep (DMS).

Table 1. Demographic Characteristics of Analyzed Subjects in a Sample of the Japanese Adult General Population (N = 24,686)[a]

	Percentage in Age Group					
Data Set	20–29 y	30–39 y	40–49 y	50–59 y	60–69 y	70+ y
Present study						
Male (N = 11,752)	18	18	19	21	15	9
Female (N = 12,934)	18	18	18	20	14	12
Census						
Male	19	18	17	20	15	12
Female	17	16	16	19	15	17

[a]Data for both the present study and the overall census were obtained in 2000.

3. "Do you wake up too early in the morning?" (yes/no): early morning awakening (EMA).
4. "Do you fall asleep when you must not sleep (for example when you are driving a car)?" (yes/no): excessive daytime sleepiness (EDS).
5. "Do you obtain sufficient rest during sleep?" (very sufficient/sufficient/insufficient/very insufficient): subjective sleep sufficiency.
6. "How many hours do you sleep on average?": sleep duration.

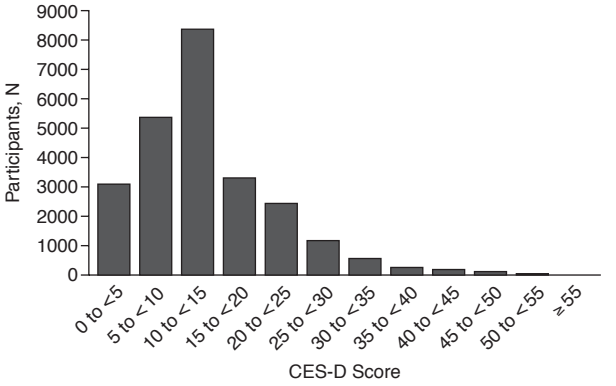
Experience of physical and psychological complaints during the previous month was indicated by an answer of yes or no. These complaints included headache, dizziness, palpitation/dyspnea, epigastric discomfort, constipation/diarrhea, stiff neck/shoulder, backache, easy fatigability, persistent fatigue, irritability, anxiety, and worrying about health.

Statistical Analysis

Questionnaires were returned by 32,729 subjects. The Ministry of Health, Labour and Welfare did not publish the number of residents contacted in the target communities, and so the return rate could not be calculated. However, the collection rates of similar investigations carried out 3, 4, and 6 years prior were 87.1%, 89.6%, and 87.3%, respectively. It can be assumed that since the present study was performed using similar methods, the collection rate is likely to have been similar to those observed previously. The Minister of Health, Labour and Welfare gave us permission to use these survey data. Before analysis, 707 subjects who submitted blank answer forms were excluded from the study. Subjects under 20 years of age (N = 3086) were also excluded, because this study was aimed at adults. In addition, subjects who had not responded to the questions on gender and/or age were also excluded (N = 222). Furthermore, subjects who had omitted 6 or more answers on the CES-D were excluded from the analysis (N = 4028).

For the statistical analysis, the CES-D scores were first calculated. To examine the association between sleep and CES-D scores, we calculated CES-D scores based on responses to the remaining 19 questions after excluding 1 sleep question from the CES-D questionnaire. In addition, because some subjects may have omitted 5 or fewer answers on the CES-D questionnaire, we adjusted for CES-D scores using the following formula, to correct them as a conventional scale of 0 to 60: "CES-D score" = "sum of 19 item scores" × "20/19" × "19/number of answered questions." The prevalence of those having a CES-D score of 16 or higher and of 25 or higher and the mean value and standard deviation of the CES-D scores were then calculated according to gender and age group. Similarly, the associations between symptoms of depression and sleep duration and subjective sleep sufficiency, as well as with sleep disturbances such as DIS, DMS, EMA, and EDS, were examined. The significance of the categorical data, such as the prevalence of symptoms of depression, was analyzed using the χ^2 test, and the significance of the raw data of the CES-D was calculated using the Kruskal-Wallis test. Finally, logistic regression analyses were conducted to investigate factors associated with CES-D scores of 16 or higher and of 25 or higher. The following parameters were used as covariates: gender, age group, community size, physical and psychological complaints, sleep duration, subjective sleep sufficiency, DIS, DMS, EMA, and EDS. An odds ratio was calculated from both the univariate analysis and the multivariate logistic regression analysis with 95% confidence intervals. All analyses were performed using SPSS 11.5 for Windows (SPSS Inc., Chicago, Ill.).

Figure 1. Distribution of Center for Epidemiologic Studies Depression Scale (CES-D) Scores in a Sample of the Japanese Adult General Population (N = 24,686)[a]



[a]Mode peaking in the distribution was observed for scores of 10 or higher and below 15.

RESULTS

The total number of cases analyzed was 24,686 (11,752 men, 12,934 women). The demographic characteristics of the analyzed participants are shown in Table 1.

Table 2. Prevalence of Depressive Symptoms and Mean Center for Epidemiologic Studies Depression Scale (CES-D) Score by Gender and Age Group

Age Group, y	N	Prevalence of Depressive Symptoms, % (95% CI) CES-D Score ≥ 16	CES-D Score ≥ 25	Mean ± SD CES-D Score
Male				
20–29	2,151	28.6 (26.7 to 30.5)	8.9 (7.7 to 10.1)	13.4 ± 8.3
30–39	2,157	23.2 (21.4 to 25.0)	6.2 (5.2 to 7.2)	12.3 ± 7.9
40–49	2,251	26.7 (24.9 to 28.5)	8.2 (7.1 to 9.3)	13.2 ± 8.0
50–59	2,468	24.4 (22.7 to 26.1)	6.6 (5.6 to 7.6)	12.9 ± 7.5
60–69	1,712	23.5 (21.5 to 25.5)	8.1 (6.8 to 9.4)	13.1 ± 8.0
70+	1,013	32.3 (29.4 to 35.2)	14.1 (12.0 to 16.2)	14.6 ± 9.1
Total	11,752	25.9 (25.1 to 26.7)	8.1 (7.6 to 8.6)	13.1 ± 8.0
Female				
20–29	2,329	31.3 (29.4 to 33.2)	11.2 (9.9 to 12.5)	14.0 ± 8.7
30–39	2,362	29.2 (27.4 to 31.0)	9.1 (7.9 to 10.3)	13.2 ± 8.2
40–49	2,368	29.1 (27.3 to 30.9)	9.5 (8.3 to 10.7)	13.7 ± 8.4
50–59	2,592	28.7 (27.0 to 30.4)	8.7 (7.6 to 9.8)	13.6 ± 7.8
60–69	1,766	26.0 (24.0 to 28.0)	7.0 (5.8 to 8.2)	13.2 ± 7.7
70+	1,517	38.6 (36.2 to 41.0)	16.7 (14.8 to 18.6)	16.0 ± 9.8
Total	12,934	30.1 (29.3 to 30.9)	10.1 (9.6 to 10.6)	13.8 ± 8.4
Overall	24,686	28.1 (27.5 to 28.7)	9.1 (8.7 to 9.5)	13.5 ± 8.3

Abbreviation: CI = confidence interval.

Although the percentages of both men and women aged 70 years or older were slightly less than those revealed by the census, the percentages of other age groups were similar.

The distribution of the CES-D scores of the analyzed participants is shown in Figure 1. Mode peaking in the distribution was observed for scores of 10 or higher and below 15.

The prevalence of those having a CES-D score of 16 or higher and of 25 or higher and the mean value and standard deviation of the CES-D scores sorted by gender and by age group are shown in Table 2. The prevalence of depressive symptoms and the mean CES-D scores among women were significantly higher than those among men ($p < .01$ for both). By age group, both the prevalence of depressive symptoms and the mean CES-D scores among those aged 70 years or more showed the highest values.

The associations between (1) CES-D score and (2) sleep duration, subjective sleep sufficiency, and insomnia symptoms are shown in Table 3. As the sleep duration increased in 1-hour increments from 5 to 8 hours, there was a reduction in the prevalence of those having CES-D scores of 16 or higher and 25 or higher and in the mean value of the CES-D scores. However, after sleep duration exceeded 8 hours, the prevalence of those having CES-D scores of 16 or higher and 25 or higher and the mean value of the CES-D scores increased. The association between sleep duration and the mean value of the CES-D scores sorted by age group is shown in Figure 2. For all age groups, a U-shaped association was observed between sleep duration and CES-D score. A U-shaped association was observed in the analysis separated by gender (data not shown). As subjective sleep sufficiency decreased, the prevalence of those having CES-D scores of 16 or higher and 25 or higher and the mean value of the CES-D scores increased in inverse proportion. The association between subjective sleep sufficiency and the mean value of the CES-D scores sorted by age group is shown in Figure 3. For all age groups, a linear and unidirectional association was observed between subjective sleep sufficiency and CES-D score. A linear and unidirectional association was observed in the analysis separated by gender (data not shown). Among those having insomnia symptoms such as DIS, DMS, EMA and EDS, the prevalence of those having CES-D scores of 16 or higher and 25 or higher and the mean value of the CES-D scores were significantly higher than for those not having these insomnia symptoms.

The results of the logistic regression analyses, which were conducted to investigate factors associated with CES-D scores of 16 or higher and of 25 or higher, are shown in Table 4. In the multivariate logistic regression model, sleep duration, subjective sleep sufficiency, DIS, DMS, EMA, and EDS showed significant associations with symptoms of depression. The multivariate logistic regression model also revealed a U-shaped association between sleep duration and symptoms of depression; the odds ratio bottomed out at between 6 and 7 hours of sleep and became higher as sleep duration became either shorter or longer. The multivariate logistic regression model also revealed a unidirectional association between subjective sleep sufficiency and symptoms of depression.

DISCUSSION

The prevalence of those having CES-D scores of 16 or higher and 25 or higher among the general adult population in Japan was 28.1% and 9.1%, respectively. Although a simple comparison should be avoided because the age

Table 3. Prevalence of Depressive Symptoms and Mean Center for Epidemiologic Studies Depression Scale (CES-D) Score by Sleep Duration and Sleep Problems (N = 24,686)

		Prevalence of Depressive Symptoms					
Variable	N (%)	CES-D Score ≥ 16, % (95% CI)	p Value*	CES-D Score ≥ 25, % (95% CI)	p Value*	Mean ± SD CES-D Score	p Value†
Sleep duration, h[a]			< .01		< .01		< .01
< 5	608 (2.6)	47.9 (43.9 to 51.9)		23.8 (20.4 to 27.2)		18.1 ± 10.8	
5 to < 6	2,672 (11.3)	35.8 (34.0 to 37.6)		12.4 (11.2 to 13.6)		14.8 ± 8.8	
6 to < 7	7,452 (31.5)	27.3 (26.3 to 28.3)		8.1 (7.5 to 8.7)		13.2 ± 8.0	
7 to < 8	7,239 (30.6)	23.5 (22.5 to 24.5)		6.7 (6.1 to 7.3)		12.5 ± 7.5	
8 to < 9	4,442 (18.8)	25.5 (24.2 to 26.8)		7.9 (7.1 to 8.7)		13.1 ± 8.1	
9 to < 10	711 (3.0)	32.1 (28.7 to 35.5)		11.5 (9.2 to 13.8)		14.1 ± 8.6	
≥ 10	562 (2.4)	50.2 (46.1 to 54.3)		27.2 (23.5 to 30.9)		19.4 ± 11.3	
Subjective sleep sufficiency[b]			< .01		< .01		< .01
Very sufficient	4,449 (18.7)	14.5 (13.5 to 15.5)		3.7 (3.1 to 4.3)		10.7 ± 7.1	
Sufficient	11,204 (47.1)	23.2 (22.4 to 24.0)		6.2 (5.8 to 6.6)		12.5 ± 7.3	
Insufficient	6,988 (29.4)	39.5 (38.4 to 40.6)		13.5 (12.7 to 14.3)		15.6 ± 8.7	
Very insufficient	1,145 (4.8)	56.9 (54.0 to 59.8)		29.8 (27.2 to 32.4)		20.3 ± 11.5	
Difficulty initiating sleep			< .01		< .01		< .01
No	20,372 (82.5)	24.0 (23.4 to 24.6)		7.0 (6.6 to 7.4)		12.7 ± 7.7	
Yes	4,314 (17.5)	47.4 (45.9 to 48.9)		19.5 (18.3 to 20.7)		17.5 ± 9.7	
Difficulty maintaining sleep			< .01		< .01		< .01
No	19,574 (79.3)	23.6 (23.0 to 24.2)		6.8 (6.4 to 7.2)		12.6 ± 7.7	
Yes	5,112 (20.7)	45.4 (44.0 to 46.8)		18.1 (17.0 to 19.2)		17.1 ± 9.4	
Early morning awakening			< .01		< .01		< .01
No	19,061 (77.2)	25.6 (25.0 to 26.2)		8.0 (7.6 to 8.4)		12.9 ± 8.0	
Yes	5,625 (22.8)	36.7 (35.4 to 38.0)		13.0 (12.1 to 13.9)		15.4 ± 8.9	
Excessive daytime sleepiness			< .01		< .01		< .01
No	24,011 (97.3)	27.6 (27.0 to 28.2)		8.8 (8.4 to 9.2)		13.4 ± 8.2	
Yes	675 (2.7)	45.3 (41.5 to 49.1)		21.5 (18.4 to 24.6)		17.4 ± 10.0	

[a]Total N = 23,686. Subjects with missing data were excluded from the analysis.
[b]Total N = 23,786. Subjects with missing data were excluded from the analysis.
*χ^2 test.
†Kruskal-Wallis test.
Abbreviation: CI = confidence interval.

compositions of subject groups are different, the prevalence of those having CES-D scores of 16 or higher reported by most of the studies from Western countries[14–17] is 20% or less, which is lower than that revealed by the present study. A study in Korea[12] targeting subjects aged 20 to 59 years reported a prevalence of 25.3% and 8.7% for those having CES-D scores of 16 or higher and 25 or higher, respectively, which is similar to our results.

The higher prevalence of symptoms of depression rated by the CES-D in our study compared with those reported in other countries may be in part attributable to the fact that subjects aged 70 years or older accounted for about 10% of the subjects in our study, which targeted all adult age groups; that percentage was smaller in the other studies. The prevalence of those having a CES-D score of 16 or higher among the subjects aged 70 years or older in our study was 32.3% for men and 38.6% for women, which was the highest among any of the age groups. These figures pushed up the prevalence of symptoms of depression overall. It has already been reported that the prevalence of symptoms of depression among elderly people is higher,[18,19] and our results support this. Another reason may be the different attitude toward responding to CES-D questions due to differences in race and culture between Japan and Western countries. Iwata et al.[20] pointed out that CES-D scores were likely to be higher among Japanese than among Americans because the Japanese tended to suppress their positive emotional expression.

In our study, those getting less than 6 hours of sleep and those getting 8 hours or more were more depressed than those getting 6 to 8 hours of sleep, and a U-shaped association was thus observed between sleep duration and CES-D score. Chang et al.[6] reported, in their long-term prospective study, that those getting 7 hours of sleep or less were at higher risk of becoming depressed than those getting more than 7 hours of sleep. With regard to the association between long sleep duration and depression, Hartmann et al.[21] found in a laboratory study that people who always got more than 9 hours of sleep per night tended to be mildly depressed. Our results reconfirm the results of those previous studies, yet are independently important for the following reasons: (1) our sample size was large (over 24,000) and was representative of the general Japanese population, and (2) our study revealed a U-shaped association between sleep duration and symptoms of depression. This finding was made possible by our breaking down sleep duration into 1-hour increments between less than 5 hours and 10 hours or more. Although a U-shaped association between mortality and sleep dura-

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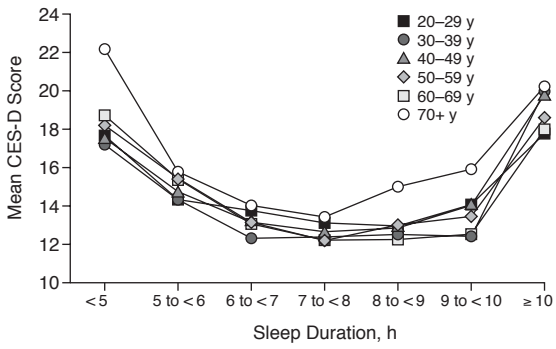
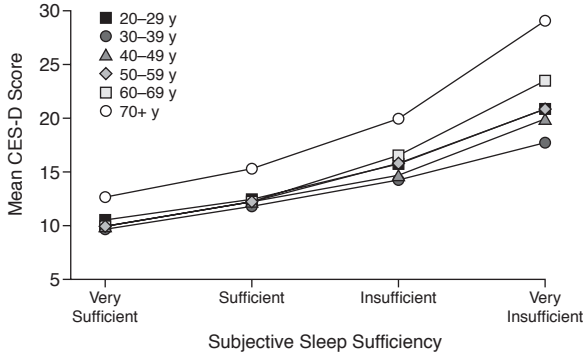
Figure 2. Relationship Between Sleep Duration and Mean Center for Epidemiologic Studies Depression Scale (CES-D) Score by Age Group in a Sample of the Japanese Adult General Population (N = 24,686)[a]



[a]For all age groups, a U-shaped association was observed between sleep duration and CES-D score.

Figure 3. Relationship Between Subjective Sleep Sufficiency and Mean Center for Epidemiologic Studies Depression Scale (CES-D) Score by Age Group in a Sample of the Japanese Adult General Population (N = 24,686)[a]



[a]For all age groups, a linear and unidirectional association was observed between subjective sleep sufficiency and CES-D score.

tion has been reported,[22–26] our report is the first to reveal a U-shaped association between sleep duration and symptoms of depression.

It is easy to assume that people tend to become depressed as a result of short sleep duration or that depression causes people to have less sleep. But why do those who sleep more than 8 hours show a trend toward becoming depressed? This phenomenon may be affected by some confounding factors, such as certain diseases or physical handicaps. To clarify this, we entered 12 physical and psychological complaints included among the survey items as adjustment factors into the logistic model for analysis. However, these factors in themselves do not explain why those who sleep more than 8 hours tend to become depressed. Detre et al.[27] reported that hypersomnia was not an unusual symptom of depression. Therefore, a longer sleep duration may be one of the pathological features of depression. Unfortunately, the mechanism underlying the association between hypersomnia and depression could not be clarified in the present study, and further investigations will be required.

On the contrary, a linear inversely proportional association was observed between subjective sleep sufficiency and CES-D scores, and it was found that as subjective sleep sufficiency decreased, the prevalence of symptoms of depression increased. Although the prevalence of depression among those aged 70 years or older was extremely high, common patterns were observed in all age groups with regard to the relationship between symptoms of depression and both sleep duration and subjective sleep sufficiency. These common patterns were also observed when we performed a gender-stratified analysis. The results suggested a U-shaped association between sleep duration and symptoms of depression and a linear inversely proportional association between subjective sleep sufficiency and symptoms of depression, regardless of gender and age. In addition, it is interesting that different patterns of associations with symptoms of depression were observed for sleep duration and subjective sleep sufficiency. It may be that these 2 sleep parameters each have their own significance.

As to each insomnia symptom, subjects having DIS, DMS, EMA, or EDS were more depressed than subjects who were free of those symptoms. Our study indicated that, among these insomnia symptoms, DIS had the strongest association with symptoms of depression. So far, the associations with DMS and EMA have been more greatly emphasized than that with DIS,[2,28,29] but the present study revealed a contrary result. Sukegawa et al.[30] investigated associations between sleep disturbances and depression in a study targeting elderly Japanese people and reported that an association was indicated between depression and DIS, but that no association was indicated between depression and DMS or EMA. Difficulty initiating sleep may be a symptom of sleep disturbance that appears characteristically among Japanese people suffering from depression. This factor requires future investigation.

There are some limitations to our study. Firstly, as this study was a cross-sectional survey, a causal relationship could not be determined between symptoms of depression and sleep disturbances. However, it is known that symptoms of depression and sleep disturbances can mutually become each other's cause and effect.[31] The investigation of such a causal relationship was outside the scope of this study, and the study's main purpose, which was to clarify which patterns of sleep disturbance are associated with symptoms of depression, was achieved. Secondly, objective data (i.e., physiologic measurement such as electroencephalography) could not be used for the present evaluation of sleep disturbances. Although such measurement

Table 4. Multiple Logistic Regression Results for Prediction of Depression in a Sample of the Japanese Adult General Population (N = 24,686)[a]

	CES-D Score ≥ 16			CES-D Score ≥ 25		
Variable	Adjusted OR	95% CI	p Value	Adjusted OR	95% CI	p Value
Sex			.16			.17
Male	1.00			1.00		
Female	1.05	0.98 to 1.13		1.08	0.97 to 1.20	
Age group, y			< .01			< .01
20–29	1.56	1.40 to 1.74		1.70	1.43 to 2.01	
30–39	1.00			1.00		
40–49	1.20	1.08 to 1.34		1.33	1.12 to 1.58	
50–59	1.24	1.11 to 1.39		1.22	1.02 to 1.46	
60–69	1.11	0.98 to 1.26		1.22	1.00 to 1.50	
70+	1.59	1.39 to 1.83		2.51	2.04 to 3.08	
Size of community			.3			.06
City of ≥ 500,000 people	1.00			1.00		
City of 150,000 to < 500,000 people	0.96	0.87 to 1.06		0.88	0.76 to 1.02	
City of 50,000 to < 150,000 people	0.92	0.83 to 1.02		0.87	0.74 to 1.02	
City of < 50,000 people, suburban district	1.00	0.91 to 1.10		1.01	0.88 to 1.17	
Sleep problem						
Difficulty initiating sleep	1.56	1.44 to 1.70	< .01	1.60	1.43 to 1.79	< .01
Difficulty maintaining sleep	1.49	1.38 to 1.61	< .01	1.44	1.28 to 1.61	< .01
Early morning awakening	1.34	1.23 to 1.44	< .01	1.21	1.08 to 1.36	< .01
Excessive daytime sleepiness	1.22	1.01 to 1.47	.04	1.55	1.23 to 1.95	< .01
Sleep duration, h			< .01			< .01
< 5	1.25	1.02 to 1.54		1.47	1.14 to 1.90	
5 to < 6	1.06	0.95 to 1.19		1.07	0.91 to 1.26	
6 to < 7	1.00			1.00		
7 to < 8	1.08	0.99 to 1.18		1.14	0.99 to 1.32	
8 to < 9	1.36	1.23 to 1.51		1.48	1.26 to 1.75	
9 to < 10	1.98	1.63 to 2.41		2.34	1.75 to 3.13	
≥ 10	4.04	3.25 to 5.01		5.58	4.26 to 7.32	
Subjective sleep sufficiency			< .01			< .01
Very sufficient	0.64	0.57 to 0.71		0.58	0.47 to 0.70	
Sufficient	1.00			1.00		
Insufficient	1.53	1.41 to 1.66		1.64	1.45 to 1.86	
Very insufficient	2.07	1.76 to 2.43		2.96	2.43 to 3.61	

[a]Other adjustment factors included headache, dizziness, palpitation/dyspnea, epigastric discomfort, constipation/diarrhea, stiff neck/shoulder, backache, easy fatigability, persistent fatigue, irritability, anxiety, and worrying about health.
Abbreviations: CES-D = Center for Epidemiologic Studies Depression Scale, CI = confidence interval, OR = odds ratio.

is desirable, it would be very difficult to adopt these in community-based epidemiologic studies, particularly in which data are collected from a large number of randomly selected participants located throughout the country. However, some studies have reported that self-reported data on sleep status do concur, to a certain extent, with physiologic data.[32,33] Thirdly, the present study evaluated sleep habits and sleep disturbance only retrospectively. In future studies, to improve the accuracy of the research results, it would be advisable to perform a prospective evaluation, even on a portion of the subjects, with the aid of sleep diaries, actinography, or polysomnography. Fourthly, as a self-reported survey was adopted, the percentage of respondents aged 70 years or older was less than that of people aged 70 years or older in the general population as revealed by the census. It is assumed that physical difficulties of old age, such as poor eyesight and difficulty in writing, might impede elderly subjects from responding to our questionnaire. Further improvements, such as introducing an interviewing method, would be helpful in the future. Fifthly, adjustments for sampling weight or variance were not conducted in the statistical analyses of this study because necessary data had not been made available to us by the Ministry of Health, Labour and Welfare. However, the influence of not performing adjustments for sampling weight or variance was assumed to be negligible, since the survey precincts in this study were apportioned to be virtually identical in population.

In psychiatric studies, there are 2 methods for case ascertainment of depression: diagnostic methods and nondiagnostic methods.[34] The CES-D is a commonly used nondiagnostic tool. Although there are a few differences in the prevalence of symptoms of depression between that classified by the CES-D and that determined by diagnostic methods used in clinical treatment, the reliability and validity of the CES-D are widely recognized in epidemiologic studies targeting general populations. The relationship between symptoms of depression calculated from the CES-D scores and sleep disturbance can be useful for diagnosis and management of mental disorders. For example, this study suggests that for diagnosis of a patient

who exhibits symptoms of depression it is important to evaluate his or her sleep status multilaterally, from aspects such as sleep duration, subjective sleep sufficiency, and insomnia. Conversely, for diagnosis of a patient who complains of a sleep disorder, it is necessary to examine if he or she has symptoms of depression. Because sleep disturbances may appear in a patient before he or she meets the diagnostic criteria for depression,[35–37] it is always necessary to consider the possibility of depression for management of sleep disturbances. Our present findings do not make it possible to discuss the causal relationship between symptoms of depression and sleep disturbances, but they do suggest that they are closely related. It is suggested that symptoms of depression are milder when sleep duration is between 6 and 8 hours, as subjective sleep sufficiency is higher, or as symptoms of insomnia are milder. We hope that the results of this study will be widely utilized for clinical care in psychiatric medicine.

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